WATERFOWL ASSESSMENT

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FINAL

Andrew Weik

Maine Department of Inland Fisheries and Wildlife

Wildlife Division

Wildlife Resource Assessment Section

650 State Street

Bangor, Maine 04401

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INTRODUCTION

Since 1968, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has aggressively pursued development and refinement of wildlife species assessments and implementation of cost-effective comprehensive programs that support selected goals and objectives for the next 15 years. Assessments are based upon available information and the judgments of professional wildlife biologists responsible for individual species or groups of species. Precise data may not always be available or are too limited for meaningful statistical analysis; however, many trends and indications are sometimes clear and deserve management consideration.

The assessment has been organized to group information in a user-meaningful way. The Natural History section discusses general biological characteristics of waterfowl that are important to its management; additional natural history information is provided under Species Profiles. The Management section contains history of regulations and regulatory authority, past management, past goals and objectives, and current management. The Habitat and Population sections address historical, current, and projected conditions for the species; specific population level and trend information is contained in Species Profiles. The Use and Demand section addresses past, current, and projected use and demand of the species and its habitat; specific harvest information is contained in Species Profiles. A Summary and Conclusions section summarizes the major points of the assessment.

This document is an update of the 1985 Waterfowl Management Plan written by Patrick O. Corr; some of Corr's text from the 1985 Plan is included verbatim in this

document. For a thorough review of a species' natural history and conservation throughout its North American range, including range maps, the reader is referred to Ducks, Geese, and Swans of North America (1980) by Frank C. Bellrose, and to Appendix I where one can find the title of the appropriate The Birds of North America species account.

NATURAL HISTORY

Taxonomy

The group of animals classified as waterfowl consists of ducks, geese, and swans, and constitutes the Family Anatidae. Worldwide there are 145 species of waterfowl divided among 43 genera and 11 tribes. Forty-three species of waterfowl are native to North America. North America's waterfowl are grouped into two Subfamilies: Anserinae (geese, swans, and the whistling ducks), which consists of two tribes; and Anatinae (the other ducks), which consists of five tribes. The common names, scientific names, and phylogenetic grouping (i.e. evolutionary relatedness) of 37 species of waterfowl that have been recorded in Maine are listed in Table 1.

Life History

Waterfowl populations in Maine are difficult to characterize. First, they are migratory, which causes major seasonal fluctuations in species composition and abundance. Second, waterfowl utilize a wide variety of habitat types based on seasonal preferences, which results in populations shifting within Maine. A third factor is the diversity of species involved.

Appreciation for the complexity of waterfowl management may be enhanced by considering the following: thirty-seven species have been recorded in Maine as either breeding, migrating, or wintering populations (Table 2). Appendix II contains range maps for Maine waterfowl. Waterfowl habitat requirements during the breeding season are complex. Maine wetlands provide these requirements for only 15 of 34 species, and

four of these are classified as rare breeders or individual records. The wintering habitat requirements are next in order and 18 species have found adequate habitat during this period. During the migration period, the life requisites of 34 species are met for brief periods.

Breeding Ecology

Reproductive strategies for waterfowl are varied. Geese and swans form pair bonds for life while most ducks form pair bonds annually during the late winter and spring. Reproductive age for most dabbling ducks (e.g., mallard, wood duck, American black duck) and diving ducks (*Aythya* spp; e.g. ring-necked duck) is attained within one year, while many of the mergansers, goldeneyes, sea ducks, and geese (e.g. common goldeneye, common eider, and Canada goose) attain sexual maturity in their second or third year. These latter species are generally longer-lived than those breeding by age one.

All waterfowl build nests, lay and incubate eggs, and rear young (broods) to flight stage. Nest building and egg-laying begins for some species in April. The actual time involved for each of the activities varies by species, but occurs so that most young obtain flight capabilities by mid-July to mid-August. Occasional late nesting or second clutches (caused by nest failure, desertion, or depredation) result in young gaining flight in September.

Maine's breeding waterfowl may be grouped according to nest site preference into two major categories: ground nesters and cavity nesters (Table 3). Cavity nesters readily use nest boxes.

Among Maine's breeding waterfowl, Canada geese, common eiders, and ruddy ducks generally lay the fewest eggs (average approximately 4-7). The rest of the ducks lay about 10 eggs per clutch, with pintails being on the low end (6-9) and wood ducks laying the most (10-15). The number of eggs laid in late nesting or second clutches tends to be fewer. Brood parasitism (known commonly as "dump nesting"), defined as more than one female laying one or more eggs in the same nest, is common among wood ducks that use nest boxes. The incidence of dump nesting is greater among nest boxes that are highly visible or distributed in groups. Wood duck nests are most often parasitized by other wood ducks; however, hooded mergansers will also lay eggs in wood duck nests, resulting in mixed-species broods. Clutch size of parasitized nests may number in excess of 40 eggs. Hatching success of eggs in dump nests is reduced relative to that of non-parasitized nests.

The female performs all incubation, except in the case of the mute swan, in which the male also has been observed incubating. Length of incubation varies both among and within species, lasting as little as 21 days for green-winged teal to as many as 37 days for some wood ducks (average: 30 days), however most waterfowl species that breed in Maine have an incubation period of about 22-28 days. Male ducks typically abandon their mates late in egg-laying or during incubation and do not take part in rearing of young. Among geese and swans, however, the male will guard its mate during incubation and will take part in brood-rearing.

Waterfowl are precocial at hatch – they are down-covered, mobile, they follow the parent, and they find their own food. The mother will brood young during cold or wet weather. Young grow rapidly, feeding on a protein-rich diet of macroinvertebrates. As

young Canada geese, dabbling ducks and ring-necked ducks grow, their diets will include more vegetable matter; common mergansers will shift to a diet predominantly consisting of small fish. Age of first flight and independence varies among species. Teal attain flight as young as 34-35 days; ring-necked ducks fledge at 49-56 days; mallards, black ducks, and goldeneyes typically fledge around 60 days, and wood ducks and mergansers do not attain flight until they are 60-70 or more days old. Resident Canada geese fledge at 85 days; family units stay together until spring migration.

After reaching the definitive plumage by which adult birds are recognized (also known as *breeding* or *alternate* plumage), waterfowl molt (replace) their body feathers at least once annually due to feather wear. Ducks molt into the nonbreeding plumage (also known as *basic* or *eclipse* plumage) after the breeding period, and molt back into breeding plumage before the next breeding season. The amount of time in breeding versus nonbreeding plumage varies among species, with species such as mallard molting into breeding plumage relatively early in autumn, and species such as blue-winged teal not attaining breeding plumage until early winter. Geese have only one plumage, and undergo the body molt during the post-breeding period prior to fall migration.

Waterfowl undergo a complete, simultaneous wing molt, during which they are flightless. Regrowth of wing feathers takes 3-5 weeks depending on species and condition of the bird. The wing molt occurs after the breeding period for most male ducks, after the brood-rearing period for most female ducks, and during the brood-rearing period for geese. Males and/or nonbreeding birds of some species undergo a molt migration to suitable marsh areas where they spend the flightless period.

Migration and Wintering

Waterfowl species have evolved to survive major seasonal climatic changes, which limit availability of food and water. Their migratory behavior distributes North American waterfowl populations to provide optimum spatial and temporal distribution. Often these migrations are timed to coincide with peak food availability, which promotes rapid growth of young after hatching. Migration for many species minimizes the physiological stress induced by severe winter weather.

Waterfowl food habits are diverse and frequently change throughout the year as birds capitalize on abundant food supplies. Waterfowl foods consist of both plant and animal materials. Some species have very specific food preferences while others are more opportunistic. Seeds and vegetation of many aquatic plants, agricultural grains, green manure crops, insects, fish, crustaceans, mast crops, and fruits are all utilized during periods of abundance. Further details on this topic should be handled species by species.

Many of Maine's fall migrating waterfowl are from Northeastern U.S., Maritime Provinces, Quebec, and Labrador breeding populations. Wood duck, eider, black duck, mallard, green-winged teal, and goldeneye are largely from those areas. Scaup, scoter, long-tailed duck, and a few blue-winged teal are from prairie and arctic breeding populations. Canada geese are from local and arctic breeding areas.

Fall populations utilize all Maine wetlands and marine environments. Their numbers and distribution are dictated by wetland condition, weather patterns, population size, and time of year. Blue-winged teal are among the earliest waterfowl species to

migrate south in the fall, and few remain in Maine past mid October. Green-winged teal, wood ducks, hooded mergansers, and ring-necked ducks typically depart Maine by the end of October, although a few hardy individuals often remain into November or December. Arctic-breeding Canada geese arrive in Maine during early October; based on band returns, the majority of migrant geese appear to depart the state by November. Migrant goldeneyes typically arrive on inland rivers and lakes in late October; diving duck populations (scaup, goldeneye, and bufflehead) increase on inland waters during November. These populations utilize inland lakes until freeze-up forces them onto large river, estuarine, and marine habitats. Black duck populations also move to coastal habitats as inland wetlands become unavailable.

MANAGEMENT

Regulatory Authority

Maine's role in migratory bird management is significantly different from that for other species of wildlife. The unique aspect which differentiates the State's function is the overriding Federal responsibility for establishing migratory bird hunting seasons. This Federal responsibility is exercised through the U. S. Fish and Wildlife Service (USFWS) in the Department of Interior.

In practice, the USFWS works directly with Canada and Mexico as well as with state conservation agencies. State input on regulatory issues is through Flyway Councils, which administratively organize the 50 states into Atlantic, Mississippi, Central, and Pacific Flyways (Fig. 1). State input, through the Flyway Councils, is received by the USFWS and either accepted or rejected based on their review of the proposals. Prior to adoption of any major change in migratory bird regulations the USFWS has to publish and receive input from outside agencies and the general public. These procedures allow adequate time for public comment and assure stringent review of proposed changes.

Past Goals and Objectives

Maine’s early management goals and objectives selected for the wild duck and Canada goose management plans were harvest oriented, and later updates of Maine’s waterfowl management plans added population and habitat objectives:

1975

Management Goals: Wild Duck: increase abundance and use opportunity. Canada goose: increase distribution and abundance of breeding Canada geese, and increase harvest and use of the resources.

Management Objectives: Wild Duck: harvest 100,000 annually, maintain use (hunter days) between 40,000-105,000 days.

Canada goose: increase distribution and abundance to approximately 100 breeding pairs with an annual harvest of 4,000 geese by 8,000 hunters.

1980

Management Goals: Wild Duck: increase resource abundance and use opportunity.

Canada goose: increase distribution and abundance in remote portions of the State in order to provide increased use opportunity.

Management Objectives: Wild Duck:: harvest 80,000 to 100,000 birds annually. Reduce harvest of "local" black duck, increase harvest of immigrant black duck and other species which are in adequate supply.

Canada goose; establish naturally sustaining flocks at 20 new locations in remote portions of the State.

1985-1990

Goal: Increase breeding waterfowl populations (maintain species diversity) to maximize fall populations.

Abundance Objective 1: by 1990, increase the number of waterfowl broods by 15% and the proportion of the black duck broods from 19% to 30%, wood duck broods from 13% to 20%, and maintain ring-necked duck at 25% of the broods produced.

Abundance Objective 2: by 1990, increase the distribution of Canada geese in Wildlife Management Units (WMU; Fig. 2) 1, 2, and 3 (townships with breeding birds) by 50%.

Abundance Objective 3: by 1990, reduce the non-legal mortality of waterfowl populations by 25%.

Harvest Objective 1: through 1990, provide Maine hunters maximum annual hunting opportunity that will allow for achievement of the abundance objectives and be consistent with the Federal Framework.

Habitat Objective 1: through 1990, maintain the quantity of wetland habitat at current levels (as measured by the wetland inventories).

Attainment of Abundance Objective 1 has shown a mix of progress and failure. The mean number of waterfowl broods counted by MDIFW on annual brood surveys on waterfowl production index areas increased 28%, from 179 during 1980-84 to 229 during 1986-90, however total broods dropped to 174 by 2002. The species-specific portions of the abundance objective were achieved (i.e. within +/- 5% of objective) for wood duck and ring-necked duck, but not for black duck. The proportion of broods comprised by black ducks increased to 24% in 1986-1990, but dropped to 15% in 2002. The proportion of broods comprised by wood ducks increased to 17% in 1986-1990 and

was 18% in 2002. Ring-necked ducks dropped to 21% of broods in 1986-1990, but increased to 29% in 2002.

Although distribution of Canada geese has not been measured, Abundance Objective 2 quite likely has been attained. Canada geese currently breed statewide.

A major source of "non legal mortality" (non hunting mortality) alluded to in Abundance Objective 3 is lead poisoning. To reduce mortality of raptors and waterfowl caused by lead poisoning, Maine banned the use of lead shot for hunting waterfowl in WMU 6 in 1986, in WMUs 6, 7, and 8 in 1987, and statewide in 1988. By 1991 lead was prohibited for waterfowl hunting throughout the U.S., and in Canada by 1999. Although the effects on waterfowl mortality in Maine of the lead shot ban have not been assessed, research elsewhere suggests such effects may be substantial. By 1997 the ban on lead shot had reduced lead poisoning deaths among mallards in the Mississippi Flyway by 64% (Anderson et al. 2000).

Since the black duck harvest reduction program was implemented in 1982, MDIFW has strived to provide maximum waterfowl hunting opportunity consistent with Harvest Objective 1. Achieving the harvest objective has been constrained by efforts to reduce mortality among black ducks.

Regarding Habitat Objective 1, subsequent wetland inventories have not been conducted. State and federal wetland protection laws have provided a measure of protection for some of the wetlands important to waterfowl, however small (<10 acres) ephemeral wetlands did not receive protection until 1996, and such small but often important wetlands have not been inventoried.

Past and Current Management

The year 1870 marked the beginning of regulatory management of Maine's migratory bird populations (Spencer 1979). In a search of Maine statutes from 1820-1870 Spencer found, "little in the way of laws concerning migratory game birds". In 1870 it became illegal to use, "other than the usual method of sporting with firearms to take ducks and woodcock". Duck netting was commonly practiced throughout the State into the late 1880s in spite of this law (Stanley and Stillwell 1889).

By the end of the 19th century many regulatory management laws were in effect. These laws governed methods of take, season length, bag limits, and species-specific laws. Many of these regulations were complicated and confusing, and inconsistent among states. Mendall (1969) summarized Maine's early harvest management strategy and the logic behind these regulations.

In response to the commercialization and over-exploitation of migratory birds, in 1916 the United States and Great Britain (on behalf of Canada) signed the Convention for the Protection of Migratory Birds, the purpose being to conserve migratory birds that often cross international, state, and provincial boundaries. The U.S. implemented this treaty in 1918 when the 64th Congress passed the Migratory Bird Treaty Act (MBTA). Subsequent conventions have brought the United Mexican States (1936, 1972), Russia (1976), and Japan (1972) into this comprehensive international agreement. This Treaty, and the laws that implement it, provides for strong involvement of the federal governments in the protection and management of migratory bird populations. Most of the major provisions of the original MBTA are still in force today.

The Federal Duck Stamp Law went into effect in 1934. This stamp is required for all waterfowl hunters 16 years of age or older. Revenues generated from this stamp are used to purchase, develop and manage waterfowl habitat areas in the United States; wetlands on many National Wildlife Refuges have been acquired using duck stamp funds. Sales of federal duck stamps are summarized in Table 4.

In 1984, MDIFW instituted a state duck stamp program modeled loosely after the federal duck stamp program: the stamp was required by hunters 16 years and older, and all revenues from the sale of ducks stamps are dedicated to the conservation and management of waterfowl in Maine. In 2002, MDIFW discontinued the duck stamp requirement of hunters, but instead required the purchase of a waterfowl hunting "authority" on the hunting license. Duck stamps still are available for purchase by collectors, and revenues from the sales of both the stamp and the waterfowl hunting authority are dedicated to waterfowl conservation programs in Maine. Sales of Maine duck stamps are depicted in Figure 3.

Throughout the 1900s, the U.S. and its international partners established cooperative efforts for waterfowl population surveys and harvest management. The 1986 North American Waterfowl Management Plan (NAWMP) and NAWMP updates (1994, 1998, and 2003) extended international cooperation to include habitat conservation. Original NAWMP partners Canada and the U.S. established habitat goals and objectives, and population goals and objectives for principal species of ducks, geese, and swans. Mexico became a NAWMP partner in 1994.

Joint Ventures were established to implement the goals and objectives set forth in NAWMP. In 1989, the U.S. Congress passed the North American Wetlands

Conservation Act (NAWCA) to provide financial support for habitat joint venture activities. NAWCA provides matching funds to public and private organizations and individuals to carry out habitat conservation projects in the U.S., Canada, and Mexico. During 1990-2003, grants from NAWCA totaling $600 million were matched with nearly $1.7 billion from project partners to support more than 1,100 habitat conservation projects. Since 1990, NAWCA grants and matching funds have supported the restoration and protection of 20.6 million acres of wetlands and associated uplands.

Habitat Joint Ventures that affect waterfowl resources important to Maine are the Atlantic Coast Joint Venture (ACJV) and, to a lesser extent, the Eastern Habitat Joint Venture (EHJV). Within Maine, the ACJV has focused conservation efforts on important wetland habitats along 1) the west (south) coast, 2) the lower Kennebec River and Merrymeeting Bay, 3) Downeast coastal areas, 4) Cobscook Bay, and 5) inland wetlands (Fig. 4). Habitat protection in Maine has been conducted via the Maine Wetlands Coalition efforts targeted in ACJV Focus and Planning Areas, and seabird (eider) nesting island acquisition.

Species joint ventures that affect waterfowl resources important to Maine include the Black Duck Joint Venture (BDJV), the Sea Duck Joint Venture (SDJV), and, to a lesser extent, the Arctic Goose Joint Venture (AGJV). Species Joint Ventures typically have three program components: survey, banding, and research. The BDJV receives funding from the Canadian Wildlife Service, the U.S. Fish and Wildlife Service, the Flyway Councils from the Atlantic and Mississippi Flyways, Ducks Unlimited, Inc., and several other nongovernmental organizations.

Harvest Management

The term *harvest* used in this document means waterfowl that are legally killed and retrieved, or *bagged*, by hunters. There are several biological characteristics of waterfowl and several logistical patterns characteristic of hunting that should be considered in harvest management of waterfowl.

Unretrieved Kill or Crippling Loss

Another component of hunting mortality, in addition to harvest, is that which is killed or mortally wounded and not retrieved, termed *unretrieved kill* or *crippling loss*. Crippling rate is defined here as the proportion of waterfowl that are mortally shot but are not retrieved (i.e. [crippling loss]/[crippling loss + retrieved kill]; Van Dyke 1981).

Crippling loss is estimated via hunter questionnaire surveys and field surveys of hunter performance (e.g. Nieman et al. 1987); for use in population modeling, estimates from hunter questionnaire surveys must be adjusted for survey biases and assumptions (Martin and Carney 1977). Crippling loss would be under-estimated when crippling is undetected or unreported (reporting bias), and over-estimated when waterfowl recover from their wounds (Bellrose 1953, Kirby et al. 1981, Van Dyke 1981) or when hunters recover crippled waterfowl that they did not shoot (Kirby et al. 1981, Van Dyke 1980). Regarding reporting bias, waterfowl hunters in western Canada reported crippling rates of 6-18%, whereas observations of hunters yielded estimates of 20-45% crippling loss (Neiman et al. 1987); in Colorado, hunters reported loosing 11-16% of shot birds, while losses of 9-23% were estimated from hunter performance observations (Hopper et al. 1975). Kirby et al. (1981) found that 20% of shot, unretrieved radio-marked mallards

(n=15) in a Minnesota study were later killed and retrieved by other hunters, and another 20% recuperated from their injuries.

The estimated crippling loss is not included in harvest estimates. However, a crippling loss rate of 20% (Anderson and Burnham 1976) is incorporated into population models (e.g. USFWS 2003b, Conroy et al. 2002) used in setting season frameworks (see Adaptive Harvest Management). The crippling rate of waterfowl in the U.S., estimated from hunter questionnaire surveys and adjusted for reporting bias, declined from approximately 18% during the early 1970s to approximately 16% during the early 1980s (USFWS Office of Migratory Bird Management, Administrative Reports, 1973-1985 *in* Sanderson and Bellrose 1986). This period encompassed the transition from lead shot to steel shot use, however this long-term trend began prior to implementation of steel shot. Crippling rate of waterfowl in the Atlantic Flyway in 2001 was similarly estimated from hunter questionnaire surveys at 13.8% (calculated from data *in* Martin and Padding 2002).

Data on crippling from field studies of radio-marked waterfowl are scant. In a study of survival of black ducks during autumn in Quebec, Nova Scotia, and Vermont, of 215 radio-marked ducks that were shot, 34 (15.8%) were crippled or killed and not retrieved (Longcore et al. 2000).

Rates of crippling loss vary geographically, by habitat type, waterfowl species, hunting method, individual shooting skill, shooting distance, hunter density, and whether a retrieving dog is used (Bellrose 1953, Herbert et al. 1984, Nieman et al. 1987). Crippling rates did not differ between hunters using steel shot or lead shot in most field tests (e.g., Mikula et al. 1977, however see Herbert et al. 1984) nor in hunting preserve

tests (Nicklaus 1976). In hunter performance surveys in Michigan, significantly lower rates of crippling loss (14%) occurred when birds are first shot at when nearer (10-30 yards) rather than farther away (>45 yards; crippling rate = 23%) (Mikula et al. 1977); 61% of hunters in these surveys did not use retrieving dogs. The probability of retrieving a shot duck increases as distance decreases due to the greater number of pellets available to hit the duck as well as the greater pellet energy at close distances (Cochrane 1976).

The Cooperative North American Shotgunning Education Program (CONSEP) is a cooperative organization of shooting industry (Winchester and Remington) and state, provincial, and federal government agencies, with the objectives of improving hunter shooting skills and hunter performance, reducing wounding loss and maintaining hunter numbers. CONSEP conducts shooting and hunting skills clinics, and has produced an excellent series of instructional videos and other materials on shooting for the waterfowl hunter. CONSEP supports the following behaviors that can reduce crippling loss: 1) limiting distance of shots, 2) improving shooting skill, 3) effective matching of load and barrel choke, 4) avoiding hunting in areas with heavy escape cover, 5) using a trained retrieving dog, 6) limiting the number of shooters per flock to one or two when party hunting, 7) counting struck but unretrieved birds as part of the bag limit, 8) immediately dispatching wounded birds on the water, and 9) shooting at isolated individual birds, never into a flock. MDIFW currently is not a member agency of CONSEP.

Harvest Potential

A species' ability to sustain hunting harvests is dependent on its life history characteristics (e.g. rate of natural increase, age at first breeding, clutch size, and life span) (Patterson 1979). Current ecological theory places waterfowl into two groups (r-selected and K-selected species) based on-reproductive strategies.

The first group, r-selected species, is thought to have evolved in seasonal or unpredictable environments. They tend to have high rates of natural increase, early sexual maturity, large clutch sizes, and short life spans. Most dabbling duck species (including the black duck) are characteristic of this group with the mallard being the typical r-strategist.

The second group, K-selected species, is believed to have evolved in more stable habitats. They tend to have lower rates of natural increase, delayed breeding, small clutch sizes, and long life spans. Most diving ducks, geese and sea ducks are characteristic of this group with the canvasback being the typical K-strategist. In reality, waterfowl species occur somewhere between pure r- to pure K-selected species.

The importance of this theory to waterfowl management involves a measure of harvest rate (the proportion of a population taken by hunting) and the concept of threshold. The threshold level is the point above which hunting harvest becomes an additive form of mortality. In this case, hunting mortality is added to natural mortality (the number that would have died through natural causes). Below the threshold level, hunting mortality is thought to be a compensatory form of mortality. In this case, hunting mortality replaces some of the natural mortality.

Threshold levels have been estimated for the more important species in the sport harvest but can only be guessed at for most waterfowl. Because of their life history characteristics, r-strategists can sustain a higher harvest rate (nearly 40 percent for the mallard) than K-strategists (about 10 percent for the canvasback). Patterson (1979) suggested that the threshold levels for intermediate species will fall between these extremes. These theories and concepts are critical when considering harvest management recommendations. Increases in the harvest rate of K-strategists must be considered carefully since these species have low thresholds and their populations respond slowly to regulatory management. Actual harvest rates for adult male mallards from the mid-continent population ranged from 10.1-13.1% during 1996-2002 (Johnson 2002).

Species and Sex-specific Regulations

Species and sex-specific hunting regulations are employed to limit the harvest of uncommon or vulnerable species or allow additional hunting opportunity for common species, particularly males of common species. Managers often restrict the bag of some species relative to the general bag limit, for example black duck, wood duck, pintail, canvasback, hooded merganser, and harlequin duck. All of the common dabbling and diving duck populations in North America have sex ratios that are skewed in favor of males (Bellrose et al. 1961), owing to the higher mortality rates experienced by females (e.g., during nesting and brood-rearing). In an effort to reduce harvest of female ducks, managers have used bag limit restrictions on female mallards, and in some states (e.g., Massachusetts) female common eiders, relative to males; this is

possible because male mallards and eiders can be readily differentiated by sight from females during the hunting season. Varying the bag limit by sex is not feasible for species that are not sexually dimorphic until winter (e.g. green-winged teal), or in which both sexes have similar plumage (e.g., black duck).

Requisite to the effectiveness of species or sex-specific regulations is the ability of hunters to correctly identify waterfowl. Ability of waterfowl hunters to identify waterfowl species has varied geographically and by level of experience (Evrard 1970, Nieman et al. 1987, Wilson and Rohwer 1995). Experienced waterfowl hunters in Wisconsin correctly identified 74% of flocks of 14 waterfowl species in flight, while novices correctly identified only 52% of flocks of 15 species (Evrard 1970). Correct identification varied by species, with hunters tending to be better able to identify the more commonly encountered and commonly harvested species. Hunter performance surveys in western Canada indicated poorer waterfowl identification skills (Nieman et al. 1987) than hunters in Wisconsin (Evrard 1970) and 9 other states in the Mississippi Flyway (Wilson and Rohwer 1995). Waterfowl identification training was effective in improving identification skills (Evrard 1970). Most hunters surveyed in the Mississippi Flyway expressed desire to participate in training programs, particularly those hunters in greatest need of identification training (Wilson and Rohwer 1995). Waterfowl identification training programs that focus on restricted harvest species may be particularly beneficial (Wilson and Rohwer 1995).

Waterfowl identification materials available in Maine have included booklets, posters, and brochures. In 1962 the Atlantic Flyway Council published a 56-page booklet, “Maine waterfowl identification guide”, in black and white. This later was

replaced by the 52-page color booklet, “Ducks in the distance” (Hines 1978), which is out of print but available on-line (http://www.npwrc.usgs.gov/resource/tools/duckdist/duckdist.htm 16 June 2004). Another on-line waterfowl identification guide published by the Central Flyway Waterfowl Council (1994) is available on MDIFW’s website. When USFWS restricted the black duck bag limit in 1983, the state wildlife agencies in the Atlantic and Mississippi Flyways, USFWS, and Sportsmen of America cooperatively produced and distributed, for several years, brochures and posters to educate hunters on field identification differences between black ducks and mallards.

Hunting Vulnerability and Migration Chronology

Harvest of certain species can be affected by the distribution of hunting days relative to migration. Early fall migrants such as wood duck, teal, and ring-necked duck are exposed to hunting in Maine until they migrate south in late October (Fig. 5). Later migrants such as black duck and mallard are available to hunters throughout the season, and later-arriving species such as bufflehead and goldeneye are not available until mid November (Fig. 6).

Typically there is an initial spike in waterfowl harvest during the first few days of the hunting season (Fig. 5, 6), particularly when the season opens on a Friday or Saturday. This “opening day” effect is due to the large numbers of hunters afield on opening day, as well as an abundant and naïve waterfowl population. Juvenile black ducks are especially vulnerable to high hunting mortality during the first few days of the hunting season or first few days of the second portion of a split season (Boyd 1971,

Reed and Boyd 1974). Recent research in Quebec, Vermont, and Nova Scotia on the effects of hunting on survival of juvenile black ducks demonstrated the vulnerability of young black ducks to hunting (Longcore et al. 1998), especially on opening days. The highest survival rate (0.545) was associated with the latest date of season opening (October 8), and the lowest survival rate (0.395) was at an international border where hunter numbers and activity were greatest and ducks were exposed to three opening days. As the season progresses, hunting participation wanes and waterfowl become more wary or migrate south, resulting in a decline in the daily kill rate for resident and early-migrating birds. Managers often avoid setting the opening day on a weekend in an effort to lessen the opening day effect and protect local breeding ducks and locally produced juvenile ducks.

Hunting Zones and Season Splits

A major accomplishment in waterfowl harvest management, after publication of the first species plan in 1974, was the establishment of a zone option for the Maine hunting season. This has allowed more equitable distribution of hunting opportunity than was previously possible. Maine traditionally selected straight seasons without splitting when long seasons (55-70 days) were permitted. If only 45 or 50 days were allowed, the season was split into an early and late season. This type of regulation persisted until 1977 when an experimental zoned season was instituted. Zoning became operational in 1980 and is currently utilized to satisfy hunter demand in inland and coastal regions.

The original zones used during the experimental study and the zones formally adopted since 1981 were based on Wildlife Management Unit (WMU) boundaries. In 1996, Wildlife Management Districts (WMD) boundaries became the basis for zone boundaries (Fig. 7).

Still, the zones are quite large and ice conditions during the latter part of the season vary geographically. Splitting the two zones into three zones would provide for more optimal opportunity than is currently possible in Maine, by adjusting the season splits geographically relative to different climatic conditions as is done in other states in the Atlantic Flyway that have more than two zones. States may not add zones or make significant changes to zones, such as moving zone lines around a county, without approval of USFWS. MDIFW's (and other states') recommendations for a third waterfowl hunting zone and 2-way splits in each zone, approved by the Atlantic Flyway Council, were rejected by the USFWS' Service Regulations Committee in 1996 and again in 2000-01. The USFWS allows consideration of zone adjustments approximately every 5 years.

Harvest Regulations and Season Frameworks

Harvest generally is regulated by length of season and bag limit. Federal migratory bird regulations are separated into basic and general regulations (Rogers et al. 1979). Basic regulations continue from year to year with little change and stipulate methods of take, dates within which seasons must be set, hunting zones within states, daily shooting hours, etc. The second category -- general regulations – may be subject to annual changes in response to duck population fluctuations and harvest conditions.

States must select seasons within the federal proposed general guidelines, or framework, which include season length and bag limit. States may select seasons that are more restrictive than offered in the federal framework, however season selections cannot be more liberal than the offered framework.

Adaptive Harvest Management

In 1995, the USFWS adopted the concept of adaptive harvest management (AHM) for regulating duck harvests (Williams and Johnson 1995, USFWS 2003b). The adaptive approach to resource management recognizes that results of hunting season regulations cannot be predicted with certainty, and provides a framework for objective decision-making. Post hoc analyses of hunting seasons enable the models to be improved in an annual, iterative process. Current season length and bag limit options under AHM models in the Atlantic Flyway are:

Alternative:	Season length:	bag limit (total/mallard/female mallard):
Closed		
Restrictive	30 days	3 / 3 / 1
Moderate	45 days	6 / 4 / 2
Liberal	60 days	6 / 4 / 2

Early versions of the AHM approach used models based on the population dynamics of mallards from the mid-continent region. More recently, models were developed for the Atlantic Flyway, based on eastern mallard populations. Based on the

Eastern Mallard AHM models, the expected frequency of liberal regulations in the Atlantic Flyway is >99%. AHM models are being developed for wood duck and black duck.

The harvest management objective of AHM is to maximize harvests of ducks over the long-term. Inherent in this objective is the perpetuation of viable waterfowl populations. This objective is constrained by avoidance of regulatory alternatives that would result in a population that is below the goal set by the North American Waterfowl Management Plan (USFWS et al. 2003).

Extended Framework Dates

The fact that most early migrating northern ducks, such as wood ducks, depart Maine by the end of October indicates that harvest pressure in Maine on this species can be managed by manipulating hunting opportunity during October only, irrespective of season length. However, wood ducks produced in Maine also are subject to hunting during migration and on their wintering grounds in states to the south. In 2002, the USFWS extended the duck season framework closing date in the Atlantic Flyway from the Sunday nearest January 20, to the last Sunday in January. This change in season framework was expected to increase the harvests of black duck (+1.4% - +3.2%), mallard (+4.4% - +6.7%), and ring-necked duck (+2.1%) in the southern portion of the Flyway (Atlantic Flyway Technical Section, Harvest Management Committee 2001).

In 2001, the Wood Duck and Other Dabblers Committee of the Atlantic Flyway Technical Section analyzed band recoveries of wood ducks banded in northeastern states (PA, NY, CT, RI, MA, VT, NH, and ME), and recovered in southern states (MD,

VA, NC, SC, GA, and FL) in the Atlantic Flyway. An increase of 5-7% in the kill of northeastern-produced wood ducks was predicted if southern states opt for an extended season closure. Thus, Maine-produced wood ducks would be exposed to increased hunting mortality on the wintering range in January.

Recent Technological Changes in Hunting

Motorized or motion-winged decoys have increased in popularity among ducks hunters in some areas of North America, particularly among those who hunt flooded timber in the Southeast. Opinions as to the effectiveness and appropriateness of motorized decoys are varied. As with any technological innovation (e.g., auto-loading shotguns, lay-out boats, over-sized or magnum decoys), effectiveness must be evaluated relative the harvest capacity of the waterfowl resource. To date, peer-reviewed published reports of controlled experiments on the effectiveness these decoys are scant. The State of Washington summarized preliminary findings or unpublished data on field studies conducted on motorized decoys from California, Manitoba, Missouri and Nebraska (http://wdfw.wa.gov/wlm/game/water/robo_decoy 16 June 2004). All four studies showed three-fold increases in harvest or success under certain conditions or season periods. Several states have banned (Washington, Pennsylvania) or restricted the use of motorized decoys for waterfowl hunting; California prohibited the use of motorized decoys prior to December 1, and Minnesota prohibited the use of remote electronic controls. The Canadian Wildlife Service and USFWS have not determined the effects of motorized decoys on survival or harvest rates of ducks, and have not regulated the use of motorized decoys.

Banding

Leg-banding has been a cornerstone of harvest management by providing a means of determining migratory paths, survival rate, harvest rate, distribution and derivation of harvest, and other vital information. Preseason banding can be critical for evaluating changes in harvest regulations, such as season framework extensions, increased bag limits, or changes in season length. As a member of the Atlantic Flyway Council, MDIFW participates in meeting banding quotas for resident breeding waterfowl. Important breeding species within Maine include black duck, wood duck, mallard, Canada goose, common eider, and ring-necked duck.

HABITAT ASSESSMENT

Past Habitat

Wetlands account for 25-30% of the surface area of Maine (Calhoun 2001). Wetland losses in Maine (~20%) have been less severe than in the nation as a whole, which has lost over ½ of wetlands that existed prior to European settlement overall (Whitney 1994). Wetland losses in Maine have been attributed to draining and filling for residential and commercial development (Widoff 1988), and flooding.

Maine's wetland protection laws and zoning ordinances have decreased the rate of these losses; however, they do not afford total protection. State regulations that afford some protection to wetlands include the Great Ponds Act, the Coastal and Inland Wetland Protection Acts (in organized townships), Land Use Regulation Commission Zoning (in unorganized townships), the Stream Alteration Act, and Maine's Natural Resources Protection Act. Additionally, Federal review authority for major power projects, and section 404 of the 1972 Clean Waters Act have helped to reduce losses of Maine wetlands. However, the Supreme Court decision in Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers (January 9, 2001) reduced the protection of isolated wetlands under the Clean Waters Act. Prior to this decision, isolated waters and wetlands were considered "navigable" and therefore were under the regulatory purview of the Corps. The effects of this decision on wetland conservation in Maine are unclear, although deemed to be less problematic than in states that have relatively weaker state regulation of isolated wetlands (Petrie et al. 2001).

Wetland habitats have always been, and continue to be, dynamic systems. In Maine, the importance of our many small (<10 acres), and sometimes ephemeral, wetlands to nesting and brood-rearing waterfowl has been well documented (e.g., Ringelman and Longcore 1982). Many of these small wetlands are created or mediated by beavers, and the presence of beaver on a wetland is positively associated with the use of that wetland by black ducks (Diefenbach 1988). Between 1977-80 and 1986-87, quality and quantity of black duck habitat on a central Maine study area declined as a result of a decline in the beaver population (Diefenbach 1988).

McCall and others (1996) investigated the influence of beaver trapping on beaver and waterfowl densities and wetland area on this same central Maine study area during 1988-92. They determined the density of beaver colonies, beaver harvest, wetland characteristics, and waterfowl densities on a site open to trapping and a similar site that was recently closed to beaver trapping. Beaver densities and wetland habitat remained stable on the trapped site, but increased on the untrapped site. Canada geese, hooded mergansers, and mallards increased on the untrapped site, while black duck densities remained unchanged. The number of wetlands used by pairs of all four species increased significantly on the untrapped site. The authors concluded that:

1) a trapping closure of $\geq$1 year is sufficient to increase beavers numbers,
2) a 2-3 year trapping closure is required to increase wetland area,
3) a closure of 3-4 years may be needed to increase waterfowl densities and to influence their use of wetlands, and
4) periodic trapping of beaver should be encouraged to increase the frequency of flooding and dewatering (relative to “natural” cycles), thereby increasing the

productivity of wetlands and associated invertebrate populations on which waterfowl and many other wildlife depend.

Breeding waterfowl utilize these important beaver-mediated wetlands heavily for feeding, loafing, and nesting. Unfortunately, wetlands under 10 acres were not regulated in Maine until 1996, and no baseline inventory of small ephemeral wetlands exists (see Vernal Pool Assessment by Calhoun, 2001). Increasing beaver populations since the 1950s resulted in increased small, ephemeral wetlands and improved waterfowl breeding habitat (Corr 1985).

The dynamic aspect of wetlands is a factor that provides for high productivity during initial years of flooding (Whitman 1976). Flooding of rivers and streams, creation of new beaver ponds, and historically, impoundments for the logging industry, saw and grist mills, and small hydropower reservoirs provided many acres of highly productive waterfowl habitat annually. Many of these wetlands are short-lived but extremely important.

An important aspect of habitat quality is the level of human disturbance associated with a wetland. Black ducks are less tolerant of human disturbance than other waterfowl species (Mendall 1958) such as mallard or Canada goose, and so otherwise-suitable habitat may be lower quality for black duck breeding due to human presence. Black duck use of wetlands in central Maine was negatively associated with a human habitation in view of the wetland (Diefenbach 1988).

Current Habitat

Maine's waterfowl habitat can be characterized almost exclusively as wetlands, although some upland and agricultural habitats are utilized seasonally for feeding and nesting. The migratory behavior of waterfowl species requires separation of habitat into three major categories: breeding, migrating, and wintering. Corr (1985) used data from MDIFW's Wetland Inventory, intertidal areas, and lakes and ponds under 10 acres to categorize regional differences in wetland type and acreage; no assessment of habitat quality could be made at that time. Because the Wetland Inventory has not been updated since before Maine's last Waterfowl Plan, a comparison with the current Waterfowl Assessment cannot be made. However, on a broader geographic scale, 0.4% of the Nation's wetlands and deepwater habitats have been lost (Dahl 2000) since the last update of Maine's Waterfowl Plan. Within Maine, coastal nesting and wintering habitats for eiders were addressed in the Common Eider Assessment (Allen 2000), and wintering habitat for harlequin ducks was addressed in the Harlequin Duck Assessment (Wickett 1999). Carrying capacity of breeding, migration, and wintering habitats could not be determined due to a lack of precise understanding of species-habitat relationships and a lack of precise information on habitat quality and quantity. Small, ephemeral wetlands, although very important to breeding and migrating waterfowl, are poorly represented in wetland inventories.

Two methods were used to examine statewide waterfowl habitat for the current Waterfowl Assessment. First, high and moderate value Waterfowl and Wading Bird Habitats (WWH; see Appendix II for descriptions), as categorized by Rustigian and Krohn (2002), were quantified by Wildlife Management District (WMD). I ranked WMDs

according to the area of moderate and high value WWH (Table 5). Second, four duck species habitat models (Arnold and Schaller 2001, Appendix III) were used to assess quantity and quality of waterfowl habitats. A black duck model was used as an index to breeding and migrating habitat; a wood duck model was used as an index to breeding habitat; a scaup model was used as an index to migrating and wintering habitat; and a scoter model was used as an index to wintering habitat. Descriptions of the habitat models, as well as information regarding natural history and habitat needs of these species are contained in Appendix III. Habitat areas were calculated for each model, and WMDs were ranked according to the area of medium and high value habitats (Tables 6-9). The geographical distributions of the species habitat model outputs are depicted in Figures 8-11.

Breeding and Migrating Habitat

High and moderate value WWHs amounted to 657,908 acres statewide, while area of medium and high value habitat from the black duck breeding and migrating model was 962,941 acres, and the wood duck model yielded over 2.6 million acres of medium and high value breeding habitat. Among these three models there was considerable overlap in the rankings of WMDs. Wildlife Management District 18 was ranked highest in each model; the three top-ranked WMDs from the wood duck and black duck models were identical (WMDs 18, 17, and 23). Among 10 top-ranked WMDs, black duck had 8 in common each with the WWH model and the wood duck model; the wood duck and WWH models shared 7 of 10 top-ranked WMDs. Wood duck and black duck habitat each totaled nearly 3 million acres.

Migrating and Wintering Habitat

The migrating and wintering habitat estimates from the scaup model totaled 891,697 acres, of which only 23,955 acres were categorized as medium or high value. Not surprisingly, the highest ranked areas for scaup migrating and wintering habitat are coastal WMDs (WMDs 30, 26, 24, and 27). Similarly, the scoter wintering habitat model indicated the majority of medium and high value wintering habitat is in coastal WMDs.

Habitat Projections

Only minor changes in distribution and quality of wetlands are anticipated through the next planning period. Many of the smaller wetlands are tied closely to the abundance of beaver, therefore, annual gains and losses of this type can be expected. However, if high populations of beaver continue, the total number of small wetlands will remain stable.

No major land use changes likely to affect the amount of breeding habitat are envisioned. Removal of hydropower dams may alter the local distribution of breeding, migrating, and wintering waterfowl as changes from somewhat lacustrine conditions to more riverine type habitats will improve opportunities for feeding in moving water and riffles, while roosting and resting opportunities on flatwater will be diminished.

Coastal and freshwater shorefront development is expected to continue, and activities associated with development are likely to impact the quality of habitats for both breeding and post-breeding populations. Associated activities, such as boating and picnicking, will cause disturbance on and around breeding islands and foraging and

loafing habitat. Excesses of these activities are detrimental to nesting and brood-rearing waterfowl. Less tolerant species, such as black duck and common goldeneye, will be affected more negatively than species that display a higher tolerance of human activity, such as mallard and Canada goose.

Effects of human disturbance on wintering waterfowl have not been assessed adequately. Human activities such as boating, walking, hunting, clam digging, and low-level flying of aircraft are known to cause wintering waterfowl to temporarily vacate loafing and feeding areas. The cumulative effect of disturbance on waterfowl during winter would depend on the extent and frequency of disturbance, and climatic conditions, as well as the sensitivity to disturbance of the species. For example, black duck and common goldeneye seem to be more sensitive to disturbance during winter than mallard and Canada goose.

Continued losses (direct and indirect) of wetlands caused by expansion of residential, industrial, and commercial development are expected to continue. The rate of wetland loss or degradation in Maine may increase as these demands emerge. In order to ensure habitat for Maine waterfowl populations, protection, acquisition, and management of wetlands and adjacent uplands will be increasingly important.

POPULATION ASSESSMENT

Past Populations

There is little information available to document Maine's waterfowl populations in the days prior to the arrival of Europeans. Remnants of bones in Indian middens (refuse heap) provide evidence that native North Americans utilized waterfowl and their eggs for subsistence and plumage during periods of peak abundance - spring, early summer, and fall (Cronon 1983).

Early explorers and naturalists provided a record of waterfowl occurrence and abundance (Josseyline 1672, Rosier 1605). However, species composition is somewhat clouded by their reference to local names. Their descriptions of abundance were often transcripts of verbal or written records of single observations and provide no useful population estimates. In general, it is reasonable to conclude that the abundance of many species was greater than found today.

During the 1950s, developments in widespread survey, inventory and banding programs marked the beginning of documentation of population abundance (Spencer 1979). These programs were designed to specifically address questions about population size and status, hunting effort and harvest, migration and life history, and wetland habitat inventories.

Through 1985, production surveys in Maine have shown variable trends for Maine's common breeding waterfowl. Increases in ring-necked duck, hooded and common mergansers, mallard duck, blue-winged and green-winged teal, and Canada geese have been shown (Spencer et al. 1982). During this same period declines in

black duck, wood duck, and common goldeneye were measured. Population trends are addressed more specifically in individual Species Profiles.

Current Population

Waterfowl population indices for Maine include the USFWS Waterfowl Breeding Population Survey (WBPS) for Maine and the Maritimes, and the Mid-winter Waterfowl Survey (MWS). Other population indices of importance to waterfowl management in Maine include the Black Duck Joint Venture's (BDJV) helicopter plot survey of breeding waterfowl in Quebec, the USFWS Waterfowl Breeding Population and Habitat Survey of the traditional survey area (WBPHS-TSA), the Breeding Bird Survey (BBS), and the Sea Duck Survey (SDS) of wintering populations of sea ducks in the Atlantic Flyway. Brood counts conducted by MDIFW provide a measure of annual production. There is no current estimate of the migrating populations occurring in Maine. Estimation of populations relative to habitat carrying capacity could not be determined due to a lack of precise understanding of species-habitat relationships, a lack of precise information on habitat quality and quantity, and a lack of precise population estimates.

USFWS Waterfowl Breeding Population Survey

Statewide breeding waterfowl population indices for Maine became available in 1996 when Maine was included in the USFWS' breeding waterfowl survey (Tables 10-12). However, for most species counted in the survey the total for the entire Maine and Maritimes survey strata may be more informative than the totals just for Maine. Waterfowl counted within a particular state or province can be quite variable depending

on annual differences in migration chronology for some species due to weather conditions and availability of ice-free habitat. For example, scoters and bufflehead are not known to breed in Maine, yet in most years these species are counted during migration in Maine's portion of the breeding waterfowl survey. On the other hand, early migrants such as black duck, mallard, and Canada goose may be somewhat less variable in number and their counts may better reflect their population trends in Maine.

BDJV Helicopter Plot Survey

The Black Duck Joint Venture's helicopter plot survey of breeding waterfowl in Quebec, conducted by the Canadian Wildlife Service, was designed to monitor trends in breeding black duck populations. Breeding populations of other waterfowl species that migrate through Maine are monitored as well (Tables 13-14).

Waterfowl Breeding Population and Habitat Survey

The Waterfowl Breeding Population and Habitat Survey of the traditional survey area (Fig. 12), conducted by USFWS and the Canadian Wildlife Service (CWS), is an aerial transect survey over the key waterfowl breeding regions of North America. This area includes important waterfowl areas in Alaska, central Canada, Montana, South Dakota, and North Dakota. The WBPHS-TSA has been conducted annually since 1955. Experimental surveys in the Eastern Survey Area of eastern Canada and some eastern states began in 1990, and became operational in 1996 (Table 15). Maine and the Maritime Provinces are strata within the Eastern Survey Area.

Breeding Bird Survey

Unfortunately, wood ducks are not counted on the Maine and Maritimes aerial transect survey due to their use of wooded habitats and poor detectability. MDIFW has not yet assessed the feasibility on monitoring the state's breeding wood duck population via monitoring use of nest boxes. Presently there is no reliable index to wood duck population during the breeding season in Maine. However, BBS data indicate a significant positive trend in wood ducks in northern New England (Vermont, New Hampshire, and Maine), although the reliability of this survey for monitoring waterfowl is poor.

MDIFW Brood Counts

Since 1966, MDIFW annually has conducted counts of waterfowl broods on 39 waterfowl production index areas to monitor the species, number, and size of duck broods (Table 16). These brood counts have provided an index to breeding populations (species composition of broods) as well as production (number and size of broods).

Midwinter Waterfowl Survey

The U. S. Bureau of Biological Survey, the predecessor of the USFWS, conducted the first inventory of wintering waterfowl in the U.S. in January 1935. Since 1955 a standardized MWS has been conducted annually during one week in January (Table 17). The MWS provides information about the relative size and distribution of waterfowl populations wintering in each of the four administrative flyways. In the Atlantic Flyway, the MWS population indices for black duck, tundra swan, and brant

have served as population goals for the management of those species (USFWS and CWS 1986).

Sea Duck Survey

During 1990-1999 the USFWS conducted an aerial transect survey of sea ducks wintering along the Atlantic Coast (Tables 18,19). However, the SDS was discontinued in 2000 due to lack of funds. The survey did not detect any population trends among sea ducks during this time (Caithamer et al. 2000).

Population Projection

Populations of waterfowl are difficult to project, as future populations will depend on various factors affecting survival and recruitment, both within Maine and elsewhere in their range. Annual waterfowl production and available breeding habitat may vary considerably. Weather and water availability greatly affect annual production, however these occurrences are impossible to project. Furthermore, changes in population may not be detectable at any but the broadest scale. Future populations will depend to some degree on population goals that are established, as well as our ability to achieve those goals.

Limiting Factors

Waterfowl populations may be limited by reduced nest success, juvenile survival, adult survival, and habitat. Avian and mammalian predators, human disturbance, hunting, habitat degradation, catastrophic weather, and disease may be factors.

Predators

Adult ducks may be preyed upon by a wide variety of predators, including great horned owls, bald eagles, peregrine falcons, northern harriers, raccoons, foxes, mink, and snapping turtles. Young may be taken by any of these, as well as by red-tailed hawks, great black-backed gulls, wading birds, large predacious fish, and bullfrogs. Raccoons, foxes, skunks, squirrels, mink, woodpeckers, ravens, crows, herring gulls, common grackles, and starlings may destroy eggs. Outside of the nesting season, predation is a relatively minor source of mortality among Maine's adult and fledged waterfowl; however predation is a major mortality factor among ducklings, as is the case with common eiders (Mawhinney 2000).

Disease

Disease probably accounts for a large proportion of mortality among juvenile and adult waterfowl, however disease-caused mortality is rarely documented in cases other than mass die-offs (Bellrose 1980). Predators may kill weakened individuals before a disease becomes terminal, and carcasses of animals that die from disease often are quickly consumed by predators and scavengers. Other than avian cholera epidemics among common eiders (Allen 2000), major disease events rarely have been documented among waterfowl in Maine. In 2001, a die-off among dabbling ducklings occurred at the Mars Hill waste water treatment facility. Within a two-week period in July, 63 mallard and black duck pre-fledgling ducklings died and were collected by MDIFW regional biologists. Biologists at the U. S. Geological Survey's Wildlife Disease

Laboratory diagnosed at least some of the dead ducklings as having intestinal coccidiosis, an infection caused by the protozoan parasite (single-celled organism) *coccidia*.

Human Disturbance

Human disturbance in the form of catastrophic (point source) or chronic (non-point source) oil pollution events can cause mortality or morbidity among waterfowl. Nest success may be impaired and habitat use may be reduced due to pedestrian or boat traffic or other human development near nesting and brood-rearing habitats. Black ducks are less tolerant of human disturbance than other waterfowl species (Mendall 1958) such as mallard or Canada goose, and so otherwise-suitable habitat may be lower quality for black duck breeding due to encroachment by humans. Black duck use of wetlands in central Maine was negatively associated with a human habitation in view of the wetland (Diefenbach 1988).

Habitat Quantity and Quality

Wetland conditions and adjacent grassland nesting habitat in the prairie pothole region of North America drive waterfowl production for prairie-nesting populations. When wetlands are abundant, prairie-nesting waterfowl are quite productive. However, populations decline during periods of drought. In the East, wetlands typically are more stable although less fertile, and waterfowl productivity also tends to be more stable.

Weather

Heavy rains during the nesting season can cause delayed and reduced production because of the susceptibility of nests constructed on the ground or on marsh vegetation to flooding. Flooding caused 6-24% of nest failures among ring-necked ducks in Maine (McAuley and Longcore 1989); the major cause of egg loss was eggs rolling out of the nest during construction in response to rising water levels.

Nest Sites

Historically, nest sites were probably limiting for cavity-nesting waterfowl following deforestation of wetlands and riparian areas. Reforestation and expanding beaver populations created habitat conditions favorable to cavity-nesters, and their recovery was aided by the placement of nest boxes on wetlands lacking sufficient natural nest cavities. Wood ducks, hooded and common mergansers, and common goldeneyes do not excavate their own nest cavities and so must rely on natural tree cavities of suitable size, which may be lacking in young secondary forest. Artificial nest boxes were effective in enhancing local populations of wood ducks (Bellrose 1955, Soulliere 1990a).

Hunting

Liberalized regulations for sport hunting have been used to intentionally limit growth of arctic-breeding snow geese populations and resident populations of Canada geese. Among snow geese populations that were considered above the carrying

capacity of their habitat, increased hunting pressure has lead to an increase in harvest rate and a decrease in population growth.

Over hunting was implicated in the population decline among American black ducks prior to 1983. During the 1950s –1980s the MWS indicated a decline in black ducks of 3% per year (Rusch et al. 1989; Table 17, Fig. 21). Since harvest restrictions on black ducks in the U.S. were implemented in 1983, MWS counts of black ducks have stabilized (Longcore and Clugston 1997). According to band recovery analyses for black ducks, hunting mortality was additive during much of the time the black duck population was declining (Krementz et al. 1988, Francis et al. 1998).

Hunting is one source of mortality that can be influenced through hunting regulations. For more information see **Harvest Management**.

Lead Poisoning

Lead is a toxic metal which has no value to any known biological system. Its lethal and sublethal effects have been well documented in humans and animals. National efforts have been successful in eliminating lead from paints and in reducing the content in automotive fuels. These major efforts are attempts to lower environmental lead contamination for the protection of human populations.

Lead poisoning in waterfowl was first documented in the United States in 1894. It has been reported throughout the country since that time. In spite of the widespread and common occurrence of lead poisoning deaths in waterfowl, the significance of this disease as a mortality factor in North American waterfowl was slow to be acknowledged by waterfowl hunters. This weak acknowledgement of mortality stemmed from the

inherent properties of lead toxicosis in waterfowl. There have been a few large scale die-offs caused by lead poisoning, but spectacular, disaster-type outbreaks are rare. Most deaths due to lead poisoning occur solitarily, over a period of days or weeks, after an individual bird ingests lead pellets.

Spent shot pellets are ingested by waterfowl while feeding, and the pellets are retained in the gizzard. Grinding and digestive action in the gizzard erode the lead pellet and make it available to be absorbed in the digestive system. During the period following ingestion, the affected bird becomes debilitated, seeks seclusion, and often succumbs to predation prior to death from lead poisoning. After death from lead poisoning, the carcass is quickly consumed by scavengers and predators. Because of these factors, lead poisoning has been termed the "Silent Killer of Waterfowl" (Anon 1983).

The major source of lead ingested by waterfowl and other birds was spent shot from sport hunters. Nationally, nearly 3,000 tons of lead were deposited annually in the environment by waterfowl hunters in pursuit of their sport (Hair 1983). During 1979-1983 an estimated 16.8 tons of lead were deposited annually in Maine (Corr 1985).

During 1938-1954, annual mortality of mallards in the Atlantic Flyway due to lead poisoning was estimated at 3-4% (Bellrose 1959). Anderson et al. (1987) reported a 34% reduction in the incidence of lead pellet ingestion by mallards during 1977-1979 in the Mississippi Flyway, compared to lead ingestion rates prior to implementing the use of steel shot regionally in 1977. By 1991 lead was prohibited for waterfowl hunting throughout the U.S., and was prohibited in Canada by 1999. By 1997 the ban on lead shot had reduced lead poisoning deaths among mallards in the Mississippi Flyway by

64% (Anderson et al. 2000). Despite the conversion to non-toxic shot, exposure to lead shot will continue in some local areas due to past deposition of lead shot being retained in bottom sediments (Rocke et al. 1997; MDIFW unpubl. data).

USE AND DEMAND ASSESSMENT

During the 1700s and 1800s, migratory birds, their plumage, and eggs were collected and used in interstate commerce for food and millinery trades. These uncontrolled practices reduced or eliminated many local breeding populations. This was especially true for sea bird breeding colonies where dense nesting made eggs and adults particularly vulnerable to collection and capture. By the early 1900s, Maine's eider colonies were reduced to a few breeding pairs on remote islands (Gross 1944).

Waterfowl populations, particularly wood ducks and common eiders, declined drastically in the late 1800s and early 1900s due to excessive mortality from market hunting, unregulated sport hunting, and habitat degradation. Populations dwindled to the point that early ornithologists believed wood ducks might become extinct. With full protection afforded by the Migratory Bird Treaty Act in 1918, wood duck populations began to recover. Market hunting was eliminated, and sport hunting regulations for migratory birds were coordinated by the federal government.

Trends in Hunting Seasons, Hunter Numbers, and Hunting Activity

Prior to the mid-1950s, duck hunting seasons were quite variable in length (Table 20). Harvest and hunter use surveys initiated in the 1950s have provided a measure of trends relative to demand (Table 4). From the 1950s through the early 1980s, seasons were fairly liberal in length. The federal surveys, which until 2001 were structured around the sale of duck stamps, documented increasing waterfowl hunting activity from the 1960s to peak participation in the 1970s (Fig. 13, 14).

In response to drought conditions in the so-called “duck factory” of the U.S. and Canadian prairies, seasons in the Atlantic Flyway were shortened from 50 days and a 5-bird bag in 1984 to 40 days in 1985, and shortened further to 30 days and a 3-bird bag in 1988. The restrictive seasons of 1988-1990 also marked modern lows in number of hunters (Fig. 13), total number of days spent hunting (Fig. 14), and total duck harvest in Maine (Table 21).

With improvements in habitat conditions and waterfowl populations, hunting season frameworks were increased to 40 days and 4 birds in 1994-95, 50 days and 5 birds in 1996, and 60 days and 6 birds in 1997-2003. During this recent period of liberalized hunting season frameworks, trends of hunter participation have stabilized or increased (Fig. 13, 14). In 2001, 9,394 adult active duck hunters spent 81,268 days hunting ducks. The average number of days spent duck hunting and the average seasonal bag per duck hunter have remained fairly stable during 1961-2001 (Fig.15). Beginning in 1997, states with Sunday hunting prohibitions, such as Maine, have been allowed additional hunting days to compensate for lost opportunity.

Long term trends in waterfowl harvests include decreases in black duck, blue-winged teal, common goldeneye, and scoters. Increased harvests during 1961-2001 have occurred among Canada goose, mallard, mergansers, and, more recently, wood duck (Tables 22-25). Since the 1985 waterfowl plan (Corr 1986), dabbling ducks have increased slightly as a proportion of the total duck harvest, while the proportion of diving ducks in the harvest has declined and sea ducks have remained stable (Table 21, Fig.16). Waterfowl harvests are addressed further in specific Species Profiles.

Harvest Information Program

Since the early 1950s, the USFWS conducted an annual survey of federal duck stamp purchasers to estimate waterfowl hunter activity and harvests in the U.S. The duck stamp based survey was conducted through the 2000-2001 season, after which it was replaced by the Harvest Information Program (HIP) survey. The HIP survey provides estimates of hunting activity of all migratory birds, not just waterfowl. Migratory bird hunters are identified when they buy their hunting licenses, and are the pool from which USFWS now samples for the annual surveys of hunting activity and harvests. Harvest and hunter activity estimates for the 2001 and 2002 hunting seasons based on HIP are presented in Tables (HIP 26-28).

Youth Waterfowl Day

Since 1997, Maine has held a Youth Waterfowl Hunt, during which hunters aged of 10-15, accompanied by an adult, are allowed to hunt Canada geese and ducks. The one-day hunt takes place on a Saturday in September at least one week prior to the start of the regular duck season. A mail survey conducted in 2001 indicated approximately 7-9% of waterfowl hunters took a youth hunting on the Youth Waterfowl Hunt.

Youth hunt days, such as the Youth Waterfowl Hunt, are probably under-utilized. Duda et al. (2003) reported that *slightly less than half* of youth in the U.S. expressed some interest in going hunting, and *one in five* were very interested in going hunting. Lack of a mentor or family member who hunts was identified as a barrier to hunting participation by youths.

Demographic and Economic Analysis of Waterfowl Hunting

Very little statewide data on waterfowl hunters are available. A 1988 survey of adult waterfowl hunters in Maine (Teisl et al. 1991) estimated 10,979 adult residents hunted waterfowl in Maine during the 1988 season, with hunting of inland ducks being most popular (85%), followed by sea ducks (41%) and geese (32%). Most waterfowl hunters were male (92%), the average age was 37 years, the average education included some college or technical school, and the average household income was $42,210. Most waterfowlers hunted every year (45%) or more than half the years (29%), and the average amount of waterfowl hunting experience was15 years. In comparison, the averaged licensed resident hunter in Maine in 1988 was 40 years old, had a high school education, and had a household income of $29,700.

Hunt quality of the 1988 Maine waterfowl hunting seasons was considered "good" or better by large majorities of inland duck hunters (70%) and sea duck hunters (75%), but by only about half of goose hunters (53%) (Teisl et al. 1991). The most popular hunting method was hunting over decoys (71%), followed by pass shooting (64%), using a blind (63%), jump shooting with a canoe (53%), hunting from a boat (34%), and using a sculling boat (7%). Only 39% of hunters used a retrieving dog. Most hunters (57%) supported the then-new steel shot requirement, despite nearly 40% of hunters feeling it decreased their hunting success. The majority of hunters (62%) changed hunting methods because of the steel shot requirement; such changes included shooting only inside of 30 yards (40%), purchasing a new shotgun or selecting a different choke (33%), and moving the decoys closer to the blind (31%). A majority of

waterfowl hunters (58%) felt that the black duck population had stabilized or increased since harvest restrictions were imposed in 1982, and 63% felt the length of the 1988 black duck season was okay. Nearly equal proportions of hunters supported shortening the October season (29%), shortening the December season (26%), or establishing a season bag limit (24%) as potential methods of reducing black duck harvest.

The National Survey of Fishing, Hunting and Wildlife Associated Recreation-Maine (Anon. 1998, 2002) presented data on migratory bird hunters in Maine. Migratory bird hunters included those who hunted woodcock, snipe, and rail as well as waterfowl hunters; sample sizes were too small to report waterfowl hunters separately. Even when all migratory bird hunters in the sample are grouped together, the authors caution that the sample size is small. The 1996 survey estimated hunting trip and equipment expenditures by 21,000 people totaled $2,515,000 or $122 per person, whereas the 2001 survey estimated hunting trip and equipment expenditures by 11,000 people totaled $5,277,000 or $459 per person. For comparison of hunter numbers, federal duck stamp sales in Maine were 9,251 in 1996, and 11,041 in 2001. Regardless of the variability of the estimates, it is obvious that waterfowl hunting has considerable economic and social impact in Maine.

Demographic and Economic Analysis of Birding

Bird watching, or birding (i.e. taking a trip one mile or more from home for the primary purpose of observing birds and/or closely observing or trying to identify birds around the home (La Rouche 2003)), is quite popular among Mainers. Of Maine residents 16 years old or older, 36% participated in bird watching in 2001. Birding is

also a popular activity among nonresident visitors to Maine, as 39% of the 595,000 people who birded in Maine in 2001 were nonresidents (La Rouche 2003). Nationally, waterfowl were the most popular type of birds to observe, with 78% of birders reportedly observing them, followed by songbirds (70%), birds of prey (68%), other waterbirds (56%), and other birds (43%) (La Rouche 2003).

Wildlife watching-related expenditures contribute substantially to Maine's economy. The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (Caudill 2003) estimated the total wildlife-watching expenditures and economic impacts for Maine in 2001 at $856.5 million, or 2.3% of the gross state (GSP) product. Maine ranked 3rd nationally in total wildlife-associated economic output as a percentage of GSP, behind Alaska and Montana. Maine ranked 4th highest among states for both wildlife-watching-generated employment as a percentage of total state employment (2.2%) and wildlife-watching-generated employment income as a percentage of total state wage and salary disbursements (1.4%).

The preceding economic figures are for all wildlife-watching activity, not just waterfowl watching or even just birding. However, 84% of those who make trips to observe wildlife away from home are birders, and waterfowl are the most popular group of birds (nationally) among birders (La Rouche 2003). Therefore, it is clear that waterfowl provide Maine with substantial aesthetic and economic nongame value in addition to their traditional value as game species.

Use and Demand Projections

Opportunity for hunting and observing waterfowl is expected to follow recent trends, i.e. is likely to remain stable. However, opportunity could be reduced locally if access to waterfowl habitats is reduced due to posting of private property or establishment of municipal ordinances prohibiting firearms discharge. Waterfowl hunting season frameworks based on eastern-derived mallards are expected to remain liberal throughout the planning period.

SPECIES PROFILES

Tundra Swan

Background

Tundra swan is a rare migrant in Maine. During fall migration, tundra swans typically feed in upland agricultural habitats. Eastern population tundra swans breed in arctic North America and winter in the mid Atlantic states (Fig. 17).

Population status and trend

The eastern population of tundra swans was increasing during 1993-2002. The mean population estimate for 2000-2002 was >25% above the North American population objective (USFWS et al. 2003).

Harvest trend

There is no hunting season for tundra swans in Maine, although they are hunted in two other Atlantic Flyway states (Department of Interior 2003).

Mute Swan

Background

The mute swan is indigenous to Europe and parts of Asia. It was introduced into North America in the late 1800s as a decorative species in waterfowl collections, private estates, and parks. Feral populations were established as a result of escaped and released birds, presumably in the Hudson River area during the early 1900s (Atlantic

Flyway Technical Section 2003). Mute swans are non migratory, but will move short distances to open water.

Mute swans feed primarily on submerged aquatic vegetation (SAV), and have been implicated in reduction of SAV in wetlands in Connecticut (Chasko 1986), Rhode Island (C. Allin, Rhode Island Department of Environmental Management, personal communication cited in Atlantic Flyway Technical Section 2003), and Chesapeake Bay (Hindman and Harvey 2003). Mute swans can detrimentally affect native waterfowl by reducing availability of SAV in shallow wetlands. Furthermore, mute swan pairs are strongly territorial and may even kill intruding pairs and/or offspring of other swans, ducks and geese (Reese 1980, Kania and Smith 1986). Territorial defense by mute swans directed toward humans has resulted in human injury requiring medical treatment (Atlantic Flyway Technical Section 2003).

In 1998 the USFWS Refuge System, Regions 1-7, instituted a policy to control mute swans and prevent degradation of wetland habitats. Executive Order 13112 on Invasive Species, signed by the president of the United States in 1999, directed federal agencies to prevent the introduction of invasive exotic (non native) species, including mute swans, and to provide for control of existing invasive exotic species.

Until 2001, the mute swan had not been under the jurisdiction of the Migratory Bird Treaty Act (MBTA) of 1918, and so management of mute swans was the responsibility of the states. Strategies to control expansion of mute swan populations employed by states have included harassment, egg addling, nest destruction, capture and euthanasia of nuisance swans, and shooting (Atlantic Flyway Technical Section 2003). However, private citizens brought a lawsuit in an effort to end state efforts to

control burgeoning mute swan populations. Consequently, on December 28, 2001 the U. S. Court of Appeals (Hill vs. Norton, U. S. D. I. et al.) ruled that the mute swan, being a member of the family Anatidae, is a federally protected species under the jurisdiction of the MBTA. As such, management and control of feral mute swans by states now is subject to permitting by the U. S. Fish and Wildlife Service.

Population status and trend

Feral mute swans are well established in North America, particularly in the Great Lakes states, and along the Atlantic coastal plain from Chesapeake Bay to New England. The population of mute swans in the Atlantic Flyway grew from <1,000 in the 1950s to >14,000 in 2002. During 1986-2002, mute swans in the Atlantic Flyway increased by 6% annually, and now exceed the flyway population objective by 400% (Atlantic Flyway Technical Section 2003).

Feral mute swans are rare in Maine; two or three pairs have been reported from the towns of Eliot and Kittery. MDIFW minimizes the potential of population growth among mute swans by denying permits to import and release this species. The population estimate in 2002 was zero, which has been used by default as Maine's population objective in the Atlantic Flyway's Mute Swan Management Plan (Atlantic Flyway Technical Section 2003). Four mute swans were counted near Portland and Eliot during the Midwinter Waterfowl Survey in 2004.

Harvest trend

USFWS currently does not offer a hunting season for mute swans.

Canada Goose – resident population

Background

The stock of Canada geese that nested in the Atlantic Flyway from southern Quebec southward (Fig. 18) was extirpated following European settlement. Today's resident birds are descendants of captive geese released by private individuals in the early 1900s. When use of live decoys for waterfowl hunting became illegal in 1935, captive decoy flocks of geese were released. Beginning in the 1950s through 1990, state fish and game agencies in the Atlantic Flyway introduced Canada geese into predominantly rural areas to establish resident breeding populations (RP).

Prior to 1965, resident Canada geese breeding in Maine were thought to be few or none. During 1965-1975, 2,341 geese were imported from New York, New Jersey, and Connecticut. During 1981-1985, 1,723 more geese were transported from Connecticut into northern Maine. Through the 1990s, 50-75 geese per year were moved within the state to relieve nuisance situations. Nuisance complaints received by MDIFW regional biologists averaged about 30 per year during the late 1990s. Most nuisance issues in Maine involve geese defecating on lawns or beaches; however, Canada goose feces pose relatively little risk to human health (Converse et al. 2001).

The breeding distribution of Canada geese is now statewide, including some offshore islands. Resident Canada geese are present in the state throughout the year. In addition to resident birds that winter in Maine, some geese that breed in Maine apparently are somewhat migratory; summer-banded geese from Maine have been

recovered during December through March in Massachusetts, Connecticut, Rhode Island, and New York.

Recoveries of summer-banded RP geese from Maine and the Maritime Provinces indicate RP geese in this section of the Flyway may be associated. During 1996-2000, 5 of 12 (42%) Maine recoveries of bands from RP geese that were banded in New Brunswick and Prince Edward Island, were shot in Maine during September. During 2003, 3 of 7 Maine-banded geese reported through November were recovered in New Brunswick, with the other 4 birds having been shot in Maine.

Population status and trend

The mean population estimate (2000-2002) for Atlantic Flyway RP Canada geese of approximately 1 million birds was >50% above the North American population objective. RP geese estimated by the FWS aerial transect survey in Maine during 1996-2003 averaged 15,700, with no trend discernable for this period (Table 12). Canada geese that winter in Maine have increased steadily since the 1960s (Table 17).

Harvest trend

Early (September) goose hunting seasons became operational in Maine in 1996 (Table 20). The purpose of the early season is to effect additional hunting mortality of RP geese while protecting the migratory population, and to provide hunting opportunity. The harvest during the first season was 1,100 geese; early season goose harvests during 1998-2001 averaged 4,100 birds (Table 25).

The proportion of RP geese in the regular season harvest is not known. Based on band returns, and movements of radio-marked geese (Malecki et al. 2001; R. A. Malecki unpublished data), birds from northern stocks are relatively unlikely to be killed in Maine after October. However, RP geese from Maine (and to some extent, from the Maritimes) are vulnerable to hunting during early and regular goose seasons in Maine, and during hunting seasons elsewhere in the Atlantic Flyway. Resident population geese banded during summer 2002 and 2003 in Maine have been recovered during the early season in Maine, and during the regular season in Maine, New Brunswick, Massachusetts, Connecticut, Rhode Island, and New York. Banded Canada geese recovered by hunters in Maine during 2003 (n=6) were summer-banded in Maine, New Hampshire, Connecticut, and New York; all were recovered during the regular goose season.

Canada Goose – migratory population

Background

Canada geese that migrate through Maine belong primarily to the North Atlantic Population (NAP), and secondarily to the Atlantic Population (AP) of Canada geese that breed in eastern Canada (Fig. 18).

Population status and trend

A North American population objective has not been established for NAP geese; the AP population estimate (mean for 2000-2002) of 134,900 was 23% below the North

American population objective (USFWS et al. 2003). Both populations showed increasing trends during 1990-2003 (Table 14).

Harvest trend

Regular season goose harvests in Maine during 1962-1994 averaged 1,660 birds annually. The regular goose season was not offered during 1995-1997 to allow NAP geese to increase. During 1998-2001 regular season goose harvests in Maine have averaged 5,450 annually (Table 25). The proportion of RP geese in Maine's regular season harvest is not known, but it is presumed substantial.

Band recoveries of NAP geese by Maine hunters indicate a swift fall migration through Maine. During 1991-2000, 5 of 7 recoveries (71%) in Maine of banded NAP geese occurred on or before October 18, and only 1 of 7 recoveries occurred after October. Average daily hunter kill of Canada geese in Maine reaches a second peak in early to mid October, reflecting an influx of migrant (NAP and AP) Canada geese during that period (Fig. 19). Most AP Canada geese arrive on their wintering grounds to the west and south of Maine during October and November (Malecki et al. 2001), and are not likely to be available to hunters in Maine.

White-fronted Goose

Background

White-fronted geese rarely migrate through Maine. White-fronted geese breed in arctic Canada and Alaska, and winter in the Central and Pacific Flyways (Fig. 20).

White-fronted geese typically feed in upland agricultural habitats during migration in Maine, often among a flock of Canada geese.

Population status and trend

The mean population estimate for 2000-2002 of 914,300 was >50% above the North American population objective. White-fronted geese populations were increasing during 1993-2002 (USFWS et al. 2003).

Harvest trend

White-fronted geese have not been recorded in harvest surveys in Maine.

Snow Goose

Background

Snow geese that migrate through Maine belong primarily to the Greater subspecies. Greater snow geese breed in eastern arctic Canada and winter in the mid Atlantic states (Fig. 20). Both the white and "blue" morphs are represented. Snow geese typically feed in upland agricultural habitats during migration in Maine, sometimes mixing with flocks of Canada geese.

Population status and trend

The mean population estimate for 2000-2002 of 763,500 was >50% above the North American population objective. Greater snow geese populations were increasing during 1993-2002 (USFWS et al. 2003).

Harvest trend

Snow geese have made up a minor portion of the total goose harvest in Maine since the 1960s (Table 25, 27), but harvests seem to have increased during this time. The mean hunter kill of snow geese during 1991-2000 was 108 birds per year (Table 29). These harvest estimates are based on very small samples of feathers collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Ross' Goose

Background

Ross' geese that migrate through Maine typically are few in number and intermixed with larger numbers of snow geese. Ross' geese breed colonially, interspersed with lesser snow geese, in arctic Canada. Ross' geese winter in the Central and Pacific Flyways, including Mexico and coastal Texas (Ryder and Alisauskas 1995; Fig. 20). Ross' geese typically feed in upland agricultural habitats during migration in Maine, sometimes mixing with flocks of Canada geese.

Population status and trend

The mean population estimate for 2000-2002 of 610,000 was >500% above the North American population objective. Ross' geese populations were increasing during 1993-2002 (USFWS et al. 2003).

Harvest trend

Ross' geese have not been recorded in harvest surveys in Maine.

Brant

Background

The subspecies of brant that migrates through Maine is the Atlantic brant (Fig. 20). Brant are common on the Maine coast during spring migration, but are less common in Maine during fall migration. Atlantic brant breed in the arctic of eastern North America and Greenland, and they winter in marine habitats of the mid Atlantic states (Reed et al. 1998). Relatively few brant winter in Maine.

Population status and trend

The mean population estimate during 2000-2002 of 161,400 was 30% above the North American population objective (USFWS et al. 2003).

Harvest trend

Brant are uncommon in the hunter's bag in Maine, and were not recorded in waterfowl harvest estimates in Maine until 2001 (Table 25). These harvest estimates are based on very small samples of feathers collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Fulvous Whistling Duck

Background

Fulvous whistling duck has isolated breeding populations in Asia, Africa, South America, and North America. The North American breeding range includes Mexico, California, and the Gulf coast states. Aberrant migration records are clumped along the Mississippi River drainage, the Great Lakes system, and the Pacific and Atlantic coasts. The fulvous whistling duck is a rare visitor to Maine.

Population status and trend

Fulvous whistling duck population was increasing during 1970-2002; a North American population objective has not been established (USFWS et al. 2003).

Harvest trend

Fulvous whistling duck has not been recorded in harvest surveys in Maine.

Black Duck

Background

Black duck breeds from Chesapeake Bay north to Ungava Bay and northeastern Manitoba. The wintering range includes the Atlantic Coast from the Maritime Provinces to Florida, and inland waters west to the Mississippi River (Longcore et al. 2000). Black ducks in Maine prefer forested and scrub-shrub wetlands, beaver-created wetlands, and bogs in boreal forests for breeding (Coulter and Miller 1968, Ringelman et al. 1982). During spring, pairs feed in vernal pools in forests and agricultural fields, on seasonally

flooded river floodplains (McAuley et al. 1998), and along smaller alder-lined brooks (Cowardin et al. 1967). Newly created or re-flooded beaver meadows are particularly important brood habitat due to abundant invertebrates needed as food by ducklings (Ringelman and Longcore 1982, Parker et al. 1992, Merendino et al. 1995). Winter habitat in the Northeast is predominantly marine – tidal and saltmarsh habitats (Jorde 1986). During migration, and during winter in mid-Atlantic states, black ducks use emergent marsh, beaver-mediated wetlands, riverine marshes, estuaries, tidal flats, ponds, lakes and reservoirs (Jorde et al. 1989, Frazer et al. 1990).

Habitat loss and excessive hunter harvest have been implicated in a decline among black ducks of >60% since the 1950s. The decline in the Mississippi Flyway has been relatively more severe than in the Atlantic Flyway. Important historical inland and coastal breeding and wintering habitats have been eliminated or degraded by deforestation, wetland drainage associated with agriculture, and urban and industrial development (Longcore et al. 2000). Black duck has been the principal duck in the hunter harvest among northeastern states and eastern provinces, and has been heavily exploited (Wright 1947).

During the 1950s –1980s the MWS in the Atlantic Flyway indicated a decline in black ducks of 3% per year (Rusch et al. 1989; Table 17, Fig. 21). Since harvest restrictions on black ducks in the U.S. were implemented in 1983, MWS counts of black ducks have stabilized (Longcore and Clugston 1997). According to band recovery analyses for black ducks, hunting mortality was additive during much of the time the black duck population was declining (Krementz et al. 1988, Francis et al. 1998).

Recent research in Quebec, Vermont, and Nova Scotia on the effects of hunting on survival of juvenile black ducks demonstrated the vulnerability of young black ducks to hunting (Longcore et al. 1998), especially on opening days (Boyd 1971, Reed and Boyd 1974). The highest survival rate (0.545) was associated with the latest date of season opening (Oct. 8). The lowest survival rate (0.395) was at an international border where hunter numbers and activity were greatest and ducks were exposed to 3 opening days (one in Quebec and 2 in Vermont). Eighty-six percent of duck mortalities were from hunting (72% retrieved + 14% unretrieved).

In addition to habitat alteration and hunting mortality, effects of interactions between black ducks and an increasing mallard population have also been suspected in the decline of black ducks (Ankney et al. 1987). However, speculation that the decline in black ducks was caused by hybridization between black ducks and mallards (Ankney et al. 1987) or competitive exclusion of black ducks by mallards (Merendino et al. 1993) has not been substantiated (Longcore et al. 1998). An experiment using captive birds found that mallards generally were not dominant to black ducks (Hoysak and Ankney 1996), however an earlier study of captive birds reported that mallard males were more aggressive than black duck males (Brodsky et al. 1988). Field research in Maine on interactions between breeding sympatric black ducks and mallards found that mallards were not dominant over black ducks, and displacement from a wetland of one species by another was rare and equal between species (McAuley et al. 1998). Brood sizes of mallards and black ducks on the study area did not differ (Longcore et al. 1998).

Population status and trend

Winter counts of black ducks in the Atlantic Flyway declined an average of 3% annually during the 1950s –1980s (Rusch et al. 1989; Table 17, Fig. 21), and subsequently stabilized (Longcore and Clugston 1997). The black duck breeding population estimate for North America during 1993-2002 was 381,000; the North American population objective is 640,000 (USFWS et al. 2003). The trend during 1970-2002 was decreasing. The breeding population trend in the eastern survey area during 1996-2003 was stable (Fig. 22), and the trend in Quebec from the BDJV helicopter plot surveys was increasing slightly during 1990-2003 (Fig. 23).

Within Maine, breeding population counts are highly variable due to presence of northern migrants in some years, and have ranged from 22,515 in 1999 to 91,958 in 1998 (Table 10). Occurrence of black duck in MDIFW's annual survey of waterfowl broods on production index areas increased between 1966-1976 and 1986-1990, but decreased by 50% from 1991-1995 to 2002 (Table 16). Black duck broods in 2002 comprised 15% of all duck broods observed on production index areas, compared to 29% during 1966-1976.

Harvest trend

Spencer (1979) developed background data suggesting the need to reduce hunter kill of Maine breeding populations. A summary of the important facts leading to this conclusion follows, with recent information added in brackets. This information supported harvest restrictions that were implemented in 1982:

(1) Annual mortality (all causes) approximating 60 percent results in a stable population, maximum allowable kill rate of immatures is 30 percent, and maximum allowable kill rate of adults is 20 percent.

(2) Approximately 50 percent of immature and 23 percent of the adults killed in Maine were from Maine breeding populations.

(3) Over 40 percent of flyway harvest of Maine banded black ducks occurs in Maine. [Author's note: during 2002-03, 12 of 28 (43%) direct recoveries of Maine-banded black ducks were killed in Maine.]

(4) Of the Maine-banded black ducks recovered in Maine, over 89 percent were killed prior to November 9 (73 percent prior to October 21). [Author's note: considering direct band recoveries during 2002-03, 8 of 12 (67%) were killed by Oct 28.]

(5) Low hunter kill of Maine winter-banded black ducks suggest that additional harvest is possible from this component of the population. (Corr's (1985) note: this may not be the case when a population is at a very low level.)

(6) Continued decline of Maine black duck harvests, and the proportion of total Maine kill through 1978, suggests lower populations were available to hunters.

(7) Analysis of production data (from 37 reference areas) indicated a significant decline in black duck production in Maine.

(8) Banding analysis indicated a "very high" hunter kill rate for Maine breeding black ducks - first season kill rate 42 percent (pre-season bandings). [Author's note: recent preliminary banding analysis indicates a first season

kill rate of approximately 10-13% based on 2002-2003 pre-season bandings.]

During 1961-1965 black duck harvests averaged 21,080 per year, constituting 45.8% of the Maine duck harvest (Table 22). Harvests increased through 1971-1975, then decreased through 1980. After implementation of the 1979 species management plan, a program was developed through the Atlantic Flyway Council to reduce the black duck kill by 25% or more. Maine initiated harvest restrictions in 1982 and further curtailed hunting regulations in subsequent seasons (Table 20). Restrictions included reducing the bag limit to 1 black duck per day, shortening the number of days for hunting black ducks, and delaying the opening date for hunting of black ducks.

Restrictions implemented for the 1982 season resulted in a reduction in harvest of 27%. During 1983-2001, harvests of black duck in Maine were reduced an average of 54% relative to the mean for 1977-1981 (Table 30). During 1976-1980, black duck was the leading species in the harvest, making up 28.3% of the total duck kill (Table 22). By contrast, in 2001 black duck accounted for 14.4% of the total duck harvest, and was the 4th most common duck in the hunter's bag. Harvests of black duck are highest during the first few days they can be hunted in the duck season, but substantial numbers are bagged throughout the season (Fig. 6).

A sample of bands recovered in Maine (n=12) during the 2003-2004 season indicates Maine's harvest of black duck is derived from Maine, Quebec, New Brunswick, and Prince Edward Island.

Mallard

Background

Mallard is the most numerous and most heavily hunted duck species in North America. Mallards prefer open emergent marsh and aquatic bed wetlands for breeding (Losito and Baldassarre 1995), but will use forested wetlands, farm ponds, and urban park ponds. The breeding distribution currently ranges across most of the continent, from Alaska to Quebec and south to Mexico, Texas, and South Carolina (Drilling et al. 2002). Until the 1900s, mallard bred almost exclusively in the central and western regions of the continent with peak abundances in the prairie pothole area. Mallards winter throughout the U.S. and southern Canada wherever it can find sufficient food and open water. During winter in Maine, mallards use marine habitats and rivers, often near areas of human development. Aquatic as well as upland, agricultural foods are used.

Mallard breeding range extended east and northeast into black duck range with the help of habitat alteration from agriculture and urbanization, releases of captive-bred mallards for hunting, and the establishment of urban park mallard flocks (Heusmann 1974, 1981; Figley and VanDruff 1982). The Maine Department of Fish and Game (now MDIFW) released 151 hand-reared mallards during 1940-1970. During 1972-1975 local sportsman's groups released 8,004 juvenile mallards, mostly in the vicinity of Merrymeeting Bay (Longcore et al.1987). Survival of released mallards (Foley 1954) likely was sufficient to establish mallards breeding in the wild. Large releases of mallards in mid Atlantic states also likely contributed to the increase of mallards in Maine (Longcore et al. 1987).

Prior to the 1960s, mallards were rarely observed during the breeding season in Maine (Coulter 1953, Coulter and Mendall 1966). Waterfowl investigations during 1956-1986 indicated increases in mallard pairs and broods, and increased proportion of mallards and mallard x black duck hybrids in pre-season banding (Longcore et al. 1987).

Longcore et al. (1987) attributed the increase of mallards and mallard x black duck hybrids primarily to release and survival of hand-reared mallards, and the coincidental establishment of impounded wetlands (Spencer 1962, 1963) that apparently were more attractive to mallards than to black ducks. Several studies in the Northeast indicate construction of impounded wetlands favors mallards over black ducks (Figley and VanDruff 1982, Belanger and Coutoure 1987, Longcore et al. 1987). Mallards have demonstrated adaptability in use of natural habitats. Additionally, mallards' flexible food habits (Drilling et al. 2002) and tolerance of human activity have enabled the species to exist or thrive in human-altered areas such as human-impounded wetlands, agricultural areas, developed lake shores and river fronts, and urban parks that less tolerant species, such as black duck, avoid.

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 8.4 million is above the North American population objective of 8.2 million (USFWS et al. 2003). The continental population during 1970-2002 was stable. The population in the eastern survey area showed no trend during 1996-2003 (Fig. 24). Within Maine, breeding population counts are highly variable due to presence of northern migrants in

some years, and have ranged from 6,272 in 2001 to 24,843 in 1998 (Table 10); in contrast, the statewide estimate in 1986 was 657 pairs (Longcore et al. 1987).

Occurrence of mallard in MDIFW's annual survey of waterfowl broods on production index areas increased during 1956-1986 (Longcore et al. 1987). Mallard broods in 2002 comprised 5% of all duck broods observed on production index areas, compared to 1% during 1966-1976.

Maine's winter population of mallard, as indexed by the MWS, increased from zero during 1961-1965 to an average of 2,193 during 2001-2003 (Table 17).

Harvest trend

During 1961-1965 mallard harvests in Maine averaged 960 per year, constituting 2.1% of the Maine duck harvest (Table 22). Harvests increased and then stabilized at 4,600-5,040 during 1971-1990, and then increased during 1991-2001 to a high of 15,000 birds per year and 18.1% of the total duck kill in Maine (Fig. 16, 25). Harvests of mallard are highest during the first few days of the duck season, but substantial numbers are bagged throughout the season (Fig. 6).

Harvests of mallard x black duck hybrids increased from 224 per year (0.5% of harvest) during 1961-1965, to 760 per year (1.1% of harvest) during 1996-2000. Hybrids have comprised <4% of the harvest of mallard and black duck (hybrid harvest / (hybrid harvest + mallard harvest + black duck harvest)) in Maine every year during 1961-2001 except 2000 (7.8%).

A sample of bands recovered in Maine (n=32) during the 2003-2004 season indicate Maine's harvest of mallard is derived from Maine, Quebec, Ontario, New

Brunswick, Nova Scotia, New Hampshire, Massachusetts, and New York. Twelve of 15 (80%) in-state recoveries of Maine-banded birds occurred on or before October 18, whereas a majority of the birds (59%) derived from outside of Maine were shot November 4 or later. Considering direct recoveries of a sample of mallards banded in Maine during 2002-2003, 15 of 25 (60%) hunting season recoveries of Maine-banded mallards occurred in Maine; the remaining 40% of the kill of Maine mallards occurred in Massachusetts, Rhode Island, New Jersey, Delaware, Maryland, and North Carolina.

Green-winged teal

Background

American green-winged teal breed across the northern half of the continent, using a wide variety of wetland types including forested wetlands, freshwater emergent marshes, and beaver flowages (Bellrose 1976, Baldassarre and Bolen 1994). Green-winged teal reaches the southern limit of its breeding range in Maine. Within Maine, the breeding distribution is statewide (Adamus 1987), though it is less common in the southern part of the state. The winter distribution includes the southern half of the United States, Mexico, and the Caribbean. Wetlands used during migration include freshwater emergent marsh and saltmarsh.

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 2.3 million is above the North American population objective (USFWS et al. 2003). The continental population during 1970-2002 was increasing. The population in the eastern

survey area showed no trend during 1996-2003 (Fig. 26). Within Maine, breeding population counts are highly variable due to presence of northern migrants in some years, and have ranged from 5,564 in 1996 to 99,245 in 2002 (Table 10). Occurrence of green-winged teal in MDIFW's annual survey of waterfowl broods on production index areas has remained low during 1966-2002 (Table 16).

Harvest trend

The majority of hunter harvest of green-winged teal in Maine occurs during the first two weeks of the season (Fig. 5). During 1961-1980 green-winged teal were among the top three duck species in the Maine harvest, averaging 11.5%-15.3% of the annual state duck kill (Table 22). More recently harvests of green-winged teal in Maine averaged 10,240 annually during 1996-2000, making up 15% of the annual duck kill, and third only to mallard and eider.

In 1970-1972 experimental teal seasons during September were instituted in limited areas in Maine (e.g. Merrymeeting Bay). During 1975-1987 two "bonus teal" (green-winged and/or blue-winged) could be taken in addition to the regular duck bag during the first 9 days of the season (Table 20). During 1997-2003 two teal (green-winged and/or blue-winged) could be taken in addition to the regular duck bag for the entire season.

Blue-winged teal

Background

Blue-winged teal breeding distribution includes the northern half of the U.S. and Canada, but it reaches highest densities in the prairie states and provinces. Within Maine blue-winged teal occur most commonly in emergent marshes in central and northeastern parts of the state (Adamus 1987). The winter distribution is largely south of the United States, extending into South America. Habitats during migration predominantly include freshwater emergent wetlands.

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 5.6 million is above the North American population objective (USFWS et al. 2003). The continental population during 1970-2002 was stable. Blue-winged teal are not among the 10 most abundant species in the eastern survey area, and thus are not regularly reported. Within Maine, breeding population counts are highly variable due to irregular distribution, and late arrival of resident birds or presence of northern migrants in some years. Population estimates have ranged from zero in most years to 6,254 in 1996 (Table 10). Frequency of blue-winged teal in MDIFW's annual survey of waterfowl broods on production index areas has declined from 4% of all broods during 1966-1976 to zero during 1996-2002 (Table 16).

Harvest trend

The majority of hunter harvest of blue-winged teal in Maine occurs during the first two weeks of the season (Fig. 5). During 1961-2001 blue-winged teal constituted a small portion of the Maine harvest, averaging 0-5.7% of the annual state duck kill (Table 22).

In 1970-1972 experimental teal seasons during September were instituted in limited areas in Maine (e.g. Merrymeeting Bay). During 1975-1987 two "bonus teal" (green-winged and/or blue-winged) could be taken in addition to the regular duck bag during the first 9 days of the season (Table 20). During 1997-2003 two teal (green-winged and/or blue-winged) could be taken in addition to the regular duck bag for the entire season.

American wigeon

Background

American wigeon breed predominantly in northwestern North America, using relatively open, shallow wetlands including sloughs, small lakes, ponds, freshwater emergent marshes (Mowbray 1999). Wigeon breed locally in the East, often using impounded wetlands, sewage lagoons, and ponds or marshes in agricultural landscapes. Wigeon were first found breeding in Maine in Corinna in 1975 (Spencer 1977), and now breed locally across the state, most notably in the Easton area. The winter distribution includes Pacific and Atlantic coasts of the U.S., the southern half of the U.S., Mexico, and the Caribbean. Habitats during migration and wintering include freshwater and marine wetlands that contain an abundance of aquatic vegetation.

Diet during migration and wintering is almost exclusively vegetarian; wigeon will feed on vegetation brought to the surface by diving ducks (Aythya spp) and American coots (*Fulica americana*), and wigeon commonly steal food from coots (Ryan 1981, Eddleman et al. 1985).

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 2.6 million is above below the North American population objective of 3 million (USFWS et al. 2003). The continental population during 1970-2002 was stable. The population in the eastern survey area fluctuated but showed no trend during 1996-2003 (Fig. 27). Within Maine, breeding population counts are highly variable due to irregular distribution and presence of northern migrants in some years, and have ranged from 0 in most years to 16,566 in 2002 (Table 10). Occurrence of wigeon in MDIFW's annual survey of waterfowl broods on production index areas is sporadic at best, and was not reported during 1966-2002 (Table 16).

Harvest trend

During 1961-2001 wigeon constituted <1% of the Maine duck harvest, (Table 22). Harvest of wigeon averaged 162 per year during 1981-1990, and 183 per year during 1991-2000 (Tables 31, 32).

Northern shoveler

Background

Northern shoveler breed predominantly in northwestern North America, using relatively open, shallow wetlands containing SAV, and common on sewage treatment ponds (Belrose 1976). Shovelers breed locally in the East, often using impounded wetlands, sewage lagoons, and ponds or marshes in agricultural landscapes. Shovelers were first reported breeding in Maine in Easton in 1979 (Adamus 1987), and now may breed locally across the state, most notably in the Easton area. The winter distribution includes Pacific and Atlantic coasts of the U.S., the southern half of the U.S., Mexico, and the Caribbean. Habitats during migration and wintering include freshwater and marine wetlands that contain an abundance of aquatic vegetation. Shovelers are unusual among North American dabblers in feeding principally on animal matter year round (Dubowy 1996).

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 3.2 million is above below the North American population objective of 2 million (USFWS et al. 2003). The continental population during 1970-2002 was increasing. Shoveler is not among the 10 most abundant species in the eastern survey area, and thus is not regularly reported. Shovelers have not been recorded on breeding surveys in Maine during 1996-2003, and only sporadically in the Maritime Provinces portion of the survey (Table 10). Occurrence of shovelers in MDIFW's annual survey of waterfowl broods on

production index areas is sporadic at best, and is not reported during 1966-2002 (Table 16).

Harvest trend

During 1961-2001 shovelers constituted <1% of the Maine duck harvest, (Table 22). Harvest of shovelers averaged 8 per year during 1981-1990, and 39 per year during 1991-2000 (Tables 31, 32). These harvest estimates are based on very small samples of wings collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Northern pintail

Background

Northern pintail breed predominantly in northwestern North America, with core breeding areas in the prairie states and provinces, and in Alaska. Pintails prefer relatively open, shallow emergent wetlands in a landscape dominated by grasslands or tundra (Stewart and Kantrud 1973, Austin and Miller 1995). Breeding range in the East includes coastal areas in Quebec, eastern Labrador, and locally in the Maritime provinces (Erskine 1992) and northeastern states. Pintails have not been confirmed breeding in Maine (Adamus 1987), although adults have been observed in Maine during the breeding season. The winter distribution includes Pacific and Atlantic coasts of the U.S., the southern half of the U.S., Mexico, and the Caribbean; small numbers of pintails are observed during the Midwinter Waterfowl Survey in Maine. Habitats during migration and wintering include freshwater and marine wetlands.

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 2.8 million is only half the North American population objective of 5.6 million (USFWS et al. 2003). The continental population during 1970-2002 was decreasing. Pintail is not among the 10 most abundant species in the eastern survey area, and thus is not regularly reported. Within Maine, breeding population counts are highly variable due to irregular distribution and presence of northern migrants in some years, and have ranged from 0 in some years to 5,145 in 2002 (Table 10). Pintails have not been observed in MDIFW's annual survey of waterfowl broods on production index areas during 1966-2002 (Table 16).

Harvest trend

During 1961-2001 pintails constituted <1% of the Maine duck harvest (Table 22). Harvest of pintails in Maine averaged 320 per year during 1996-2000.

Gadwall

Background

Gadwall breed predominantly in north-central U.S. and the prairie provinces of Canada. Gadwall prefers relatively open, shallow emergent wetlands containing SAV in a landscape dominated by grasslands (Sousa 1985). More recently (since 1939) the breeding range includes local or sporadic nesting in the northeastern U.S. and southeastern Canada, where habitats include human-altered wetlands such as

impoundments and sewage treatment ponds (Leschack et al. 1997). Gadwall is an uncommon breeder in Maine, and was first confirmed breeding in the mid-coast area in 1976 (Adamus 1987). The winter distribution includes Pacific and Atlantic coasts of the U.S., the southern half of the U.S., and Mexico. Habitats during migration and wintering include freshwater and marine wetlands that contain an abundance of aquatic vegetation.

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 2.9 million is nearly twice the North American population objective of 1.5 million (USFWS et al. 2003). The continental population during 1970-2002 was increasing. Gadwall is not among the 10 most abundant species in the eastern survey area, and thus is not regularly reported. Gadwalls have not been counted in the Maine survey stratum, nor observed in MDIFW's annual survey of waterfowl broods on production index areas during 1966-2002 (Table 16).

Harvest trend

During 1961-2001 gadwalls constituted <1% of the Maine duck harvest (Table 22). Harvest of gadwalls in Maine averaged 27 per year during 1981-1990 and 7 per year during 1991-2000 (Tables 31, 32). These harvest estimates are based on very small samples of wings collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Wood duck

Background

Wood duck is a common duck of forested wetlands and swamps of east of the Great Plains, and in the Northwest. The breeding range extends from southern Canada to Florida, and wood ducks winter as far north as Massachusetts in the East and British Columbia in the West (Hepp and Bellrose 1995). Wood duck populations declined drastically in the late 1800s and early 1900s due to excessive mortality from market hunting and unregulated sport hunting, clearing of forests, and draining or filling of wetlands. Populations dwindled to the point that early ornithologists believed wood ducks might become extinct. With full protection afforded by the Migratory Bird Treaty Act in 1918, wood duck populations began to recover. Reforestation and expanding beaver populations created habitat conditions favorable to wood ducks.

Wood ducks' recovery was aided by the placement of nest boxes on wetlands lacking sufficient natural nest cavities in trees. Wood ducks do not excavate their own nest cavities and so must rely on natural tree cavities of suitable size, which may be lacking in young secondary forest. Typical nest cavities form where broken tree limbs expose heartwood to decay (Soulliere 1990b). Artificial nest boxes are readily used and have been shown to enhance local populations (Bellrose 1955, Soulliere 1990a).

MDIFW regional biologists maintain approximately 900 nest boxes for waterfowl, of which approximately 300 are checked intensively (2 times per year). Allen et al. (1988) analyzed data from a large-scale, intensive nest box program on 24 wetlands in central Maine during 1970-1986. Box use averaged 61%; boxes were used by wood duck (67%), hooded merganser (28%), and common goldeneye (5%). Nest success of

5,203 nest attempts averaged 80% over the 17-year period. On average, 2,798 ducklings per year were produced in nest boxes on the study area.

Population status and trend

The eastern population (Mississippi and Atlantic Flyways) during 1993-2002 was 4.4 million; a North American population objective has not been established for wood duck (USFWS et al. 2003). The eastern population during 1970-2002 was increasing.

Presently there is no reliable index to wood duck population during the breeding season in Maine. Wood ducks are detected on too few routes of the Breeding Bird Survey (BBS) in Maine for a reliable trend analysis (long term: n=11 routes; short term: n=7 routes). At a broader scale, BBS data indicate a significant positive trend of 5.7% per year (p=0.01, n=26 routes) during 1966-2002 among wood ducks in northern New England (Vermont, New Hampshire, and Maine). The short-term trend (1980-2002) in northern New England was increasing at 5.4% per year (p=0.07, n=23 routes). This trend information should be used with caution, as the reliability of the BBS for monitoring waterfowl is poor. In this case the important deficiency is due to very low abundance of birds along survey routes (less than 0.1 birds/route).

Occurrence of wood duck in MDIFW's annual survey of waterfowl broods on production index areas increased from a mean of 15 broods (12% of total broods) during 1966-1976 to 43 broods (21% of total broods) during 1991-1995. Between 1991-1995 and 1996-2000, wood duck broods declined by 25% to 32 broods (22% of total). The 2002 count of 31 broods is double that counted during 1966-1976 (Table 16).

Harvest trend

Sport hunting of wood ducks in North America resumed in 1941 when a daily bag of one bird was permitted. In 1959 the bag limit was increased to two, where it has remained. Today the wood duck is second only to mallard in duck harvests of the Atlantic and Mississippi Flyways.

During 1961-1980 wood duck was among the top three duck species in the Maine harvest, averaging 7.0%-11.9% of the annual state duck kill (Table 22). Wood duck consistently comprised >12% of the duck harvest during 1981-2000. Wood duck harvest in Maine peaked in 2001, when 15,100 wood ducks comprised the greatest proportion of the duck kill (18.3%).

Prior to the imposition in 1982 of regulations designed to reduce the black duck kill, waterfowl managers were concerned that hunters would shift pressure to other species. This was of particular concern with regard to wood ducks, for which harvest rates were thought to be in approximate balance with replacement capacity of the population (Spencer 1979). In retrospect, there is scant evidence, other than a slight increase in the 1983 wood duck harvest, that wood ducks experienced increased hunting pressure in Maine during the 1980s.

Nearly 100% of Maine's harvest of this popular bird is derived from local breeding populations; banded wood ducks recovered during 2003 in Maine were banded in Maine, New Brunswick, and Ontario. Direct recoveries (n=44) of birds banded in Maine during 2002-2003 occurred in Maine (39%) and states from New York and southward (61%).

The majority of Maine's hunter harvest of wood duck occurs during the first two weeks of the season (Fig. 5); all Maine band recoveries during 2002-2003 were in October, and 15 of 17 (88%) banded ducks were recovered by October 12. Twenty-four of 27 (89%) Maine-banded wood ducks that were recovered in southern states were shot November 11 or later.

Ring-necked duck

Background

Ring-necked duck breeds across the continent from subarctic river deltas in Alaska and western Canada through taiga, prairie-parklands, and boreal forest to Newfoundland and south to Maine. The breeding range of ring-necked duck expanded into the Northeast in the 1930s (Mendall 1958), and extended west into Alaska in the 1980s (Hohman and Eberhardt 1998). Breeding ducks in Maine use shallow freshwater marshes and bogs containing ericaceous shrubs, emergent plants, and submerged or floating vegetation (Mendall 1958, Hohman and Eberhardt 1998). Heavy rains during the breeding season can cause delayed and reduced production because of the susceptibility of their nests to flooding.

The winter distribution includes Pacific and Atlantic coasts of the U.S., the southern half of the U.S., and Mexico. Habitats during migration and wintering include shallow freshwater wetlands.

Population status and trend

The mean population in the traditional survey area during 1993-2002 was 1.1 million birds. Although the population estimate for ring-necked ducks in the mid-continent region is not considered as reliable as those for other ducks, the long-term continental population trend is thought to be increasing (USFWS et al. 2003). A North American population objective has not been determined for ring-necked duck. The population in the eastern survey area showed no trend during 1996-2003 (Fig. 28). Ring-necked duck is a common breeder in Maine, however breeding population counts are highly variable due to presence of northern migrants in some years, and have ranged from 15,800 in 2003 to 87,686 in 1997 (Table 11). Ring-necked duck has constituted an average of 19-24% of broods observed in MDIFW's annual survey of waterfowl broods on production index areas during 1966-2000, and 29% in 2002 (Table 16).

Harvest trend

Ring-necked duck ranks among the 8-10 most frequently bagged ducks by hunters in Maine. During 1961-2000, ring-necked ducks constituted 1.4-4.6% of Maine's annual duck harvest (Table 23). Harvests in Maine peaked at over 4,000 birds killed per year during the early to mid 1980s, a period coinciding with implementation of harvest restrictions on black ducks. Increased harvest pressure during that time did not have a measurable effect on breeding populations (Corr 1985), and recent breeding populations within Maine and continentally seem relatively abundant. However, continental population estimates are imprecise due to difficulty in censusing this species

and the fact that much of the breeding range is outside the survey area (Hohman and Eberhardt 1998).

Ring-necked ducks potentially are vulnerable to over-harvest (Hohman and Eberhardt 1998), a concern that has increased with liberal season frameworks (60 days / 6 bird bag) and recent late-season framework extensions in southern states. Information regarding the harvest distribution of Maine-produced ring-necked ducks is lacking because few ring-necked ducks have been banded in Maine. Harvest of ring-necked ducks in the Atlantic Flyway increased by 33% between 1981-1985 and 1996-2000; harvest of ring-necked ducks as a proportion of the total duck harvest increased from 6.6% to 8.0% during this time. Most of the Atlantic Flyway harvest of ring-necked ducks occurs in Florida, where the harvest of this species averaged 71,380 per year during 1996-2000; ring-necked duck constitutes the largest proportion of Florida's total duck harvest.

Canvasback

Background

Canvasback breeds largely in the prairie states and provinces, and is a rare visitor to Maine. Half the continental population winters in the Atlantic Flyway, with most of these inhabiting Chesapeake Bay (Bellrose 1980).

Population status and trend

The mean population in the traditional survey area during 1993-2002 of 648,000 is above the North American population objective of 540,000 (USFWS et al. 2003). The

continental population during 1970-2002 was stable. Canvasbacks are not reported in the eastern survey area and are not known to breed in Maine.

Harvest trend

During 1981-2001 canvasbacks were not recorded on harvest surveys in Maine.

Redhead

Background

Redhead breeds largely in the prairie states and provinces, inhabiting freshwater emergent mashes (Woodin and Michot 2002). Redhead is unusual among North American waterfowl for the extent to which it engages in facultative nest parasitism, or laying eggs in other duck nests. Most redheads winter along the coast of the Gulf of Mexico, with lesser numbers on the Atlantic coast (Chesapeake Bay) and the Pacific coast (Mexico). Redhead is a rare visitor to Maine during migration. Habitats during migration and wintering include shallow freshwater and marine wetlands that contain an abundance of aquatic vegetation. Redheads include more plant and less animal matter in their diet than do other divers (Bellrose 1980).

Population status and trend

The mean breeding population in the traditional survey area during 1993-2002 of 796,000 is above the North American population objective of 640,000 (USFWS et al. 2003). The continental population during 1970-2002 was stable. Redheads are not

reported in the eastern survey area and are not known to breed in Maine, although they have bred sporadically in the Maritime Provinces of Canada (Erskine 1992).

Harvest trend

During 1961-2001 redhead constituted <1% of the Maine duck harvest, (Table 23). Harvest of redhead in Maine was zero during 1981-1990, and 3 per year during 1991-2000 (Tables 33, 34). These harvest estimates are based on very small samples of wings collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Lesser Scaup

Background

Lesser scaup breed in emergent marshes and small lakes with emergent vegetation in the boreal forests and parklands from Alaska through Manitoba and into Quebec (Austin et al. 1998). Wintering habitat includes freshwater wetlands and estuarine and marine habitats along the Pacific and Atlantic coasts of the U.S., Mexico, Central America, and the Greater Antilles. Lesser scaup commonly migrate through Maine.

Population status and trend

Lesser and greater scaup cannot reliably be differentiated during aerial surveys, and so breeding estimates in the traditional survey area are for the two species combined. The mean breeding population in the traditional survey area during 1993-

2002 of 4.1 million is below the North American population objective of 6.3 million (USFWS et al. 2003). The continental population during 1970-2002 was decreasing. The breeding population of lesser scaup in the eastern survey area (differentiated from greater scaup on the basis of distinct distribution in the East) showed an increasing trend during 1996-2003 (Fig. 29), however the estimates of lesser scaup in the Black Duck Joint Venture survey area in Quebec during 1990-2003 were highly variable, and no trend was indicated (Table 13). Lesser scaup are not known to breed in Maine (Adamus 1987). Counts of wintering scaup in Maine are quite variable (Table 17).

Harvest trend

During 1961-2001 lesser scaup constituted <1% of the Maine duck harvest, (Table 23). Harvest of lesser scaup in Maine was 168 per year during 1981-1990, and 121 per year during 1991-2000 (Tables 33, 34). During 1962-1982, 2 additional scaup could be taken in certain coastal areas in Maine; during 1983-1987, 5 additional scaup could be taken. In 1999 scaup were no longer a “bonus” bird, and the daily limit was reduced to three.

Greater Scaup

Background

Greater scaup is one of the few circumpolar duck species. In North America it breeds predominantly in coastal tundra in arctic and subarctic areas, particularly in western Alaska and in the Hudson Bay-Ungava Bay region of eastern Canada. Interestingly, greater scaup also breed locally in the Maritime Provinces (McAlpine et al.

1988, Erskine 1992). The core wintering area includes shallow bays along the northeast Atlantic Coast, particularly Long Island Sound (Kessel et al. 2002). Smaller numbers winter farther south along the Atlantic Coast, the north coast of the Gulf of Mexico, the Great Lakes, and the Pacific Coast south to Mexico. Availability of mollusks and crustaceans, important food items for greater scaup, is an important component of wintering habitat (Kessel et al. 2002). Several hundred scaup typically are counted most years in Maine's portion of the MWS (Table 17); although lesser and greater scaup cannot reliably be differentiated during aerial surveys, wintering birds in Maine are presumed to be predominantly greater scaup.

Population status and trend

Breeding population estimates in the traditional survey area for the two scaup species are combined. The mean breeding population in the traditional survey area during 1993-2002 of 4.1 million is below the North American population objective of 6.3 million (USFWS et al. 2003). The continental population during 1970-2002 was decreasing. The breeding population of greater scaup (differentiated from lesser scaup on the basis of distinct distribution in the East) in the Black Duck Joint Venture survey area in Quebec during 1990-2003 was highly variable, and no trend was indicated (Table 13). Counts of wintering scaup in Maine are quite variable (Table 17).

Harvest trend

During 1961-2001 greater scaup constituted <1% of the Maine duck harvest, (Table 23). Harvest of greater scaup in Maine was 141 per year during 1981-1990, and

78 per year during 1991-2000 (Tables 33, 34). During 1962-1982, 2 additional scaup could be taken in certain coastal areas in Maine; during 1983-1987, 5 additional scaup could be taken in designated tidal waters. In 1999 scaup were no longer a "bonus" bird, and the daily limit was reduced to three.

Common Eider

Background

Common eider is the largest duck native to North America and the entire Northern Hemisphere, with weights commonly in excess of five pounds (Bellrose 1980). Common eider occupies marine habitats and has a circumpolar distribution. There are five races of common eider, four of which occur in North America, and three of which occur in the Atlantic Flyway. Common eiders winter south to Long Island, New York. Maine supports the only major breeding population in the lower 48 states (Blumpton et al. 1988); Maine's nesting population consists entirely of the American race (*Somateria mollissima dresseri*), which also makes up 94% of Maine's winter population of common eider (Mendall 1980). American eiders nest on coastal islands from south-central Labrador, Newfoundland, eastern Quebec, Nova Scotia, New Brunswick, and Maine to Massachusetts. Blue mussels (*Mytils edulis*) and green sea urchins (*Strongylocentrotus droebachiensis*) are principle food items for adult eiders; greater black-backed gulls (*Larus marinus*) are important predators of eider ducklings (Mawhinney 1997).

Common eiders have a long history of exploitation throughout their range, and the American race was almost extirpated from the east coast by the end of the 19th century (Goudie et al. 2000). With protection this population has recovered since the

early 1900s, and today common eiders are the most conspicuous waterfowl found year round on the Maine coast. For more information see the Common Eider Assessment (Allen 2000).

Population status and trend

The continental population of the American race of common eider during 1993-2002 was 300,000. During 1970-2002 the continental population was decreasing; no North American population objective has been established for common eider (USFWS et al. 2003). Common eiders in the Atlantic Flyway increased during 1972-1997 (Caithamer et al. 2000). In Maine, the eider breeding population increased from two pairs on one island in 1907, to 2,000 pairs in 31 colonies in 1944 (Gross 1944), to 20,000 pairs in 215 colonies in 1970 (Fefer 1977), to approximately 29,000 pairs nesting in 320 colonies in 2000 (Allen 2000).

Harvest trend

Sea duck harvests in Maine increased numerically from the 1960s through mid 1970s, and sea ducks increased in proportion of Maine's total duck harvest in the 1980s when black duck harvest restrictions were instituted (Table 20). Common eider is the most numerous sea duck in the hunter bag in Maine, and makes up the highest proportion of any single species in the total duck harvest in Maine. During 1996-2000 harvest of common eider averaged 15,420 birds annually, or 22.6% of the total annual duck kill in Maine (Table 24). In 1999, the limit on eiders was reduced from 7 to 5 per day.

King Eider

Background

King eider breeds in coastal marine habitats in the arctic in Siberia, Alaska, Canada south to southern Hudson Bay, and Greenland. Wintering distribution includes the Pacific Coast from the Alaska Peninsula to Oregon, and the Atlantic Coast from southern Labrador to Rhode Island (Bellrose 1980). King eider is a rare but regular winter visitor to the Maine coast, mixing with flocks of common eider.

Population status and trend

The continental population during 1993-2002 was 575,000. During 1970-2002 the continental population was decreasing; no North American population objective has been established for king eider (USFWS et al. 2003).

Harvest trend

Harvest of king eider in Maine was zero during 1981-1990, and 7 per year during 1991-2000 (Tables 35, 36). These harvest estimates are based on very small samples of wings collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Harlequin Duck

Background

See the Harlequin Duck species assessment (Wickett 1999).

Population status and trend

The Harlequin duck is listed as Threatened by the state of Maine. The eastern population was listed as endangered in Canada in 1990, however the status was downgraded to Special Concern in 2001 based on new information that the population breeding in eastern Canada was greater than previously thought. The population of harlequins wintering in eastern North America, most of which winter in Maine, has been increasing in recent years (Canadian Wildlife Service Waterfowl Committee 2003).

Harvest trend

The hunting season for Harlequin ducks in the Atlantic Flyway has been closed since 1989.

Long-tailed Duck

Background

Long-tailed duck has been the common name of this species in Europe, but until recently it was known in North America by the common name “oldsquaw”. Long-tailed duck breeds in coastal habitats throughout the arctic and subarctic in Siberia, Alaska, Canada, Greenland and Iceland (Robertson and Savard 2002). Wintering distribution includes the Pacific and Atlantic coasts and the Great Lakes, and long-tailed ducks are common on the Maine coast in winter. Long-tailed ducks feed on a broad array of animal prey. Long-tailed ducks are unusual in having three plumages instead of two

(Salomonsen 1949); the male alternate plumage persists until early spring, when the basic or breeding plumage is acquired.

Population status and trend

The continental population during 1993-2002 was 1 million. During 1970-2002 the continental population was decreasing; no North American population objective has been established for long-tailed duck (USFWS et al. 2003).

Harvest trend

During 1961-2001 long-tailed duck constituted ≤4.4% of the Maine duck harvest (Table 24). Average annual harvests of long-tailed duck peaked during 1986-1995 but decreased to earlier levels during 1996-2000.

Black Scoter

Background

Black scoter breed in Alaska and northern Quebec; key wintering areas include shallow marine waters from Alaska to Washington, and from Maine to Rhode Island (Bordage and Savard 1995).

Population status and trend

The continental population during 1993-2002 was 400,000. During 1970-2002 the continental population was decreasing; no North American population objective has been established for black scoter (USFWS et al. 2003).

Harvest trend

During 1961-2000 black scoter constituted ≤2% of the Maine duck harvest (Table 24), and was the least frequently bagged of the scoter species. In 1994, the limit on scoters (all 3 species in aggregate) was reduced from 7 to 4 per day.

Surf Scoter

Background

Surf scoter is the only scoter endemic to North America. The breeding range is poorly known; it breeds on freshwater lakes in Alaska and northern Quebec. Surf scoter winters in shallow marine waters along the east and west coasts of North America and the north coast of the Gulf of Mexico (Savard et al. 1998).

Population status and trend

The continental population during 1993-2002 was 600,000. During 1970-2002 the continental population was decreasing; no North American population objective has been established for surf scoter (USFWS et al. 2003).

Harvest trend

During 1961-2000 surf scoter constituted ≤5.1% of the Maine duck harvest (Table 24). During 1996-2000 surf scoter was the second most frequently bagged sea duck, after common eider. In 1994, the limit on scoters (all 3 species in aggregate) was reduced from 7 to 4 per day.

White-winged Scoter

Background

White-winged scoter breeds on freshwater lakes and wetlands from Manitoba to interior Alaska (Brown and Fredrickson 1997); sporadic breeding occurs in eastern Canada. White-winged scoter winters in shallow marine waters along the east and west coasts of North America and the north coast of the Gulf of Mexico.

Population status and trend

The continental population during 1993-2002 was 600,000. During 1970-2002 the continental population was decreasing; no North American population objective has been established for white-winged scoter (USFWS et al. 2003).

Harvest trend

During 1961-2000 white-winged scoter constituted ≤4.5% of the Maine duck harvest (Table 24). In 1994, the limit on scoters (all 3 species in aggregate) was reduced from 7 to 4 per day.

Bufflehead

Background

Bufflehead breeds on freshwater lakes and wetlands in the boreal forest and aspen parklands from Quebec to Alaska (Gauthier 1993). Bufflehead winters in shallow marine waters along the east and west coasts of North America and in lower densities

throughout the interior U.S. Bufflehead are not known to breed in Maine, however Gilles (1993) referenced an unspecified historical breeding record from Maine.

Population status and trend

The population estimate in the traditional survey area during 1993-2002 was 931,000. During 1970-2002 the continental population was increasing; no North American population objective has been established for bufflehead (USFWS et al. 2003). The breeding population of bufflehead in the eastern survey area did not show a clear trend during 1996-2003 (Table 15, Fig. 30).

Harvest trend

During 1961-2000 bufflehead constituted $\leq$7.5% of the Maine duck harvest (Table 23). The harvest of bufflehead in Maine during 1996-2000 averaged 2,300 birds annually, accounting for 3.4% of the total duck harvest. Virtually all harvest of bufflehead occurs in November and December (Fig. 6).

Common Goldeneye

Background

Common goldeneye breeds on freshwater lakes and wetlands in the boreal forest from Alaska to Newfoundland (Eadie et al. 1995). Common goldeneye winters in shallow marine waters along the east and west coasts of North America and in lower densities throughout the interior U.S. Common goldeneye nests at the southern end of the traditional breeding range in Maine. In northern and eastern Maine it is a common

user of nest boxes. During 1970-1986 common goldeneye accounted for 5% of duck nests in boxes on 24 wetlands in central Maine, and experienced a nest success rate of 87% (Allen et al. 1988).

Population status and trend

The continental population estimate during 1993-2002 was 750,000. During 1970-2002 the continental population was stable; no North American population objective has been established for common goldeneye (USFWS et al. 2003). The breeding population of goldeneye (common and Barrow's not differentiated) in the eastern survey area was stable or increasing during 1996-2003 (Table 15, Fig. 31). The BDJV helicopter survey in Quebec also showed a stable or increasing trend for common goldeneye during 1990-2003. Within Maine, breeding population counts are highly variable due to presence of northern migrants in some years, and have ranged from 0 in 2000 to 29,205 in 2002 (Table 11). Common goldeneye has constituted an average of 15-20% of broods observed in MDIFW's annual survey of waterfowl broods on production index areas during 1966-2000, averaging 23-39 broods per year. Thirty-one goldeneye broods (29% of total) were counted in 2002 (Table 16).

The MWS indices for goldeneye (common and Barrow's not differentiated) in the Atlantic Flyway and in Maine declined during 1961-1993 by >50%; the MWS trend during 1993-2003 seems to have stabilized (Fig. 32, Table 17).

Harvest trend

During 1961-2000 common goldeneye constituted 1.5-5.5% of the Maine duck harvest (Table 23). Harvests in Maine peaked at over 4,000 birds killed per year during the early to mid 1980s, a period coinciding with implementation of harvest restrictions on black ducks. The harvest of common goldeneye in Maine during 1996-2000 averaged 1,040 birds annually, accounting for 1.5% of the total duck harvest. Virtually all harvest of common goldeneye occurs in November and December (Fig. 6).

Barrow's Goldeneye

Background

Barrow's Goldeneye occurs in two disjunct populations in North America. A large population (70,000 – 100,000) breeds from Alaska through Montana, wintering largely on the Pacific coast from Alaska to California. In the East, however, the breeding population is much smaller and less well studied. A small population breeds in Quebec and perhaps Labrador. Best estimates of this eastern population come from wintering birds; a few thousand individuals winter in the St. Lawrence estuary with perhaps several hundred more scattered among coastal and riverine waters in the Maritimes and coastal New England.

MDIFW conducted land-based surveys of migrating and wintering Barrow's goldeneye during 1993 -1994 and 1999 –2000. Few birds were found at any time; however, based on MDIFW data and historical records from birders, several sites appear to hold concentrations of birds. Important sites are the Penobscot River near Orono, Passagassawakeag River near Belfast Harbor, Harraseeket River near Freeport

Harbor, Kennebec River near Fairfield, and near Roque Bluffs State Park and Shoppee Point on Englishman Bay. Flocks as large as 60 have been recorded in recent years in Maine.

Barrow's goldeneye was called a "sensitive species" in MDIFW's 1985 Waterfowl Plan and subsequently has been listed as a special concern species. Limiting factors are thought to include nest site availability and habitat loss or alteration. Hunter harvest, at least in Maine, is thought to be low, however, some birds likely are taken in most years. At best, it is very difficult to distinguish between Barrow's and common goldeneye males on the wing, and virtually impossible to distinguish between females of the two species in flight; therefore, traditional methods of restricting harvest, such as a reduced bag limit or closed season on Barrow's, would effectively reduce the bag or close the hunting season on common goldeneye as well. Quebec has addressed this dilemma by prohibiting the hunting of goldeneyes (both species) only within the hunting district where most of the Barrow's are concentrated during that time in the fall. Similarly, site-specific closures on goldeneye hunting in known concentration areas in Maine may reduce harvest of Barrow's.

Barrow's goldeneye is addressed more fully by Meehan (Appendix IV).

Population status and trend

The eastern population estimate of Barrow's goldeneye during 1993-2002 was 5,000. During 1970-2002 the continental population was stable; no North American population objective has been established for Barrow's goldeneye (USFWS et al. 2003).

Breeding population estimates from the BDJV helicopter survey in Quebec during 1990-2003 are highly variable, but no trend was evident (Table 13).

Until recently, there were only anecdotal records of Barrow's goldeneye in Maine, consequently, we cannot estimate population trend. Moreover, wintering populations should be monitored over the entire wintering range of the population, as birds likely distribute themselves at least partly in response to changes in weather and other habitat conditions, irrespective of political boundaries.

Harvest trend

Harvest estimates of Barrow's goldeneye in Maine were 94 per year during 1981-1990, and 34 per year during 1991-2000 (Tables 33, 34). These harvest estimates are based on very small samples of wings (0-7 per year) collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

Hooded Merganser

Background

Hooded merganser breeds on forested wetlands throughout the eastern half of North America and in the Pacific Northwest. There is considerable overlap of the breeding and wintering distributions, with hooded mergansers wintering as far south as California, Texas, and Florida, and as far north as the Great Lakes and New England (Dugger et al. 1994). Hooded mergansers have a diverse diet that includes aquatic insects, crustaceans, and small fish (Dugger et al. 1994).

Hooded mergansers commonly use nest boxes. During 1970-1986 hooded mergansers accounted for 28% of duck nests in boxes on 24 wetlands in central Maine, and experienced a nest success rate of 80% (Allen et al. 1988). Over the 17-year period of the study the proportion of hooded merganser nests increased, as did the number of nest boxes available, suggesting an increase in the hooded merganser population during this time.

Population status and trend

The continental population of hooded merganser is loosely estimated as 350,000 during 1993-2002; no population objective has been established for hooded merganser (USFWS et al. 2003). During 1970-2002 the continental population was increasing. There is no breeding pair survey in Maine, however nest box data from Maine during 1970-1986 and Massachusetts during 1979-1998 (Heusmann et al. 2000), and Christmas Bird Count data from Massachusetts during 1979-1998 (Heusmann et al. 2000), suggest population increase among hooded mergansers. The proportion of hooded mergansers among duck broods observed in MDIFW's annual survey of waterfowl broods on production index areas increased from 8% during 1966-1976 to 14% during 1996-2000 (Table 16).

Harvest trend

During 1961-2000 hooded merganser constituted 0.6-2.3% of the Maine duck harvest (Table 23). Harvests in Maine seem to have increased in recent years; harvests averaged 960 during 1991-1995, 1,540 during 1996-2000, and 3,100 in 2001.

Despite a daily bag limit of only 1, hooded merganser harvests annually exceed those of common or red-breasted mergansers, which have a bag limit of 5.

Red-breasted Merganser

Background

Red-breasted merganser breeds among the boreal forest and tundra from Alaska to Newfoundland, and winters in marine habitats along the Pacific and Atlantic coasts to Mexico (Titman 1999). Red-breasted merganser is reported to have bred on inland lakes in western Maine (Adamus 1987). Red-breasted merganser is a common winter visitor on the Maine coast. Red-breasted merganser feeds predominantly on fish (McCaw et al. 1996), which it catches by visual pursuit. Red-breasted merganser is noted for cooperative hunting of fish (Des Lauriers and Brattstrom 1965).

Population status and trend

The continental population of red-breasted merganser was loosely estimated as 250,000 during 1993-2002; no North American population objective has been established for red-breasted merganser (USFWS et al. 2003). During 1970-2002 the continental population was increasing. Red-breasted and common mergansers are not differentiated during fixed-wing aerial surveys, and so breeding estimates in the eastern survey area are for the two species combined; the breeding population of mergansers in the eastern survey area was stable during 1996-2003 (Table 15, Fig. 33).

Harvest trend

During 1961-2000 red-breasted merganser constituted <1% of the Maine duck harvest (Table 23). The harvest of red-breasted merganser in Maine during 1996-2000 averaged 300 birds annually, accounting for 0.4% of the total duck harvest.

Common Merganser

Background

Common merganser breeds along rivers and lakes among the boreal forest and aspen-parkland from Alaska to Newfoundland (Mallory and Metz 1999). Common merganser is common breeder on inland wetlands statewide in Maine (Adamus 1987). Winter distribution includes lakes, rivers, and estuaries along the Pacific and Atlantic coasts and inland to Mexico; common merganser will winter on fresh water habitats as far north as ice conditions permit (Mallory and Metz 1999). Common merganser is a common winter visitor on the Maine coast and ice-free lakes and rivers. Common merganser feeds predominantly on fish (McCaw et al. 1996), which it catches by visual pursuit. Common merganser is noted for cooperative hunting of fish.

Population status and trend

The continental population of common merganser was loosely estimated as 1 million during 1993-2002; no North American population objective has been established for common merganser (USFWS et al. 2003). During 1970-2002 the continental population was increasing. Red-breasted and common mergansers are not differentiated during fixed-wing aerial surveys, and so breeding estimates in the eastern

survey area are for the two species combined; the breeding population of mergansers in the eastern survey area was stable during 1996-2003 (Table 15, Fig. 33). The proportion of common mergansers among duck broods observed during 1966-2000 in MDIFW's annual survey of waterfowl broods on production index areas ranged from 3-6% (Table 16).

Harvest trend

During 1961-2000 common merganser constituted <1.2% of the Maine duck harvest (Table 23). Maine led the Atlantic Flyway states in harvest of common merganser during 2001 with a retrieved kill of 1,400 birds.

Ruddy Duck

Background

Ruddy duck breeds predominantly in emergent wetlands in the prairie pothole region, and winters in coastal habitats as well as large inland lakes from the Great Lakes south to Central America (Brua 2002). Ruddy ducks are not known to breed in Maine (Adamus 1987), however adult birds have been observed during summers of 2002-2004 in Easton. Ruddy ducks are seen regularly during spring and fall migration, and are sometimes counted on the MWS in Maine.

Population status and trend

The population estimate in the traditional survey area during 1993-2002 was 566,000. During 1970-2002 the continental population was increasing; no North

American population objective has been established for ruddy duck (USFWS et al. 2003). Ruddy duck population estimates are not available for the eastern survey area or the BDJV survey area.

Harvest trend

During 1961-2001 ruddy duck constituted <1% of the Maine duck harvest, (Table 23). Harvest of ruddy duck was 36 per year during 1981-1990, and 6 per year during 1991-2000 (Tables 33, 34). These harvest estimates are based on very small samples of wings collected by the USFWS parts collection survey, consequently estimates are highly variable and may be unreliable.

SUMMARY AND CONCLUSIONS

Thirty-six waterfowl species use wetlands in Maine to meet some portion of their habitat needs. Eighteen species breed, or occur during the breeding season, in Maine, and 20 species spend the winter months in our coastal waters. Maine is the geographic division for a number of breeding ranges. The wood duck reaches its northern limit and the common goldeneye and common eider reach their southern limits here. These differences in breeding ranges cause Maine's breeding populations to vary from south to north. Similarly, Maine is the geographic division for several wintering species. Maine is near the southern extent of wintering ranges of Barrow's goldeneye and king eider, whereas ruddy duck, pintail, and scaup reach their northern wintering range near the Gulf of Maine.

The United States Fish and Wildlife Service (USFWS) has overriding authority on matters of migratory bird conservation. Maine DIFW works directly with USFWS and through the Atlantic Flyway Council on issues of waterfowl conservation.

Approximately 9 percent of the total land area of the state is in wetlands 10 acres or larger. A significant, but undocumented, percentage is in wetlands less than 10 acres. These smaller wetlands are tremendously important to spring migrating and breeding waterfowl, especially the black duck. Beaver-mediated wetlands are of particular importance to breeding and migrating waterfowl.

During the last planning period many developments in waterfowl management important to Maine have occurred, including:

- **North American Waterfowl Management Plan (NAWMP).** In 1986, USFWS and the Canadian Wildlife Service published NAWMP, which is a comprehensive international plan for the management of North America's waterfowl. NAWMP included goals and objectives for waterfowl populations and their habitats, and recently has been updated. NAWMP objectives are implemented through Joint Ventures (ACJV), including the Atlantic Coast JV for implementing habitat objectives, and the Black Duck JV and Sea Duck JV for implementing research and monitoring objectives. Habitat protection in Maine has been via the Maine Wetlands Coalition efforts targeted in ACJV Focus Areas, and seabird (eider) nesting island acquisition.
- **USFWS aerial breeding waterfowl survey instituted in Northeast in 1996.** Prior to this time, annual statewide estimates for breeding waterfowl populations in Maine did not exist. This survey is critical for monitoring waterfowl populations that breed in the eastern region, however state-specific estimates are highly variable.
- **Sea Duck Survey instituted in the Atlantic Flyway**. This survey of wintering sea ducks was instituted by USFWS in 1991, but was suspended in 2002 due to lack of funds. Monitoring of sea duck populations is needed, but currently is lacking.
- **Lead shot banned for hunting waterfowl and rails in Maine (1988), U.S. (1991), and Canada (1999).** The prohibition on the use of lead shot has reduced mortality from lead poisoning among waterfowl. By 1997,

lead poisoning mortality among mallards had been reduced by 64% in some areas.

- **Black duck harvest reduction program**. To reduce hunting mortality among black ducks and increase breeding populations, USFWS and Atlantic Flyway states reduced black duck harvests by half during 1983-2001 compared to levels during 1977-1981. Midwinter Waterfowl Survey counts of black duck in the Atlantic Flyway subsequently stabilized, and then increased slightly.
- **Sea duck bag limit restrictions**. To reduce hunting mortality on scoters, USFWS reduced the aggregate bag limit on scoters to 4/day in 1993. Similarly, MDIFW reduced the bag limit on eiders to 5/day in 1999.
- **Compensatory days allowed for states with Sunday hunting prohibition**. Beginning in 1997, states with Sunday hunting prohibitions, such as Maine, have been allowed additional hunting days to compensate for lost opportunity.
- **Early (September) Canada goose seasons**. Beginning in 1996, Maine instituted an early Canada goose season to increase the harvest of resident population Canada geese while protecting arctic-breeding migratory populations.
- **Youth Waterfowl Hunt**. Since 1997, Maine has offered a Youth Waterfowl Hunt, a one-day hunt for youth hunters only, held prior to the regular duck season. Approximately 7-9% of Maine waterfowl hunters take a youth hunting during this special hunt.

- **Adaptive Harvest Management (AHM), liberal season frameworks, and framework extensions in the Atlantic Flyway**. In 1995 USFWS adopted the concept of adaptive management for regulating duck harvests. The adaptive approach to resource management recognizes that results of hunting season regulations cannot be predicted with certainty, and provides a framework for objective decision-making. Liberal season frameworks for duck hunting (60 days/6 bird bag) have been offered in the Atlantic Flyway since 1997. Based on the Eastern Mallard AHM models, the expected frequency of liberal regulations in the Atlantic Flyway is >99%. In 2002, USFWS extended the duck season framework closing date approximately 10 days in the Atlantic Flyway; this change in season framework dates is expected to increase the harvests Maine-produced waterfowl, particularly wood ducks and ring-necked ducks, in the southern portion of the Flyway. Preseason banding and population monitoring of Maine ducks are necessary to monitor the effects of these regulations changes on Maine's breeding waterfowl populations.
- **Record high harvests of six species of waterfowl in Maine**. Recent record high harvests of waterfowl in Maine include 25,900 eiders in 1991; 5,400 long-tailed ducks (oldsquaw) in 1992; 12,600 Canada geese in 1999; and 3,100 hooded mergansers, 15,000 mallards, and 15,100 wood ducks in 2001.
- **Harvest Information Program (HIP)**. Harvest and hunter surveys changed from the federal duck stamp-based survey to HIP, a survey

which is based on sales of hunting licenses and which yields estimates of hunter and harvest activity of all migratory game birds, not just waterfowl. Estimates of harvest and hunter activity since 2002 are based on HIP.

- **Coast-wide surveys of Barrow's goldeneye in Maine**. Land-based surveys of wintering Barrow's goldeneye conducted by MDIFW during 1993-1994 and1999-2000 identified several concentration areas, and smaller numbers were distributed along Maine's coast. Information on wintering philopatry and movements on the wintering range is needed for the conservation of this species.
- **Maine Harlequin Duck Assessment**. A species-specific assessment for harlequin duck was prepared by MaryEllen Wickett, MDIFW, in 1999. Subsequently, MDIFW sponsored a study of survival and wintering philopatry of harlequin ducks in outer Jericho Bay through 2003.
- **Maine Common Eider Assessment**. A species-specific assessment for common eider was prepared by Brad Allen, MDIFW, in 2000. In 2002, MDIFW began a collaborative research project with U.S. Geological Survey and Petit Manan National Wildlife Refuge biologists to investigate survival and recruitment among common eiders in Maine.

Annual statewide breeding population estimates of most of Maine's breeding waterfowl became available in 1996 when the USFWS included Maine in aerial transect surveys of breeding waterfowl populations of eastern North America. Most breeding populations during the short-term show stable, slightly increasing, or no trend. Since

the 1985 plan, Midwinter Waterfowl Surveys in Maine and the Atlantic Flyway have shown stabilization in numbers of black ducks, and a decline among goldeneyes; wintering numbers of mallards and Canada geese have increased in Maine. Annual statewide monitoring of breeding populations of wood duck and hooded merganser currently does not exist.

Indices to production in the form of brood surveys have been conducted since the mid-1950s. Since the 1985 Waterfowl Plan, brood counts have declined among black duck, common goldeneye, blue-winged teal, and common merganser; numbers of wood duck, hood merganser, and green-winged teal broods have remained relatively stable, and mallard broods have increased slightly.

In 2001, approximately 9,400 adult hunters expended over 81,000 hunter-days pursuing waterfowl in Maine. This effort resulted in a retrieved kill of 82,700 ducks and 9,825 geese. The trend in hunter numbers and hunter-days during the last 10 years has been increasing. These slight increases may be related to liberalized hunting season frameworks and abundant waterfowl populations. Nearly half of youth in a recent national survey expressed some interest in going hunting, however lack of a mentor or family member who hunts was identified as a barrier to hunting participation by youths.

A national survey reported that migratory bird hunters in Maine spent $5.3 million on hunting trips and equipment in 2001; although the sample includes woodcock, snipe, and rail hunters it is clear that waterfowl hunting has considerable economic and social impact in Maine. The same survey found that 36% of Mainers participated in bird watching, and waterfowl were one of the most popular groups of birds to observe. With

total wildlife-watching expenditures and economic impacts for Maine in 2001 estimated at $856.5 million, it is clear that waterfowl provide Maine with substantial aesthetic and economic non-game value in addition to their traditional value as game species.

Restrictive regulations on the hunting of black ducks during 1983-2001 have resulted in an average reduction in the retrieved kill in Maine of 54% compared to harvests during 1977-1981. Since the 1985 waterfowl plan, dabbling ducks have increased slightly as a proportion of the total duck harvest, while the proportion of diving ducks in the harvest has declined and sea ducks have remained stable. Increased harvests have occurred among Canada goose, mallard, mergansers, and wood duck.

Given the prospect of liberal season frameworks and extended season framework closing dates, balancing the legal harvest of Maine's breeding population against the demand for their utilization continues to be the challenge for managers in Maine and North America. While mallard can likely sustain higher harvests, increased harvests throughout the Flyway of Maine-breeding black ducks and wood ducks require careful monitoring. Preseason banding and population monitoring are necessary to determine the effects of regulation changes on Maine’s breeding waterfowl.

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Table 1. Phylogenetic groupings, common names, and scientific names of waterfowl that occur in Maine.

Family	Subfamily	Tribe	Common Name	Scientific Name
Anatidae	Anserinae	Anserini – Geese and Swans	Tundra Swan	*Cygnus columbianus*
			Mute Swan	*Cygnus olor*
			White-fronted Goose	*Anser albifrons*
			Snow Goose	*Chen caerulescens*
			Ross' Goose	*Chen rossii*
			Canada Goose	*Branta canadensis*
			Brant	*Branta bernicla*
		Dendrocygnini	Fulvous Whistling Duck	*Dendrocyna bicolor*
	Anatinae	Cairinini	Wood Duck	*Aix sponsa*
		Anatini - Dabbling Ducks	European Wigeon	*Anas penelope*
			American Wigeon	*Anas americana*
			Gadwall	*Anas strepera*
			Green-winged Teal	*Anas crecca*
			Mallard	*Anas platyrhynchos*
			American Black Duck	*Anas rubripes*
			Northern Pintail	*Anas acuta*
			Blue-winged Teal	*Anas discors*
			Northern shoveler	*Anas clypeata*
		Aythyini – Bay Ducks	Canvasback	*Aythya valisineria*
			Redhead	*Aythya americana*
			Ring-necked Duck	*Aythya collaris*
			Greater Scaup	*Aythya marila*
			Lesser Scaup	*Aythya affinis*
		Mergini – Sea Ducks	Common Eider	*Somateria mollissima*
			King Eider	*Somateria spectabilis*
			Harlequin Duck	*Histrionicus histrionicus*
			Long-tailed Duck	*Clangula hyemalis*
			Black Scoter	*Melanitta nigra*
			Surf Scoter	*Melanitta perspicillata*
			White-winged Scoter	*Melanitta fusca*
			Bufflehead	*Bucephala albeola*
			Common Goldeneye	*Bucephala clangula*
			Barrow's Goldeneye	*Bucephala islandica*
			Hooded Merganser	*Lophodytes cucullatus*
			Red-breasted Merganser	*Mergus serrator*
			Common Merganser	*Mergus merganser*
		Oxyurini	Ruddy Duck	*Oxyura jamaicensis*

Table 2. Seasonal abundance and distribution of waterfowl in Maine[1]

	Breeding (18 species)	Migrating (36 species)	Wintering[2] (19 species)
DABBLING DUCKS			
Mallard	C - S	C - S	C - S
American Black Duck	C - S	C - S	C - S
Gadwall	I - L	R - R	
European Wigeon		R - L	
American Wigeon	O - R	O - S	
Green-winged Teal	O - S	C - S	
Blue-winged Teal	O - R	C - S	
Northern Shoveler	R - R	O - R	
Northern Pintail	I - L	O - S	O - S
Wood Duck	C - S	C - S	
Fulvous Whistling Duck		I - L	
DIVING DUCKS			
Redhead		R - L	
Canvasback		R - L	
Greater Scaup		C - R	O - L
Lesser Scaup		C - R	
Ring-necked Duck	C - S	C - S	
Common Goldeneye	C - R	C - S	C - S
Barrow's Goldeneye		O - U	O - R
Bufflehead		C - S	C - R
Ruddy Duck	R - L	O - L	O - L
SEA DUCKS			
Long-tailed Duck		C - R	C - R
Harlequin		O - R	C - L
Common Eider	C - R	C - R	C - R
King Eider		R - R	R - L
Black Scoter		C - R	C - R
White-winged Scoter		C - R	C - R
Surf Scoter		C - R	C - R
MERGANSERS			
Common Merganser	C - S	C - S	C - S
Red-breasted Merganser	I - L	C - R	C - R
Hooded Merganser	C - S	C - S	
GEESE			
Snow Goose		O - R	
Ross' Goose		R - R	
White-fronted Goose		R - S	
Canada Goose	C - S	C - S	C - S
Brant		O - R	
SWANS			
Tundra Swan		I - L	
Mute Swan	I - L		I - L

[1] Abundance: C=Common; O=Occasional; R=Rare; I=Individual; U=Unknown
Distribution: S=Statewide; R=Regionally; L=Locally; U=Unknown

[2] Statewide distribution dependent on available open water habitat.

Table 3. Maine Breeding Waterfowl Nest Site Preference

Ground Nesters	Cavity Nesters
Mallard	Wood Duck
American Black Duck	Common Goldeneye
Gadwall	Common Merganser
American Wigeon	Hooded Merganser
Green-winged Teal	
Blue-winged Teal	
Northern Shoveler	
Northern Pintail	
Ruddy Duck	
Ring-necked Duck	
Common Eider	
Canada Goose	
Mute Swan	
Red-breasted Merganser	

Table 4. Waterfowl hunter statistics for Maine and the Atlantic Flyway, 1961-2001.

year	Maine stamp sales	Maine active hunters	Flyway stamp sales	Flyway active hunters	Maine hunter days	Flyway hunter days	Maine average days	Flyway average days	Maine average daily bag	Flyway average daily bag	Maine season bag	Flyway season bag
1961	7,213	5,400	232,578	174,100	30,100	1,099,400	9.85	6.84	1.44	0.78	9.64	6.07
1962	8,020	6,400	236,311	179,200	43,100	1,160,000	4.70	6.14	0.84	0.73	6.61	5.89
1963	10,080	7,600	270,382	195,500	47,900	1,247,000	5.67	5.93	0.82	0.81	4.89	4.95
1964	10,997	8,700	284,756	224,600	53,600	1,481,800	5.51	5.55	1.06	0.74	6.20	4.79
1965	11,969	9,800	301,088	241,200	61,400	1,527,700	5.47	6.14	0.91	0.61	5.45	4.47
1966	13,641	10,800	336,472	270,000	71,100	1,800,100	5.69	5.66	1.06	0.91	6.62	5.85
1967	13,223	10,700	360,937	288,000	66,900	1,902,800	6.64	6.25	1.07	0.83	6.34	5.22
1968	14,696	12,400	384,762	304,000	73,700	1,978,300	5.40	6.26	1.18	0.80	6.65	4.97
1969	15,939	13,611	438,372	361,910	92,000	2,598,200	5.41	5.47	1.18	0.75	7.59	5.61
1970	18,182	15,086	496,387	405,367	103,700	2,895,100	6.10	6.41	1.17	0.79	7.62	5.39
1971	18,534	15,021	501,289	406,625	100,900	2,926,400	6.90	7.12	0.96	0.98	6.13	6.74
1972	15,750	13,066	438,264	358,531	91,600	2,645,600	7.72	8.16	0.96	0.63	6.38	4.48
1973	16,923	14,363	434,851	357,798	96,000	2,649,000	6.38	7.39	0.91	0.59	5.80	4.19
1974	18,200	15,327	448,849	368,039	113,500	2,819,300	6.26	7.20	0.95	0.62	6.72	4.55
1975	18,152	14,887	441,838	357,409	108,800	2,843,500	7.62	7.89	0.79	0.66	5.48	5.03
1976	17,458	14,408	435,933	352,386	116,500	2,885,400	7.55	8.07	0.85	0.73	6.56	5.73
1977	17,664	14,473	434,558	351,928	93,900	2,723,100	8.05	8.20	0.76	0.69	4.67	5.14
1978	18,650	15,500	451,321	364,831	108,700	2,935,800	6.06	7.46	0.72	0.67	4.83	5.19
1979	16,974	14,022	416,574	346,612	98,100	2,840,300	7.75	8.47	0.70	0.67	4.66	5.21
1980	16,473	13,296	409,281	328,369	94,000	2,673,300	7.38	8.65	0.87	0.74	5.82	5.73
1981	16,657	13,935	407,906	324,681	97,900	2,671,200	6.75	8.23	0.74	0.73	4.93	5.71
1982	14,470	11,517	402,929	311,166	79,500	2,631,200	8.50	8.58	0.97	0.63	6.34	5.08
1983	14,685	11,926	390,896	304,070	85,100	2,405,500	6.67	8.65	0.99	0.72	6.72	5.40
1984	13,634	11,058	412,866	316,769	76,700	2,582,200	7.70	7.59	0.81	0.73	5.31	5.68
1985	13,280	10,588	382,546	284,584	79,500	2,125,100	7.24	9.07	0.90	0.68	6.43	4.86

Table 4. Waterfowl hunter statistics for Maine and the Atlantic Flyway, 1961-2001 - continued.

year	Maine stamp sales	Maine active hunters	Flyway stamp sales	Flyway active hunters	Maine hunter days	Flyway hunter days	Maine average days	Flyway average days	Maine average daily bag	Flyway average daily bag	Maine season bag	Flyway season bag
1986	13,185	10,322	387,744	285,375	74,300	2,144,700	7.70	7.45	0.99	0.83	6.79	4.93
1987	12,274	9,551	367,049	268,637	67,500	2,019,200	7.78	7.98	0.83	0.71	5.53	5.06
1988	10,461	8,226	341,836	242,128	48,624	1,600,561	6.21	6.96	0.83	0.60	4.89	3.97
1989	10,850	8,166	331,580	232,746	47,700	1,593,300	5.84	6.85	0.89	0.75	4.94	4.88
1990	11,244	6,770	326,403	230,214	56,600	1,700,000	6.03	6.78	0.93	0.67	5.58	4.53
1991	11,298	9,052	316,468	240,158	67,600	1,710,600	7.46	7.12	0.98	0.69	7.30	4.93
1992	10,128	7,946	300,332	224,307	48,700	1,484,500	6.13	6.62	1.05	0.68	6.42	4.53
1993	9,553	8,263	292,566	220,463	56,435	1,556,610	6.49	6.71	0.96	0.76	6.21	5.07
1994	9,855	8,680	294,619	225,811	60,247	1,701,433	6.94	7.53	0.93	0.69	6.44	5.20
1995	8,784	7,110	270,097	204,451	53,229	1,591,358	7.49	7.76	1.22	1.09	9.10	8.48
1996	9,251	8,123	290,592	221,951	60,218	1,739,962	7.41	7.82	1.10	0.92	8.13	7.20
1997	9,544	8,386	305,840	240,340	60,092	2,074,375	7.17	8.75	0.94	0.91	6.74	7.98
1998	10,341	8,181	299,234	237,180	65,836	2,034,055	8.05	8.58	0.93	1.01	7.52	8.64
1999	10,676	8,469	300,020	229,619	70,051	2,005,465	8.27	8.73	0.86	1.03	7.08	9.01
2000	10,810	8,243	306,740	233,146	59,682	1,970,507	7.24	8.45	0.81	0.99	5.84	8.37
2001	11,041	9,394	310,092	244,286	81,268	2,149,278	8.65	8.80	0.93	0.80	8.06	7.05

Table 5. Number and area of high and moderate value Waterfowl and Wading Bird Habitat (WWH) by Wildlife Management District (WMD) in Maine, 2004.

	High Value WWHs			Moderate Value WWHs			High and Moderate Value WWHs			
WMD	Count	Mean acres	Sum acres	Count	Mean acres	Sum acres	Count	Mean acres	Sum acres	Rank
0[1]	5	28	141	37	51	1,876	42	48	2,017	30
1	28	104	2,913	190	112	21,217	218	111	24,130	11
2	13	74	964	136	68	9,255	149	69	10,220	23
3	18	44	786	174	112	19,570	192	106	20,356	13
4	40	147	5,890	298	101	30,062	338	106	35,952	6
5	29	105	3,053	316	93	29,363	345	94	32,415	8
6	23	62	1,421	248	77	19,033	271	75	20,454	12
7	17	33	554	174	62	10,716	191	59	11,270	21
8	93	32	2,953	525	77	40,519	618	70	43,472	3
9	36	54	1,944	245	68	16,604	281	66	18,548	16
10	71	53	3,786	275	93	25,587	346	85	29,373	10
11	43	44	1,890	333	146	48,505	376	134	50,395	2
12	19	42	806	110	60	6,646	129	58	7,452	26
13	36	36	1,314	106	33	3,493	142	34	4,807	28
14	33	36	1,192	227	52	11,895	260	50	13,088	20
15	39	73	2,863	200	79	15,865	239	78	18,729	15
16	52	64	3,341	168	70	11,701	220	68	15,042	17
17	73	60	4,413	346	82	28,224	419	78	32,638	7
18	89	47	4,190	361	192	69,236	450	163	73,426	1
19	56	132	7,396	330	98	32,397	386	103	39,793	4
20	29	73	2,130	164	48	7,950	193	52	10,080	24
21	24	46	1,098	124	39	4,803	148	40	5,901	27
22	54	112	6,057	145	51	7,337	199	67	13,394	19
23	63	60	3,803	272	100	27,158	335	92	30,961	9
24	13	47	616	70	27	1,878	83	30	2,494	29
25	55	67	3,683	156	46	7,153	211	51	10,836	22
26	37	59	2,192	114	59	6,758	151	59	8,951	25
27	40	74	2,945	203	59	11,990	243	61	14,935	18
28	43	43	1,831	211	165	34,757	254	144	36,587	5
29	47	61	2,878	168	100	16,852	215	92	19,730	14
30	5	29	147	20	16	314	25	18	461	31
Total	1,223	65	79,193	6,446	90	578,715	7,669	86	657,908	

[1] Baxter State Park

Table 6. Black duck breeding and migration habitat area estimations[1] by Wildlife Management District (WMD) in Maine, 2004.

WMD	Low[2] Value (acres)	Medium[2] Value (acres)	High[2] Value (acres)	Total (acres)	Rank (high & medium)
0[3]	4,932	760	3,698	9,390	31
1	47,209	9,126	22,501	78,835	14
2	45,585	1,983	10,169	57,737	30
3	73,020	3,816	22,440	99,277	18
4	176,732	4,889	31,943	213,564	9
5	115,148	4,084	25,160	144,392	15
6	73,853	4,094	32,647	110,595	10
7	73,662	991	14,519	89,171	28
8	122,301	6,529	41,513	170,343	5
9	154,615	2,847	18,225	175,686	23
10	74,755	3,615	29,420	107,789	12
11	175,585	4,610	45,132	225,327	4
12	17,594	3,773	15,716	37,083	26
13	13,532	2,284	10,336	26,151	29
14	41,137	1,894	15,332	58,364	27
15	50,989	2,975	36,625	90,589	7
16	56,892	6,180	25,760	88,832	13
17	72,772	3,177	49,565	125,514	2
18	121,965	13,327	72,164	207,456	1
19	147,018	2,038	38,689	187,745	6
20	26,749	1,723	33,299	61,771	11
21	52,253	2,059	18,790	73,102	24
22	18,340	3,083	24,201	45,624	17
23	52,697	3,877	48,474	105,048	3
24	6,986	2,373	22,792	32,151	20
25	22,090	1,824	22,219	46,134	21
26	22,573	3,822	16,618	43,013	25
27	51,551	2,571	25,836	79,958	16
28	52,781	1,756	36,244	90,781	8
29	41,760	1,245	20,129	63,134	22
30	2,245	14,212	11,251	27,708	19
Total	2,009,324	121,535	841,406	2,972,265	

[1] Habitat estimations according to model by Banner (1999), Appendix A.
[2] Habitat value categories assigned as: low = 1-3, medium = 4-6, high = 7-10. Habitat index values (1…10) according to Banner (1999), Appendix IIIa.
[3] Baxter State Park

Table 7. Wood duck breeding habitat area estimations[1] by Wildlife Management District (WMD) in Maine, 2004.

WMD	Low[2] Value (acres)	Medium[2] Value (acres)	High[2] Value (acres)	Total (acres)	Rank (high & medium)
0[3]	124	7,042	5,331	12,497	30
1	105	30,545	23,041	53,692	25
2	47	21,886	19,870	41,803	29
3	30	38,522	32,009	70,562	20
4	59	27,449	34,407	61,915	23
5	101	46,715	37,663	84,479	13
6	40	53,246	37,671	90,956	12
7	175	31,168	38,409	69,752	21
8	159	58,773	82,570	141,503	4
9	79	29,791	52,152	82,022	16
10	74	51,997	47,059	99,130	11
11	216	76,266	58,674	135,156	5
12	76	18,880	33,672	52,628	26
13	56	18,216	26,441	44,713	28
14	98	32,761	43,760	76,618	18
15	82	50,652	80,945	131,679	6
16	22	36,988	67,247	104,257	9
17	91	74,794	76,545	151,430	2
18	96	102,826	84,183	187,104	1
19	115	58,420	52,509	111,043	8
20	350	55,799	70,642	126,791	7
21	62	39,662	39,700	79,423	17
22	473	31,437	43,903	75,813	19
23	109	66,661	77,887	144,657	3
24	852	25,901	22,986	49,739	27
25	497	43,690	40,188	84,376	14
26	1,151	32,419	29,338	62,909	24
27	479	47,572	36,265	84,316	15
28	58	56,045	46,852	102,954	10
29	193	42,024	26,098	68,316	22
30	5,474	1,957	1,535	8,965	31
Total	11,542	1,310,106	1,369,550	2,691,198	

[1] Habitat estimations according to model by Banner (1999), Appendix IIIb.
[2] Habitat value categories assigned as: low = 1-3, medium = 4-6, high = 7-10. Habitat index values (1…10) according to Banner (1999), Appendix A.
[3] Baxter State Park

Table 8. Scaup migration and wintering habitat area estimations[1] by Wildlife Management District (WMD) in Maine, 2004.

WMD	Low[2] Value (acres)	Medium[2] Value (acres)	High[2] Value (acres)	Total (acres)	Rank (high & medium)[3]
0[4]	1,302	496	0	1,797	6
1	5,573	0	0	5,573	30
2	13,533	0	0	13,533	27
3	25,495	0	0	25,495	23
4	80,822	0	0	80,822	12
5	37,078	0	0	37,078	18
6	8,082	0	0	8,082	28
7	51,882	0	0	51,882	15
8	66,571	0	0	66,571	14
9	125,841	0	0	125,841	11
10	37,645	0	0	37,645	17
11	37,881	0	0	37,881	16
12	7,257	0	0	7,257	29
13	4,471	0	0	4,471	31
14	21,605	0	0	21,605	24
15	31,391	0	0	31,391	20
16	30,062	0	0	30,062	21
17	18,473	0	0	18,473	26
18	29,690	0	0	29,690	22
19	77,856	0	0	77,856	13
20	4,736	656	0	5,392	5
21	31,993	0	0	31,993	19
22	9,095	348	0	9,443	9
23	16,051	3	0	16,054	10
24	271	1,383	103	1,757	3
25	10,943	406	35	11,384	7
26	10,176	4,369	55	14,600	2
27	28,310	1,035	152	29,497	4
28	20,501	0	0	20,501	25
29	21,940	386	2	22,328	8
30	1,217	12,530	1,996	15,743	1
Total	867,743	21,611	2,344	891,697	

[1] Habitat estimations according to model by Banner (1999), Appendix IIIc.
[2] Habitat value categories assigned as: low = 1-3, medium = 4-6, high = 7-10. Habitat index values (1…10) according to Banner (1999), Appendix A.
[3] Ranked primarily by combined area of medium and high value habitat, and secondarily by low value habitat.
[4] Baxter State Park

Table 9. Scoter wintering habitat area estimations[1] by Wildlife Management District (WMD) in Maine, 2004.

WMD	Low[2] Value (acres)	Medium[2] Value (acres)	High[2] Value (acres)	Total (acres)	Rank (high & medium)
0[3]	0	0	0	0	-
1	0	0	0	0	-
2	0	0	0	0	-
3	0	0	0	0	-
4	0	0	0	0	-
5	0	0	0	0	-
6	0	0	0	0	-
7	0	0	0	0	-
8	0	0	0	0	-
9	0	0	0	0	-
10	0	0	0	0	-
11	0	0	0	0	-
12	0	0	0	0	-
13	0	0	0	0	-
14	0	0	0	0	-
15	0	0	0	0	-
16	0	0	0	0	-
17	0	0	0	0	-
18	0	0	0	0	-
19	0	0	0	0	-
20	118	536	0	654	3
21	0	0	0	0	-
22	56	0	0	56	8
23	0	0	0	0	-
24	157	606	30	792	2
25	14	53	0	67	5
26	3,295	37	6	3,338	6
27	148	232	15	395	4
28	0	0	0	0	-
29	12	22	4	38	7
30	1,234	5,217	1,278	7,729	1
Total	5,034	6,703	1,333	13,070	

[1] Habitat estimations according to model by Banner (1999), Appendix IIId.
[2] Habitat value categories assigned as: low = 1-3, medium = 4-6, high = 7-10. Habitat index values (1…10) according to Banner (1999), Appendix A.
[3] Baxter State Park

Table 10. Dabbling duck breeding population indices for Maine and the Canadian Maritime provinces (U.S. Fish and Wildlife Service breeding waterfowl survey strata 62-67), 1996-2003.

Mallard	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	9,682	20,534	24,843	12,456	11,468	6,272	8,454	8,000
Maritimes	13,403	17,651	23,172	8,861	9,678	3,993	7,737	6,100
Total	23,085	38,185	48,015	21,317	21,146	10,265	16,191	14,100

American Black Duck	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	32,371	54,356	91,958	22,515	49,721	30,811	47,952	32,300
Maritimes	145,877	207,039	196,698	194,255	208,065	151,818	276,059	160,600
Total	178,248	261,396	288,656	216,771	257,785	182,629	324,010	192,900

American Wigeon	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	0	0	0	0	2,209	1,104	16,566	0
Maritimes	3,158	2,668	9,227	3,723	24,200	58,435	23,848	27,700
Total	3,158	2,668	9,227	3,723	26,409	59,539	40,414	27,700

Green-winged Teal	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	5,564	23,727	86,834	30,061	23,008	19,951	99,245	26,800
Maritimes	143,851	66,287	83,137	145,090	113,477	125,934	402,672	194,600
Total	149,415	90,014	169,971	175,151	136,485	145,885	501,917	221,400

Blue-winged Teal	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	6,254	1,802	0	0	0	0	0	0
Maritimes	16,069	0	5,553	19,047	0	0	2,241	0
Total	22,323	1,802	5,553	19,047	0	0	2,241	0

Northern Pintail	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	0	643	0	522	0	0	5,145	500
Maritimes	9,060	1,508	1,722	9,640	6,525	14,203	35,113	19,500
Total	9,060	2,151	1,722	10,162	6,525	14,203	40,258	20,000

Northern Shoveler	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	0	0	0	0	0	0	0	0
Maritimes	731	0	0	0	2,132	0	3,719	0
Total	731	0	0	0	2,132	0	3,719	0

* preliminary

Table 11. Diving duck breeding population indices for Maine and the Canadian Maritime provinces (U.S. Fish and Wildlife Service breeding waterfowl survey strata 62-67), 1996-2003.

Merganser species	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	16,838	36,179	57,933	20,171	9,203	6,861	15,843	14,700
Maritimes	29,015	113,476	49,381	48,053	42,963	38,044	97,246	59,700
Total	45,853	149,656	107,313	68,224	52,165	44,906	113,090	74,400

Scaup species	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	0	0	0	0	0	0	0	0
Maritimes	0	388	641	8,690	17,459	0	2,978	4,500
Total	0	388	641	8,690	17,459	0	2,978	4,500

Ring-necked Duck	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	29,980	87,686	54,897	22,937	23,508	33,808	37,042	15,800
Maritimes	145,410	159,037	77,540	105,716	193,210	94,140	83,583	79,400
Total	175,390	246,722	132,437	128,653	216,718	127,949	120,625	95,200

Goldeneye species	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	3,832	2,524	10,625	4,439	0	1,460	29,205	14,800
Maritimes	27,351	42,762	72,665	231,901	56,645	148,182	109,500	104,000
Total	31,183	45,286	83,290	236,341	56,645	149,642	138,705	118,800

Bufflehead	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	1,934	5,201	3,111	23,398	9,831	16,456	9,404	8,100
Maritimes	1,514	2,773	0	0	3,006	8,864	5,282	4,100
Total	3,448	7,974	3,111	23,398	12,837	25,321	14,686	12,200

Scoter species	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	7,886	0	28,238	0	280	421	561	0
Maritimes	15,451	0	32,487	45,801	16,358	11,144	47,176	23,300
Total	23,336	0	60,724	45,801	16,638	11,565	47,737	23,300

* preliminary

Table 12. Canada goose breeding population indices for Maine and the Canadian Maritime provinces (U.S. Fish and Wildlife Service breeding waterfowl survey strata 62-67), 1996-2003.

	1996	1997	1998	1999	2000	2001	2002	2003*
Maine	7,479	9,647	14,109	47,962	9,516	17,952	10,032	8,900
Maritimes	224,182	175,430	215,126	230,840	187,371	137,939	209,945	144,200
Total	231,661	185,077	229,235	278,802	196,887	155,892	219,977	153,100

* preliminary

Table 13. Breeding population estimates (total indicated pairs / 503,800 km^2) from the Black Duck Joint Venture Helicopter Survey in Québec, 1990-2003.

Species	1990-1995[1]	1996	1997	1998	1999	2000	2001	2002	2003
LOONS									
Common Loon	14 775	10 851	25 319	18 860	24 286	21 185	19 894	20 410	29 195
GEESE									
Canada Goose	15 889	22 477	17 052	22 477	35 137	37 462	33 587	28 161	36 945
DABBLERS									
Wood Duck	2 450	2 325	2 325	1 292	4 134	5 684	6 201	4 650	5 167
Green-winged Teal	12 856	23 252	14 468	11 109	18 860	41 854	17 568	21 702	21 961
American Black Duck	80 339	106 056	94 947	107 736	155 145	158 116	121 300	144 164	127 113
Mallard	8 224	18 860	9 818	8 267	19 635	25 578	14 210	10 334	25 319
Northern Pintail	173	2 067	258	0	0	258	0	517	0
Blue-winged Teal	617	517	1 033	517	775	1 550	1 033	0	258
American Wigeon	624	1 033	1 550	0	775	7 173	517	258	2 842
Subtotal	105 284	154 111	124 400	128 921	199 324	238 465	160 828	181 854	182 660
DIVERS									
Ring-necked Duck	51 014	40 821	55 289	39 012	67 690	83 967	52 705	41 854	82 158
Greater Scaup	857	1 033	258	0	0	4 909	0	258	1 033
Lesser Scaup	2 164	517	517	0	0	258	0	0	258
Unidentified Scaup	751	258	0	0	0	4 134	0	0	0
Black Scoter	919	517	258	258	775	775	0	0	0
Surf Scoter	2 492	1 809	3 875	8 009	5 942	5 684	9 301	4 909	10 076
Common Goldeneye	41 224	39 271	42 371	32 295	49 605	57 614	45 213	63 556	66 657
Barrow's Goldeneye	1 207	1 033	1 292	2 842	517	258	2 845	258	0
Bufflehead	2 625	3 617	2 067	0	517	1 292	0	7 751	2 067
Hooded Merganser	11 654	12 660	12 660	12 918	26 611	23 252	15 243	27 386	20 927
Common Merganser	37 998	26 094	40 046	33 845	34 620	41 079	41 596	61 231	44 696
Red-breasted Merganser	1 503	0	0	0	0	342	0	517	258
Subtotal	154 407	127 629	158 632	129 179	186 277	223 481	166 900	207 721	228 131
Total Ducks	259 691	281 740	283 032	258 101	385 601	461 946	327 728	389 347	410 791

Table 14. Breeding population estimates of Atlantic population of Canada Goose (number of indicated pairs / 350,000 km^2; Strata 3 and 4) and North Atlantic population of Canada Goose (number of indicated pairs / 105 3000 km^2; Stratum 2) from the Black Duck Joint Venture survey in Québec, 1990-2003.

Population	1990-1995[1]	1996	1997	1998	1999	2000	2001	2002	2003
Atlantic	11 407	15 638	11 863	13 211	23 726	25 613	22 108	17 795	25 613
North Atlantic	3 645	5 552	4 212	7 275	9 190	9 573	9 190	8 233	9 190

Table 15. Breeding population estimates and standard errors (in thousands) for the 10 most abundant species of ducks in the eastern survey area (Eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1990-2003[a].

	Mergansers		Mallards		American Black Duck		American Wigeon		Am. Green-winged teal		Lesser Scaup		Ring-necked duck		Goldeneye spp.		Bufflehead		Scoter spp.	
Year	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$	$\hat{N}$	$\hat{SE}$
1990	157.5	48.3	208.6	47.7	160.9	33.5	31.0	22.6	47.1	8.6	135.7	56.2	92.1	28.3	73.3	22.2	99.9	22.9	1.9	1.9
1991	263.9	78.6	169.8	34.5	126.0	35.3	45.4	21.8	42.2	14.4	43.5	16.4	158.1	30.2	138.4	44.3	94.1	32.1	6.4	5.3
1992	128.1	24.3	362.2	54.1	160.3	33.1	15.4	9.3	43.8	13.9	65.6	23.2	251.6	62.3	241.0	55.2	59.0	13.7	3.0	2.3
1993	164.9	23.7	333.8	49.7	124.6	25.6	9.4	7.4	47.4	9.9	288.6	235.3	248.1	65.1	90.2	32.6	13.1	3.6	0.0	0.0
1994	358.4	91.8	238.6	28.8	116.3	20.7	18.9	9.6	169.2	24.0	81.9	31.7	163.5	62.6	55.0	17.4	33.4	14.0	18.3	9.7
1995	376.3	89.7	212.6	41.1	234.5	46.6	13.8	7.9	96.2	14.1	62.0	20.5	195.6	51.0	9.2	3.7	26.5	8.8	5.0	4.8
1996	1083.1	279.6	387.6	63.6	562.2	97.1	34.7	17.0	436.2	86.9	38.5	15.1	611.9	98.7	410.3	169.7	50.6	12.5	23.6	10.5
1997	379.1	53.0	287.6	44.8	434.5	63.1	22.5	11.2	211.5	31.3	16.7	7.2	617.6	151.1	220.6	54.8	22.3	6.7	88.9	50.2
1998	327.4	38.8	363.2	71.3	542.1	55.4	83.6	24.6	299.5	81.1	20.1	10.6	361.8	53.8	715.7	124.7	44.6	10.3	159.4	47.1
1999	290.0	39.4	280.8	39.2	488.7	51.3	121.1	45.6	422.4	62.3	44.9	20.5	453.2	76.0	920.0	167.3	70.5	20.8	47.0	17.7
2000	400.0	54.0	212.3	31.3	396.9	53.9	41.7	20.4	201.6	28.7	19.8	9.1	618.8	71.3	946.5	318.7	49.3	11.3	182.1	59.0
2001	428.7	62.8	285.7	40.8	422.0	48.8	77.5	18.2	220.3	33.5	203.5	92.2	352.8	39.6	1032.2	202.4	95.0	20.9	178.6	49.4
2002	815.2	97.9	295.1	38.1	602.8	86.1	86.6	25.5	604.1	129.0	136.1	48.2	416.0	57.8	954.9	209.2	83.6	21.2	314.4	76.4
2003	569.7	62.7	383.1	57.3	521.8	55.6	56.2	30.6	393.2	111.7	101.2	21.2	394.9	49.3	713.6	207.7	66.3	16.7	237.1	66.9

[a] Maine estimates were included beginning in 1995. Quebec estimates were included beginning in 1996. Therefore, estimates are only comparable within year groups 1990-94, and 1996-present.

Table 16. Mean number of broods and proportion of total, by species, during brood counts on 39 waterfowl production index areas in Maine during 1966-76, 1980-84, 1986-90, 1991-95, 1996-2000, 2002[1].

	1966-76		1980-84		1986-90		1991-95		1996-2000		2002	
	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%		%
Black Duck	37	29	34	19	56	24	50	24	24	16	26	15
Ring-necked Duck	31	24	44	25	49	21	39	19	30	20	50	29
Wood Duck	15	12	24	13	38	17	43	21	32	22	31	18
Common Goldeneye	23	18	36	20	39	17	31	15	27	19	31	18
Hooded Merganser	10	8	19	11	26	11	24	12	21	14	21	12
Green-winged Teal*	1	1	2	1	1	1	1	<1	1	1	1	1
Blue-winged Teal	5	4	4	2	1	1	1	<1	0	0	0	0
Common Merganser	4	3	11	6	12	5	8	3	6	4	5	2
Mallard	1	1	5	3	7	3	11	5	7	4	9	5
Total Observed	127	100	179	100	229	100	208	100	148	100	174	100

*Known breeder: assigned 1 brood during 1966-76 even though not observed in brood counts.

[1]Mallard x black duck hybrids and Canada geese were excluded from analysis.

Table 17. Midwinter Waterfowl Survey indices for selected species in Maine and the Atlantic Flyway, 1961-2003.

	American Black Duck		Common Goldeneye		Mallard		Scaup spp.		Canada Goose	
	Maine	Atlantic Flyway	Maine	Atlantic Flyway	Maine	Atlantic Flyway	Maine	Atlantic Flyway	Maine	Atlantic Flyway
1961-65	20,238	335,930	11,185	50,900	0	212,877	2,875	713,494	180	488,360
1966-70	23,320	308,780	10,025	73,880	0	195,100	1,900	632,540	360	654,680
1971-75	26,034	258,026	7,144	47,061	150	182,072	3,303	522,755	567	735,373
1976-80	14,477	250,661	7,632	42,211	96	245,015	3,909	370,445	739	820,243
1981-85	10,844	225,712	7,351	48,480	94	200,151	1,020	365,816	726	834,379
1986-90	10,225	222,440	7,725	36,247	148	167,159	721	382,267	1,122	761,518
1991-95	15,858	216,221	5,101	23,506	554	177,305	726	729,307	1,280	657,500
1996-2000	21,548	222,934	4,915	27,482	954	155,258	1,286	427,118	2,239	802,439
2001-03	17,207	236,518	4,000	24,106	2,193	171,240	725	458,122	3,073	

Table 18. Numbers of long-tailed ducks, eiders, and harlequin ducks observed during the Sea Duck Survey in the Atlantic Flyway, 1991-2002.

		US														Canada			
Species	Year	GA	SC	NC	VA	MD	DE	NJ	NY	CT	RI	MA	NH	ME	Total	NB	NS	Total	Total
Long-tailed duck																			
	1991	4	0	14	147	457	10	83	52	7	4	76	0	631	1,485	105	2,129	2,234	3,719
	1992	0	0	4	395	1,086	2	256	178	60	75	458	1	837	3,352	250	1,165	1,415	4,767
	1994	0	0	67	2,320	4,682	536	1,145	1,720	736	2	188	46	428	11,870	52	876	928	12,798
	1995	0	0	15	287	713	1	319	1,361	83	36	645	41	1,455	4,956	104	2,078	2,182	7,138
	1997	0	0	0	107	687	10	574	1,041	33	34	390	0	855	3,731	98	555	653	4,384
	1998	0	0	75	530	2,016	11	150	454	42	0	277	4	1,596	5,155	70	1,427	1,497	6,652
	1999	12	0	35	223	1,260	0	1,183	1,011	112	19	509	14	1,030	5,408	296	2,114	2,410	7,818
	2000	0	0	0	213	1,619	23	416	707	289	159	1,099	73	1,915	6,513	342	741	1,083	7,596
	2001	0	0	0	783	2,756	9	259	656	87	75	1,016	48	1,662	7,351	253	1,746	1,999	9,350
	2002	0	0	0	280	2,655	5	1,878	415	140	57	910	32	1,372	7,744	92	1,609	1,701	9,445
Common eider																			
	1991	0	0	0	0	0	0	0	0	0	0	15,324	114	13,670	29,108	1,183	5,216	6,399	35,507
	1992	0	0	0	0	0	0	0	2	2	77	11,804	0	11,435	23,320	1,206	7,751	8,957	32,277
	1994	0	0	0	0	0	0	0	0	0	181	5,393	260	22,225	28,059	323	2,569	2,892	30,951
	1995	0	0	0	0	0	0	2	26	11	584	7,845	243	19,941	28,652	2,128	6,724	8,852	37,504
	1997	0	0	0	0	0	0	0	0	65	962	5,381	32	11,128	17,568	892	9,022	9,914	27,482
	1998	0	0	0	0	0	0	0	0	0	7,782	11,609	74	23,986	43,451	2,715	10,413	13,128	56,579
	1999	750	0	0	0	0	0	0	30	0	795	8,200	0	27,094	36,869	2,002	9,463	11,465	48,334
	2000	0	0	0	0	0	0	0	0	0	2,008	24,434	561	36,963	63,966	4,478	8,111	12,589	76,555
	2001	0	0	0	0	0	0	0	0	5	38	3,875	331	11,564	15,813	1,833	10,854	12,687	28,500
	2002	0	0	0	0	0	0	0	0	1	171	7,971	122	13,633	21,898	2,920	9,917	12,837	34,735
Harlequin duck																			
	1991	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	7	7	8
	1992	0	0	0	0	0	0	0	0	0	0	0	0	15	15	3	6	9	24
	1994	0	0	0	0	0	0	0	0	0	26	0	0	7	33	5	4	9	42
	1995	0	0	0	0	0	0	0	0	0	0	0	0	21	21	23	4	27	48
	1997	0	0	0	0	0	0	0	0	0	0	0	0	1	1	15	7	22	23
	1998	0	0	0	0	0	0	0	0	0	0	0	0	16	16	11	6	17	33
	1999	0	0	0	0	0	0	0	0	0	0	0	0	32	32	4	18	22	54
	2000	0	0	0	0	0	0	0	0	0	28	20	7	39	94	0	0	0	94
	2001	0	0	0	0	0	0	0	0	0	8	0	0	25	33	7	7	14	47
	2002	0	0	0	0	0	0	0	0	0	2	0	0	35	37	2	3	5	42

Table 19. Numbers of scoters observed during the Sea Duck Survey in the Atlantic Flyway, 1991-2002.

		US														Canada			
Species	Year	GA	SC	NC	VA	MD	DE	NJ	NY	CT	RI	MA	NH	ME	Total	NB	NS	Total	Total
Black scoters																			
	1991	426	596	86	1,588	569	2	0	270	44	0	390	2	48	4,021	0	16	16	4,037
	1992	39	365	58	1,418	466	0	51	128	2	4	96	0	62	2,689	0	18	18	2,707
	1994	2	167	40	717	271	0	36	88	0	87	794	50	844	3,096	1	782	783	3,879
	1995	1	1,177	1,030	631	1,551	210	2	637	6	3	130	0	110	5,488	49	0	49	5,537
	1997	0	57	283	8,836	58	0	32	515	60	0	250	0	69	10,160	14	207	221	10,381
	1998	0	979	7	1,546	330	8	512	5,175	44	804	1,469	70	3,983	14,927	102	769	871	15,798
	1999	400	144	136	1,205	285	16	238	2,225	3	165	504	55	222	5,598	57	1,447	1,504	7,102
	2000	245	105	184	2,092	584	150	2,745	464	0	240	1,875	10	925	9,619	13	1,735	1,748	11,367
	2001	7	4	220	311	121	32	378	4,454	25	1	335	18	407	6,313	124	2,102	2,226	8,539
	2002	0	0	10	925	97	1	2,032	1,788	0	30	1,471	17	324	6,695	152	1,641	1,793	8,488
Surf scoters																			
	1991	0	4	6	1,658	340	8	14	17	2	8	34	0	296	2,387	9	127	136	2,523
	1992	0	0	12	554	807	0	3	8	0	34	1,986	0	222	3,626	186	741	927	4,553
	1994	0	0	122	1,258	1,590	49	0	1,533	0	0	12	0	11	4,575	22	95	117	4,692
	1995	0	30	119	4,764	986	70	107	1,180	4	37	885	41	656	8,879	134	1,226	1,360	10,239
	1997	50	6	840	6,587	156	14	7	289	1	13	465	0	149	8,577	0	847	847	9,424
	1998	25	2	128	19,985	1,980	0	2	568	11	0	0	0	10	22,711	0	0	0	22,711
	1999	150	74	0	666	912	9	83	473	31	192	771	16	282	3,659	8	551	559	4,218
	2000	33	30	646	3,066	579	1,221	110	166	1	988	7,309	115	596	14,860	35	325	360	15,220
	2001	0	0	233	2,269	1,715	19	135	2,194	8	5	543	33	333	7,487	121	555	676	8,163
	2002	0	0	2	1,304	81	0	3,007	378	0	0	1,126	81	87	6,066	130	805	935	7,001
White-winged scoters																			
	1991	0	0	0	78	267	0	0	124	1	9	344	1	332	1,156	78	537	615	1,771
	1992	0	9	0	2	52	0	1	238	2	5	163	0	88	560	12	138	150	710
	1994	0	0	35	29	4	0	0	53	0	0	146	31	102	400	2	132	134	534
	1995	0	0	0	13	106	6	6	623	37	17	720	275	813	2,616	1,500	703	2,203	4,819
	1997	0	24	120	0	0	0	0	2,085	2	14	58	0	188	2,491	0	951	951	3,442
	1998	0	0	0	9	0	3	35	1,007	0	0	109	14	79	1,256	0	134	134	1,390
	1999	0	0	0	0	0	0	276	4,202	0	0	194	3	154	4,829	35	371	406	5,235
	2000	10	0	3	3	37	0	0	222	0	20	0	0	97	392	2	200	202	594
	2001	0	0	0	0	224	0	0	1,886	63	14	253	22	19	2,481	4	233	237	2,718
	2002	0	0	0	6	0	0	2	1,134	0	4	2,095	43	215	3,499	58	129	187	3,686

Table 19. (Continued) Numbers of scoters observed during the Sea Duck Survey in the Atlantic Flyway, 1991-2002.

		US														Canada			
Species	Year	GA	SC	NC	VA	MD	DE	NJ	NY	CT	RI	MA	NH	ME	Total	NB	NS	Total	Total
Miscellaneous/unidentified scoters																			
	1991	550	125	0	28,904	476	0	0	11,243	0	63	2,907	0	296	44,564	0	41	41	44,605
	1992	5	607	74	1,185	522	0	168	2,878	0	15	428	0	317	6,199	21	705	726	6,925
	1994	0	6	0	137	0	0	0	2	0	0	0	0	0	145	23	27	50	195
	1995	0	0	0	75	200	0	0	0	0	0	0	0	75	350	0	0	0	350
	1997	0	0	0	0	0	0	0	0	0	70	5	0	2	77	22	2	24	101
	1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1999	75	1,900	0	54	0	0	100	276	55	0	116	0	119	2,695	0	148	148	2,843
	2000	0	28	0	5	168	0	24	0	0	0	0	0	40	265	3	260	263	528
	2001	0	0	0	0	0	0	30	314	5	0	1,013	42	73	1,477	0	53	53	1,530
	2002	0	952	83	121	28	5	114	354	0	2	3,045	8	135	4,847	20	162	182	5,029
Total Scoters																			
	1991	976	725	92	32,228	1,652	10	14	11,654	47	80	3,675	3	972	52,128	87	721	808	52,936
	1992	44	981	144	3,159	1,847	0	223	3,252	4	58	2,673	0	689	13,074	219	1,602	1,821	14,895
	1994	2	173	197	2,141	1,865	49	36	1,676	0	87	952	81	957	8,216	48	1,036	1,084	9,300
	1995	1	1,207	1,149	5,483	2,843	286	115	2,440	47	57	1,735	316	1,654	17,333	1,683	1,929	3,612	20,945
	1997	50	87	1,243	15,423	214	14	39	2,889	63	97	778	0	408	21,305	36	2,007	2,043	23,348
	1998	25	981	135	21,540	2,310	11	549	6,750	55	804	1,578	84	4,072	38,894	102	903	1,005	39,899
	1999	625	2,118	136	1,925	1,197	25	697	7,176	89	357	1,585	74	777	16,781	100	2,517	2,617	19,398
	2000	288	163	833	5,166	1,368	1,371	2,879	852	1	1,248	9,184	125	1,658	25,136	53	2,520	2,573	27,709
	2001	7	4	453	2,580	2,060	51	543	8,848	101	20	2,144	115	832	17,758	249	2,943	3,192	20,950
	2002	0	952	95	2,356	206	6	5,155	3,654	0	36	7,737	149	761	21,107	360	2,737	3,097	24,204

Table 20. Waterfowl season lengths and bag limits in Maine, 1933-2003.

	Season Length (Days)[7]					Bag Limit[12]										
Year	Regular Duck Early	Regular Duck Late	Black Duck	Sea Duck	Canada Goose[6]	Regular Duck[9]	Black Duck	Wood Duck	Mergan-sers[10]	Mallard[11]	Teal	Scaup	Sea Duck	Canada Goose[6]	Duck Opening[4]	Shooting hours
1933	105		105		105	15	15	0		15				4		½ S-S'
1934	30		30		30	15	15	0		15				4		
1935	30		30		30	10	10	0		10				4		7am-4pm
1936	30		30		30	10	10	0		10				4		7am-4pm
1937	30		30		30	10	10	0		10				4	10 Oct	7am-4pm
1938	45		45	16	45	10	10	0		10			10			
1939	45		45	16	45	10	10	0		10			10			
1940	60		60	16	60	10	10	0		10			10			S-4pm
1941	60		60	16	60	10	10	1		10			10			
1942	70		70	16	70	10	10	1		10			10	2	26 Sep	S-S'
1943	70		70	16	70	10	10	1		10			10			½ S-S'
1944	80		80	16	80	10	10	1		10+5			10	2	20 Sep	½ S-S'
1945	80		80	16	80	10	10	1		10			10			
1946	45		45	16	45	7	7	1		7			10			½ S- ½ S'
1947	30		30	72	30	4	4	1		4			7			½ S – 1S'
1948	12	12	24	72	24	4	4	1		4			7	2	8 Oct (N)	½ S – 1S'
1949	16	16	32	72	32	4	4	1		4			7	2	7 Oct (N)	½ S – 1S'
1950	16	16	32	72	32	4	4	1		4			7	2	6 Oct (N)	½ S – 1S'
1951	18	18	36	72	36	4	4	1		4			7	2	5 Oct (N)	½ S – 1S'
1952	22	22	44	72	44	4	4	1		4			7	2	1 Oct (N)	½ S – 1S'
1953	60	0	60	107	60	4	4	1	4 (1)	4			7	2	9 Oct (N)	½ S-S'
1954	27	27	54	107	54	4	4	1	4 (4)	4		+4	7	2	4 Oct (N)	½ S-S'
1955	70	0	70	107	70	4	4	1	4 (1)	4			7	2	7 Oct (½)	½ S-S'
1956	70	0	70	107	70	4	4	1	4 (1)	4			7	2	5 Oct (½)	½ S-S'
1957	70	0	70	107	70	4	4	1	5 (1)	4			7	2	4 Oct (N)	½ S-S'
1958	60	0	60	107	60	4	4	1	5 (1)	4			7	2	10 Oct(½)	½ S-S'
1959	30	15	45	107	60	3	3	2	5 (1)	3			7	2	9 Oct (N)	½ S-S'
1960	23	22	45	107	60	3	3	2	5 (1)	3			7	2	7 Oct (N)	½ S-S'
1961	9	36	45	107	60	2	2	2	5 (1)	2			7	2	13 Oct (N)	½ S-S'
1962	23	22	45	107	60	2	2	2	5 (1)	2		+2	7	2	12 Oct (N)	½ S-S'
1963	22	23	45	107	70	3	2	2	5 (1)	3		+2	7	2	5 Oct (N)	½ S-S'
1964	22	23	45	107	70	3	3	2	5 (1)	3		+2	7	2	3 Oct (S)	½ S-S'
1965	22	23	45	107	70	3	3	2	5 (1)	3		+2	7	2	9 Oct (S)	½ S-S'
1966	55	0	55,25	107	70	3	3	2	5 (1)	3		+2	7	2	8 Oct (½)	½ S-S'
1967	36	9	45,14	107	70	3	3	2	5 (1)	3		+2	7	2	7 Oct (½)	½ S-S'
1968	22	23	45	107	70	3	2	2	5 (1)	3		+2	7	2	5 Oct (½)	½ S-S'
1969	22	23	45	107	77	3	2	2	5 (1)	3		+2	7	3	4 Oct (½)	½ S-S'
1970	22	23	45	107	70	4	2	2	5 (1)	4	ETS[8]	+2	7	3	3 Oct (½)	½ S-S'

Table 20. Waterfowl season lengths and bag limits in Maine, 1933-2003.

	Season Length (Days)[7]					Bag Limit[12]										
	Regular Duck		Black	Sea	Canada	Regular	Black	Wood	Mergan	Mallard	Teal	Scaup	Sea	Canada	Duck	Shooting
Year	Early	Late	Duck	Duck	Goose[6]	Duck[9]	Duck	Duck	-sers[10]	[11]			Duck	Goose[6]	Opening[4]	hours
1971	30	20	50	107	70	4	2	2	5 (1)	4	ETS[8]	+2	7	3	15 Oct(½)	½ S-S'
1972	23	27	50	107	69	4	2	2	5 (1)	4	ETS[8]	+2	7	3	9 Oct (N)	½ S-S'
1973	13	37	50	107	70	4	2	2	5 (1)	4		+2	7	3	1 Oct (N)	½ S-S'
1974	18	32	50	107	70	4	2	2	5 (1)	4		+2	7	3	2 Oct (N)	½ S-S'
1975	25	25	47	107	70	4	2	2	5 (1)	4	+2	+2	7	3	8 Oct (N)	½ S-S'
1976	18	32	50	107	70	4	2	2	5 (1)	4	+2	+2	7	3	6 Oct (N)	½ S-S'
1977[1] S	18	32	50	107	70	4	2	2	5 (1)	4	+2	+2	7	3	5 Oct (N)	½ S-S'
N	50	0	50												1 Oct (S)	½ S-S'
1978[1] S	20	30	50	107	70	4	2	2	5 (1)	4	+2	+2	7	3	2 Oct (S)	½ S-S'
N	50	0	50												2 Oct (S)	½ S-S'
1979[1] S	20	30	50	107	70	4	2	2	5 (1)	4	+2	+2	7	3	1 Oct (N)	½ S-S'
N	50	0	50												1 Oct (½)	½ S-S'
1980[1] S	18	32	50	107	70	4	2	2	5 (1)	4	+2	+2	7	3	1 Oct (N)	½ S-S'
N	50	0	50												1 Oct (½)	½ S-S'
1981[2] S	17	33	50	107	70	4	2	2	5 (1)	4	+2	+2	7	3	1 Oct (½)	½ S-S'
N	50	0	50												1 Oct (½)	½ S-S'
1982[2] S	16	34	34	107	70	4	2	2	5 (1)	4	+2	+2	7	3	1 Oct (½)	½ S-S'
N	50	0	50			4	1								1 Oct (½)	½ S-S'
1983[2] S	15	34	34	107	70	5	1	2	5 (1)	5	+2	+5	7	3	1 Oct (½)	½ S-S'
N	50	0	36												1 Oct (½)	½ S-S'
1984[2] S	15	34	34	107	70	5	1	2	5 (1)	5	+2	+5	7	3	1 Oct (½)	½ S-S'
N	50	0	36												1 Oct (½)	½ S-S'
1985[3] S	15	25	25	107	70	5	1	2	5 (1)	5	+2	+5	7	3	5 Oct (½)	½ S-S'
N1	40	0	30												5 Oct (½)	½ S-S'
N2	40	0	15												5 Oct (½)	½ S-S'
1986[3] S	13	27	27	107	70	4	1	2	5 (1)	3 (1)	+2	+5	7	3	6 Oct (½)	½ S-S'
N1	40	0	30												6 Oct (½)	½ S-S'
N2	40	0	15												6 Oct (½)	½ S-S'
1987 S	14	26	26	107	70	4	1	2	5 (1)	3 (1)	+2	+5	7	3	1 Oct (½)	½ S-S'
N1	40	0	25												1 Oct (½)	½ S-S'
N2	40	0	37												1 Oct (½)	½ S-S'
1988 S	13	17	30	107	70	3	1	2	5 (1)	3 (1)			7	3	10 Oct(½)	½ S-S'
N	20	10	30												10 Oct(½)	½ S-S'
1989[2] S	13	17	30	107	70	3	1	2	5 (1)	3 (1)			7	3	9 Oct (½)	½ S-S'
N	20	10	30												9 Oct (½)	½ S-S'
1990[2] S	13	17	30	107	70	3	1	2	5 (1)	3 (1)			7	3	8 Oct (½)	½ S-S'
N	20	10	30												8 Oct (½)	½ S-S'
1991[2] S	13	17	30	107	70	3	1	2	5 (1)	3 (1)			7	3	7 Oct (½)	½ S-S'
N	20	10	30												7 Oct (½)	½ S-S'

Table 20. Waterfowl season lengths and bag limits in Maine, 1933-2003.

	Season Length (Days)[7]					Bag Limit[12]										
	Regular Duck		Black	Sea	Canada	Regular	Black	Wood	Mergan	Mallard	Teal	Scaup	Sea	Canada	Duck	Shooting
Year	Early	Late	Duck	Duck	Goose[6]	Duck[9]	Duck	Duck	-sers[10]	[11]			Duck	Goose[6]	Opening[4]	hours
1992[2]S	13	17	30	107	15,55	3	1	2	5 (1)	3 (1)			7	1,2	5 Oct (½)	½ S-S'
N	19	11	30												5 Oct (½)	½ S-S'
1993[2]S	13	17	30	107	15,55	3	1	2	5 (1)	3 (1)			7	1,2	4 Oct (½)	½ S-S'
N	20	10	30												4 Oct (½)	½ S-S'
1994[2]S	13	27	40	107	15,55	3	1	2	5 (1)	3 (1)			7	1,2	3 Oct (½)	½ S-S'
N	24	16	40												3 Oct (½)	½ S-S'
1995[2]S	13	37	37	107	0	4	1	2	5 (1)	4 (1)			7	-	2 Oct (½)	½ S-S'
N	24	16	40												2 Oct (½)	½ S-S'
1996[5]S	19	31	40	107	17,0	5	1	2	5 (1)	5 (1)			7	3,0	1 Oct (½)	½ S-S'
N	26	24	40												1 Oct (½)	½ S-S'
1997[5]S	18	28	36	96	16,0	4	1	2	5 (1)	4 (2)	+2		7	3,0	1 Oct (½)	½ S-S'
N	46	0	36												1 Oct (½)	½ S-S'
1998[5]S	15	36	43	96	16,40	4	1	2	5 (1)	4 (2)	+2		7	3,2	1 Oct (½)	½ S-S'
N	51	0	43												1 Oct (½)	½ S-S'
1999[5]S	14	36	43	96	16,40	4	1	2	5 (1)	4 (2)	+2	3	7	3,2	1 Oct (½)	½ S-S'
N	50	0	43												1 Oct (½)	½ S-S'
2000[5]S	12	42	49	96	18,40	4	1	2	5 (1)	4 (2)	+2	3	7	3,2	2 Oct (½)	½ S-S'
N	54	0	49												2 Oct (½)	½ S-S'
2001[5]S	18	42	55	96	19,45	4	1	2	5 (1)	4 (2)	+2	3	7	3,2	1 Oct (½)	½ S-S'
N	60	0	55												1 Oct (½)	½ S-S'
2002[5]S	17	43	56	96	20,60	4	1	2	5 (1)	4 (2)	+2	3	7	3,2	1 Oct (½)	½ S-S'
N	60	0	56												1 Oct (½)	½ S-S'
2003[5]S	16	44	57	106	21,60	4	1	2	5 (1)	4 (2)	+2	3	7	4,2	1 Oct (½)	½ S-S'
N	60	0	57												1 Oct (½)	½ S-S'

[1]Zoned Season: South (S) = Management Units 4, 5, 6, 7, and 8; North (N) = Management Units 1, 2, and 3.
[2]Zoned Season: South (S) = Management Units 6, 7, and 8; North (N) = Management Units 1, 2, 3, 4, and 5.
[3]Zoned Season: Similar to 2 above with N1 Black Duck Zone = Management Units 4 and 5; N2 Black Duck Zone = Management Units 1, 2, and 3.
[4]Time: N = noon; S = sunrise; and ½ = 30 minutes before sunrise.
[5] Zoned Season: Similar to 2 above, but based on Wildlife Management Districts (WMD); South (S) = WMDs 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, and 30; North (N) = WMDs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19.
[6] Early Canada goose season offered beginning 1996; season length for 1996-2003: (early season days + regular season days); bag limit for 1996-2003: (early season bag + regular season bag).
[7]Season lengths for 1953-1996 are inclusive of Sundays; season lengths after 1996 are exclusive of Sundays.
[8]Experimental teal season in September.
[9]Regular Duck bag is exclusive of mergansers, and exclusive of sea ducks in the sea duck zone.
[10] Merganser bag is aggregate for all 3 merganser species; limit for hooded merganser in parentheses.
[11] Limit for female mallard is in parentheses.
[12] "+" indicates number that may be taken in addition to regular bag limit, or "bonus birds".

Table 21. Comparison of 5-year mean and percent of duck harvests in Maine, 1961-2001.

	Dabbling Ducks		Diving Ducks		Sea Ducks		All Ducks Combined	
	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	[1]Harvest estimate	% of total duck kill
1961-65[2]	34,124	74%	5,930	13%	4,920	11%	45,980	100%
1966-70[2]	57,651	74%	6,840	9%	13,020	17%	78,360	100%
1971-75[2]	64,189	69%	9,740	11%	19,960	22%	92,360	100%
1976-80[2]	52,250	63%	14,940	18%	15,560	19%	83,360	100%
1981-85[2]	39,865	54%	14,080	19%	18,460	25%	73,180	100%
1986-90[2]	28,285	52%	9,740	18%	16,540	31%	54,200	100%
1991-95[2]	33,227	53%	8,651	14%	20,560	33%	62,520	100%
1996-2000[2]	40,210	59%	7,720	11%	21,080	31%	68,340	100%
2001	48,300	58%	11,700	14%	23,501	28%	82,700	100%

[1] harvest estimates of dabbling, diving, and sea ducks may not sum precisely to combined harvest due to rounding errors and exclusion of minor species among dabbling and diving duck estimates.
[2] data are annual averages for the 5-year period.

Table 22. Harvest estimates for the 8 most common dabbling duck species in Maine, 1961-2001.

	Black Duck		Mallard		Black Duck x Mallard Hybrid		Green-winged Teal		Blue-winged Teal		American Wigeon		Northern Pintail		Wood Duck	
	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill
1961-1965*	21,080	45.8	960	2.1	224	0.5	5,960	13.0	840	1.8	200	0.4	360	0.8	4,500	9.8
1966-1970*	32,060	40.9	2,360	3.0	376	0.5	12,000	15.3	4,460	5.7	175	0.2	680	0.9	5,500	7.0
1971-1975*	32,680	35.4	4,600	5.0	599	0.6	13,340	14.4	4,640	5.0	250	0.3	400	0.4	7,660	8.3
1976-1980*	23,580	28.3	5,040	6.0	450	0.5	9,620	11.5	2,740	3.3	400	0.5	480	0.6	9,880	11.9
1981-1985*	12,740	17.4	4,660	6.4	495	0.7	8,700	11.9	1,380	1.9	250	0.3	380	0.5	11,240	15.4
1986-1990*	8,280	15.3	4,700	8.7	205	0.4	7,120	13.1	640	1.2	160	0.3	300	0.6	6,840	12.6
1991-1995*	11,040	17.7	7,960	12.7	360	0.6	5,080	8.1	400	0.6	167	0.3	200	0.3	8,000	12.8
1996-2000*	8,780	12.8	10,450	15.3	760	1.1	10,240	15.0	760	1.1	260	0.4	320	0.5	8,640	12.6
2001	11,900	14.4	15,000	18.1	900	1.1	5,200	6.3	0	0.0	100	0.1	100	0.1	15,100	18.3

* mean annual estimates for the 5-year period.

Table 23. Harvest estimates for the 8 most common diving ducks in Maine, 1961-2001.

	Greater Scaup		Lesser Scaup		Ring-necked Duck		Common Goldeneye		Bufflehead		Common Merganser		Red-breasted Merganser		Hooded Merganser	
	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill
1961-1965*	125	0.3	60	0.1	950	2.1	2,240	4.9	1,780	3.9	120	0.3	160	0.3	475	1.0
1966-1970*	220	0.3	120	0.2	1,100	1.4	2,380	3.0	1,980	2.5	140	0.2	280	0.4	500	0.6
1971-1975*	200	0.2	160	0.2	2,620	2.8	2,040	2.2	3,340	3.6	260	0.3	240	0.3	840	0.9
1976-1980*	260	0.3	440	0.5	2,540	3.0	3,040	3.6	6,240	7.5	860	1.0	380	0.5	1,060	1.3
1981-1985*	220	0.3	200	0.3	3,220	4.4	4,040	5.5	4,340	5.9	320	0.4	420	0.6	1,260	1.7
1986-1990*	100	0.2	180	0.3	2,500	4.6	2,940	5.4	2,240	4.1	620	1.1	380	0.7	760	1.4
1991-1995*	60	0.1	120	0.2	1,680	2.7	1,720	2.8	3,100	5.0	640	1.0	360	0.6	960	1.5
1996-2000*	100	0.1	100	0.1	1,540	2.3	1,040	1.5	2,300	3.4	800	1.2	300	0.4	1,540	2.3
2001	0	0.0	0	0.0	1,100	1.3	1,800	2.2	4,100	5.0	1,400	1.7	200	0.2	3,100	3.7

* mean annual estimates for the 5-year period.

Table 24. Harvest estimates for sea ducks in Maine, 1961-2001.

	Common Eider		Long-tailed Duck[1]		White-winged Scoter		Surf Scoter		Black Scoter		Total Sea Ducks	
	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill	Harvest estimate	% of total duck kill
1961-65[2]	1,360	3.0	280	0.6	1,660	3.6	1,060	2.3	560	1.2	4,920	10.7
1966-70[2]	2,800	3.6	1,520	1.9	3,120	4.0	4,000	5.1	1,580	2.0	13,020	16.6
1971-75[2]	8,820	9.5	1,080	1.2	4,160	4.5	4,440	4.8	1,460	1.6	19,960	21.6
1976-80[2]	7,580	9.1	1,300	1.6	2,020	2.4	2,980	3.6	1,680	2.0	15,560	18.7
1981-85[2]	11,980	16.4	1,520	2.1	2,340	3.2	1,880	2.6	740	1.0	18,460	25.3
1986-90[2]	10,300	19.0	2,360	4.4	1,500	2.8	1,980	3.7	400	0.7	16,540	30.6
1991-95[2]	14,840	23.7	2,420	3.9	1,480	2.4	1,440	2.3	380	0.6	20,560	33.1
1996-2000[2]	15,420	22.6	1,220	1.8	900	1.3	3,000	4.4	540	0.8	21,080	30.9
2001	14,100	17.0	1,700	2.1	1,900	2.3	1,900	2.3	1,900	2.3	23,501	26.0

* mean annual estimates for the 5-year period.

Table 25. Estimated harvests of Canada geese, snow geese, and brant during early (September) and regular hunting seasons in Maine, 1962-2001.

Year	[1] Canada Geese September	Canada Geese Regular	Canada Geese Total	Snow Geese	Brant	Geese Total
1962-65[2]	---	550	550	0	0	550
1966-70[2]	---	980	980	0	0	980
1971-75[2]	---	2,260	2,260	0	0	2,260
1976-80[2]	---	1,840	1,840	20	0	1,860
1981-85[2]	---	1,560	1,560	0	0	1,560
1986-90[2]	---	2,320	2,320	60	0	2,380
1991-95[2]	---	1,940	1,940	0	0	1,940
1996	1,100	---	1,100	0	0	1,100
1997	1,900	---	1,900	0	0	1,900
1998	3,000	3,700	6,700	500	0	7,200
1999	4,800	7,800	12,600	0	0	12,600
2000	4,800	4,800	9,600	500	0	10,100
2001	3,800	5,500	9,300	[3]TR	100	9,400
1998-2001[2]	4,100	5,450	9,550	250	25	9,825

[1] September Canada goose seasons in Maine began in 1996.
[2] data are annual averages for the period indicated.
[3] TRace = Fewer than 50 in one year.

Table 26. Estimates of dabbling and diving duck harvest and hunting activity in Maine during 2001-2002 based on the Harvest Information Program.

	2001	2002 (preliminary)
Black Duck	5,868	9,717
Mallard	7,839	15,744
Domestic Mallard	188	0
Mallard x Black Duck Hybrid	422	861
Green-winged Teal	2,723	9,287
Blue-winged Teal	469	185
Northern Shoveler	0	62
Northern Pintail	94	554
Wigeon	47	185
Wood Duck	7,323	7,319
Greater Scaup	0	123
Lesser Scaup	0	123
Ring-necked Duck	610	1,845
Bufflehead	1,925	1,661
Goldeneyes	704	431
Hooded Merganser	1,643	1,415
Other Mergansers	845	1,292
Total dabbling and diving duck harvest	30,512	51,804
Total active adult duck hunters (not including sea duck hunters)	6,500 +/-26%	6,300 +/-25%
Total duck hunter days afield (not including sea duck hunters)	33,500 +/-29%	38,700 +/-29%
Seasonal dabbling and duck harvest per hunter	4.7 +/-40%	8.1 +/-41%

Table 27. Estimates of goose harvest and hunting activity in Maine during 2001-2002 based on the Harvest Information Program.

	2001	2002 (preliminary)
Canada Goose	5,165	12,800
Snow Goose	35	0
Total goose harvest	5,200 +/-52%	12,800 +/-41%
Total active adult goose hunters	3,900 +/-35%	4,500 +/-31%
Total goose hunter days afield	17,200 +/-46%	19,800 +/-42%
Seasonal goose harvest per hunter	1.3 +/-62%	2.8 +/-52%

Table 28. Estimates of sea duck harvest and hunting activity in Maine during 2001-2002 based on the Harvest Information Program.

	2001	2002 (preliminary)
Common Eider	17,257	20,600
Long-tailed Duck	1,371	2,800
Scoter species	5,371	6,400
Total sea duck harvest	24,000 +/-62%	29,800 +/-107%
Total active adult sea duck hunters	2,600 +/-44%	3,000 +/-47%
Sea duck hunter days afield	11,400 +/-67%	17,000 +/-83%
Seasonal sea duck harvest per hunter	9 +/-76%	10 +/-117%

Table 29. County-level average annual harvests of geese in Maine during 1991-2000.

County	Canada Goose	Snow Goose	Total
Aroostook	920	45	965
Knox	437		437
Waldo	425		425
Penobscot	405		405
Somerset	374		374
Sagadahoc	270	22	292
Oxford	250	11	261
Franklin	222	22	244
Lincoln	213		213
Cumberland	152	5	157
Kennebec	130		130
Androscoggin	127		127
York	98	3	101
Washington	91		91
Piscataquis	71		71
Hancock	4		4
Total	4,189	108	4,297

Table 30. Estimates of regular-season black duck harvests in Maine and the Atlantic Flyway, with comparisons relative to the black duck harvest-reduction program.

	Black Duck Hunter Kill - Maine	Percent change from 77-81 average	Black Duck Hunter Kill - Atlantic Flyway	Percent change from 1977-81 average
1977-81 average	20,820		245,640	
1982	15,100	-27%	186,700	-24%
1983	10,300	-51%	139,100	-43%
1984	7,000	-66%	147,800	-40%
1985	10,500	-50%	148,100	-40%
1986	6,700	-68%	140,700	-43%
1987	5,900	-72%	135,400	-45%
1988	10,700	-49%	124,600	-49%
1989	10,000	-52%	148,800	-39%
1990	8,100	-61%	110,600	-55%
1991	13,700	-34%	126,400	-49%
1992	9,100	-56%	97,700	-60%
1993	9,900	-52%	105,400	-57%
1994	11,400	-45%	101,600	-59%
1995	11,100	-47%	126,500	-49%
1996	7,800	-63%	84,000	-66%
1997	9,400	-55%	110,200	-55%
1998	9,500	-54%	119,600	-51%
1999	10,400	-50%	111,400	-55%
2000	6,800	-67%	127,500	-48%
2001	11,900	-43%	107,600	-56%
1983-2001 average	9,484	-54%	121,737	-50%

Table 31. County-level average annual harvests of dabbling ducks in Maine during 1981-1990.

County	Mallard	Mallard xBlack Duck Hybrid	Mallard - hand-reared	Black Duck	Gadwall	American Wigeon	Green-winged Teal	Blue-winged Teal	Northern Shoveler	Northern Pintail	Wood Duck	Miscellaneous Hybrids	Total
Sagadahoc	419	33	5	1,173		28	1,472	117		41	512		3,800
Cumberland	669	59	6	1,500	5	9	684	26	6	6	685		3,655
Washington	101	45	10	1,485	9	8	1,498	136		69	149		3,510
Penobscot	225	15		541	8	58	509	164		41	1,417		2,978
York	683	44	16	885			311	189		20	763		2,911
Kennebec	588	44	21	280	5		599	55		38	884		2,514
Lincoln	163	8		764		14	442	77		12	783		2,263
Aroostook	259	32		783		3	581	32		28	246		1,964
Androscoggin	470		3	344		6	403	101		10	600		1,937
Hancock	38	2		882		15	535	43		15	146		1,676
Oxford	275	17	10	351		6	123	3		15	849		1,649
Somerset	164	12		346		9	305	44		30	588		1,498
Waldo	145	6	4	409		2	139	16	2		636		1,359
Knox	292	19	21	315			42	5		6	416		1,116
Piscataquis	14			121		4	69			2	165		375
Franklin	51	6		141			48	6			85		337
Total	4,556	342	96	10,320	27	162	7,760	1,014	8	333	8,924		33,542

Table 32. County-level average annual harvests of dabbling ducks in Maine during 1991-2000.

County	Mallard	Mallard xBlack Duck Hybrid	Mallard - hand-reared	Black Duck	Gadwall	American Wigeon	Green-winged Teal	Blue-winged Teal	Northern Shoveler	Northern Pintail	Wood Duck	Miscellaneous Hybrids	Total
Sagadahoc	1,142	75	23	1,491		29	2,808	95	12	85	232		5,992
Washington	180	65	2	1,424		7	1,491	64		34	435		3,702
Cumberland	1,425	109	18	1,085		6	308	94		48	387		3,480
Kennebec	1,009	73	9	488		19	417	57		12	931		3,015
Penobscot	545	9	5	625		12	431	36	5		1,080		2,748
Lincoln	470	32		1,140		5	243	37		7	813		2,747
York	826	28	21	741	7	5	127	24			939		2,718
Oxford	595			235			163				1,326	5	2,319
Aroostook	418	38	4	307		50	730	38	22	26	132		1,765
Hancock	128	24	15	732			433	42		16	171		1,561
Somerset	451	31	3	307		22	97	33		17	573		1,534
Androscoggin	713	25	15	279		20	122	15		5	246		1,440
Knox	275	36		468			39	4		5	249		1,076
Waldo	202	11		424		8	89	7		7	316		1,064
Franklin	306	8		69			62	15			330		790
Piscataquis	54			106			106	6			169		441
Total	8,739	564	115	9,921	7	183	7,666	567	39	262	8,329		36,392

Table 33. County-level average annual harvests of diving ducks in Maine during 1981-1990.

County	Redhead	Greater Scaup	Lesser Scaup	Ring-necked Duck	Common Goldeneye	Barrow's Goldeneye	Bufflehead	Ruddy Duck	Hooded Merganser	Red-breasted Merganser	Common Merganser	Total
Hancock		47	6	100	555	6	887		95	36	14	1,746
Washington				129	534	35	721	6	116	46	15	1,602
Penobscot		3	22	373	872	30	41		143		42	1,526
Lincoln			22	354	356	10	359	9	43	36	5	1,194
Somerset		15	31	542	150			14	64	11	26	853
Cumberland		25	21	93	208		370		17	104	11	849
Waldo		13		233	129		270		17	59	76	797
Knox				14	199		248		78		7	546
Kennebec		10	15	199	166				69		35	494
York		6	6	22	28		256		34	74	11	437
Oxford				159	34		6		95	11	126	431
Piscataquis			10	213	7				49		59	338
Aroostook		13	26	187	18		8	4	30		31	317
Sagadahoc		9		27	137	13	88	3	4	8	7	296
Franklin				73	36				74		12	195
Androscoggin			9	20	29		26		29		78	191
Total	-	141	168	2,738	3,458	94	3,280	36	957	385	555	11,812

Table 34. County-level average annual harvests of diving ducks in Maine during 1991-2000.

County	Redhead	Greater Scaup	Lesser Scaup	Ring-necked Duck	Common Goldeneye	Barrow's Goldeneye	Bufflehead	Ruddy Duck	Hooded Merganser	Red-breasted Merganser	Common Merganser	Total
Washington		18	4	134	178		1,007		99	32	60	1,532
Hancock			6	71	213		607		98	76	27	1,098
Penobscot		10	12	218	387	5	28		195		60	915
Lincoln			5	20	131		321		110	118	7	712
Kennebec			6	309	69	5	34		189	5	55	672
Somerset		19	34	289	26		29		77		99	573
Cumberland		6	4	6	128	10	122		107	61	31	475
Aroostook	3		8	230	13				122		91	467
Sagadahoc		9		63	33	5	89		73	6	69	347
Knox				8	95		177		28	13	8	329
Waldo		5	10	11	62	9	123	6	25		53	304
York		11		26	33		163		28	5	11	277
Piscataquis			18	93	5		5		42	5	44	212
Franklin				79	5				12		19	115
Androscoggin				16					26		56	98
Oxford			14	25					21		22	82
Total	3	78	121	1,598	1,378	34	2,705	6	1,252	321	712	8,208

Table 35. County-level average annual harvests of sea ducks in Maine during 1981-1990.

County	Common Eider	King Eider	Long-tailed Duck	Black Scoter	White-winged Scoter	Surf Scoter	Total
Cumberland	5,173		352	120	359	240	6,244
Hancock	3,060		387	24	876	354	4,701
Sagadahoc	913		110	113	297	257	1,690
Lincoln	596		55	43	46	290	1,030
Knox	445		327	7	29	175	983
York	207		170	50	122	164	713
Washington	296		163	37	48	116	660
Waldo	24		209	24		98	355
Penobscot	199		14	15	66	28	322
Somerset			10	94		17	121
Aroostook			45			75	120
Franklin				20	10	52	82
Piscataquis					10	20	30
Androscoggin				14		10	24
Kennebec			14			10	24
Oxford							-
Total	10,913	-	1,856	561	1,863	1,906	17,099

Table 36. County-level average annual harvests of sea ducks in Maine during 1991-2000.

County	Common Eider	King Eider	Long-tailed Duck	Black Scoter	White-winged Scoter	Surf Scoter	Total
Hancock	7,504		316	104	725	343	8,992
Cumberland	2,448		347	87	85	224	3,191
Washington	966		312	155	173	936	2,542
Knox	1,881		122	30	80	373	2,486
Lincoln	1,365	7	527		46	187	2,132
Sagadahoc	217		127	18	58	33	453
York	288		20	38	8	79	433
Waldo	289		52			22	363
Penobscot	126		10		6	21	163
Kennebec	29			8		6	43
Somerset				8			8
Aroostook				6			6
Androscoggin							0
Franklin							0
Oxford							0
Piscataquis							0
							0
Total	15,113	7	1,833	454	1,181	2,224	20,812

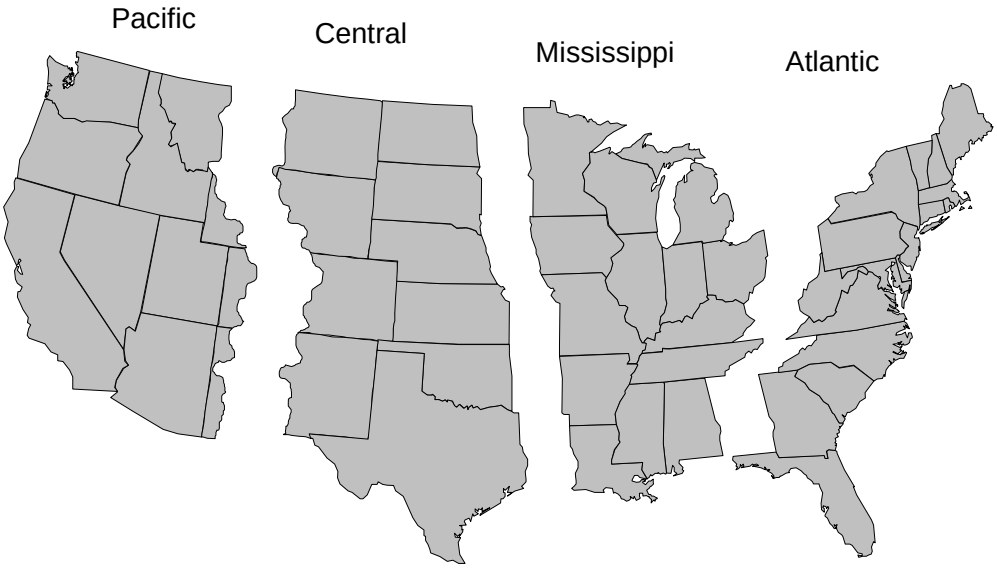

Figure 1. Administrative Flyways used for waterfowl management in the contiguous United States.

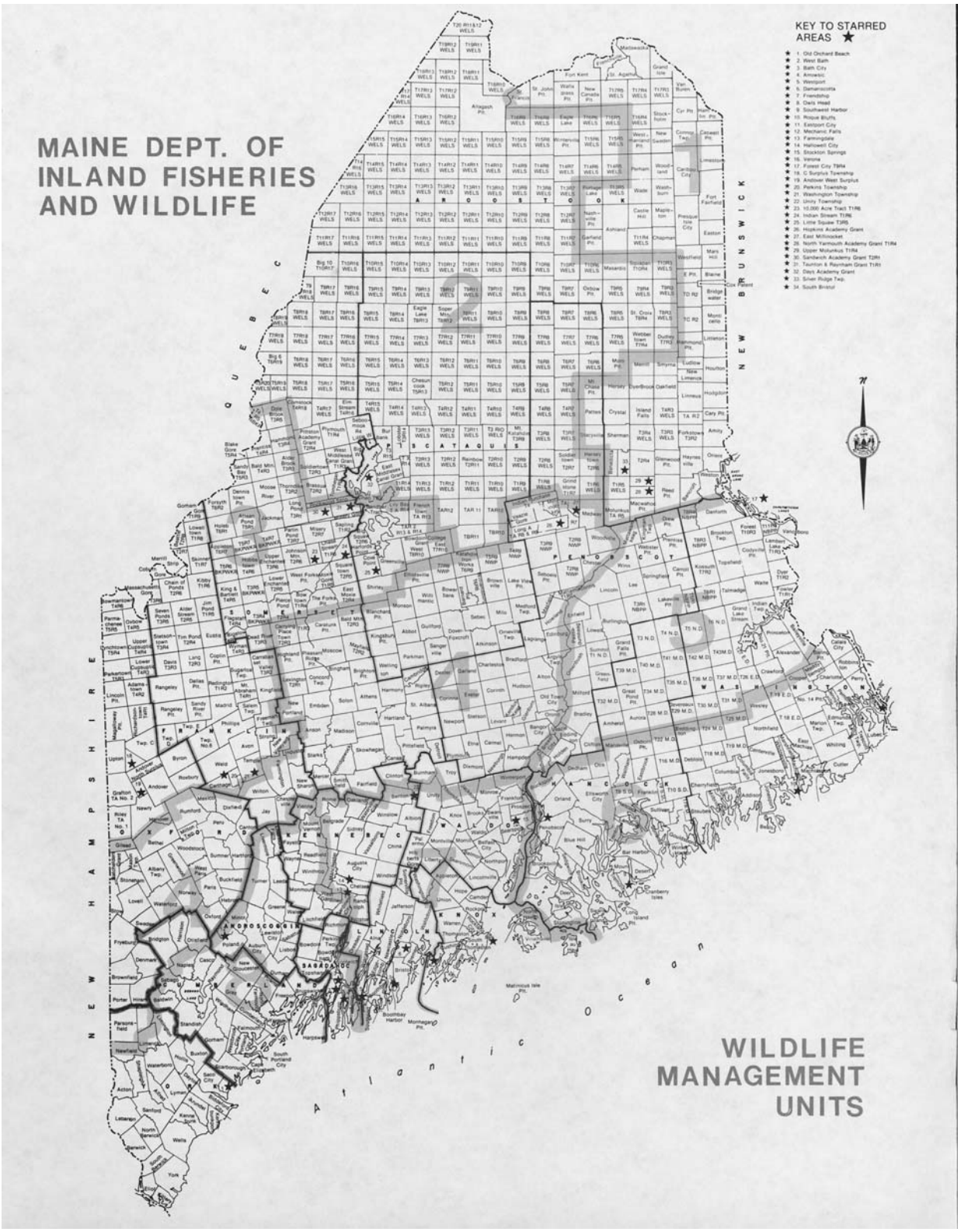

Figure 2. Maine's Wildlife Management Units.

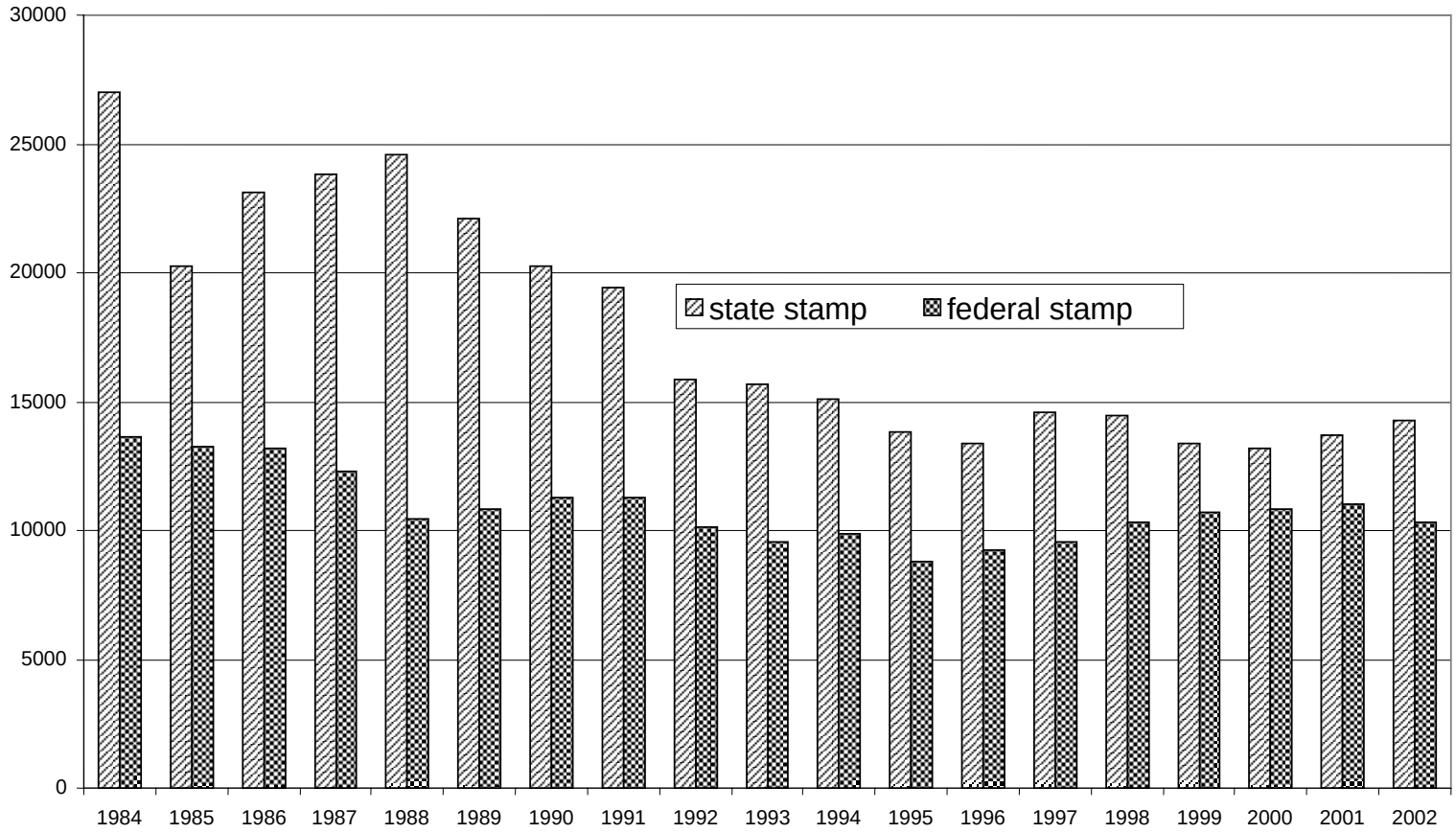

Figure 3. Sales of state and federal waterfowl conservation stamps in Maine during

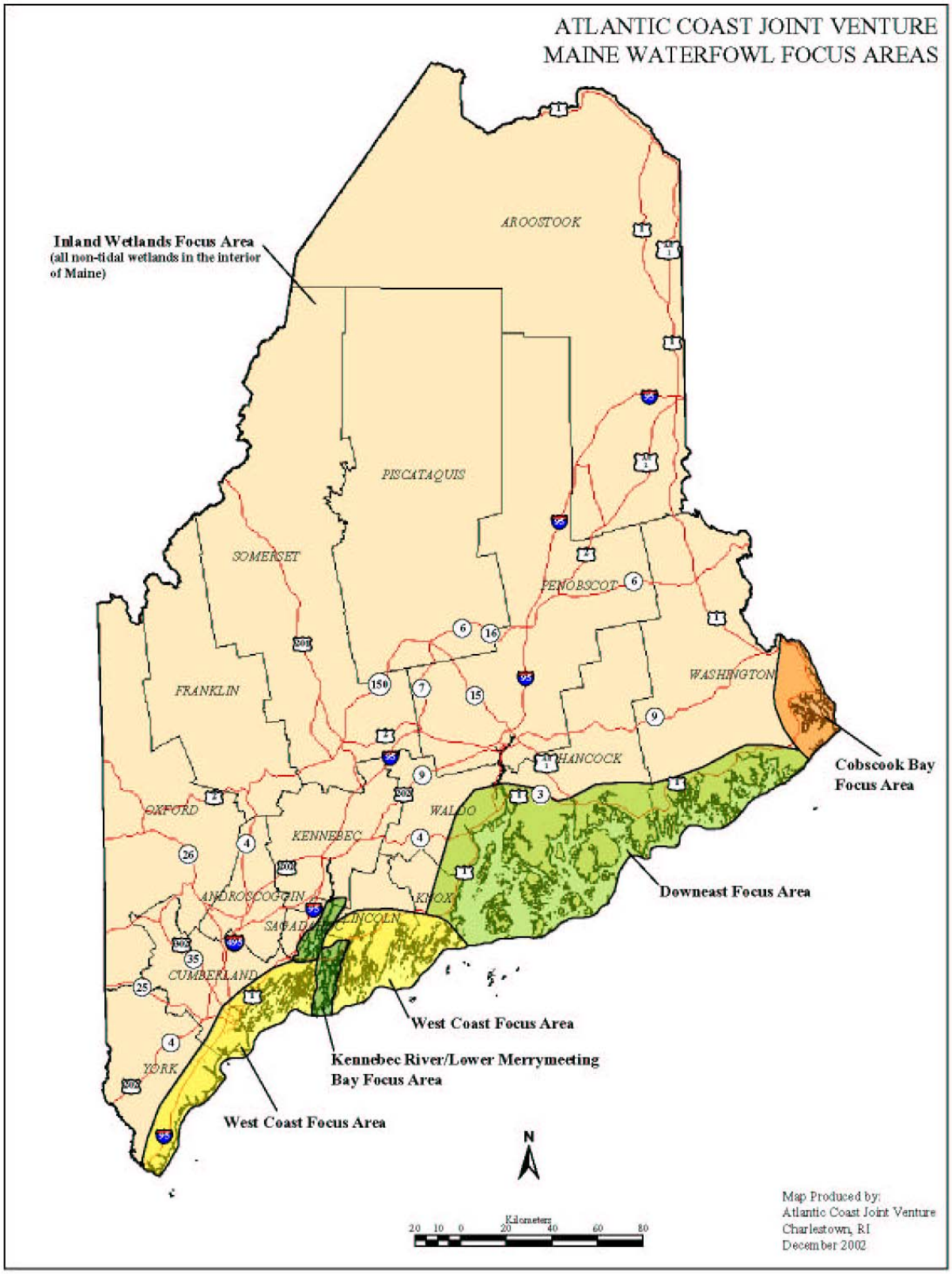

Figure 4. Atlantic Coast Joint Venture Waterfowl Focus Areas in Maine.

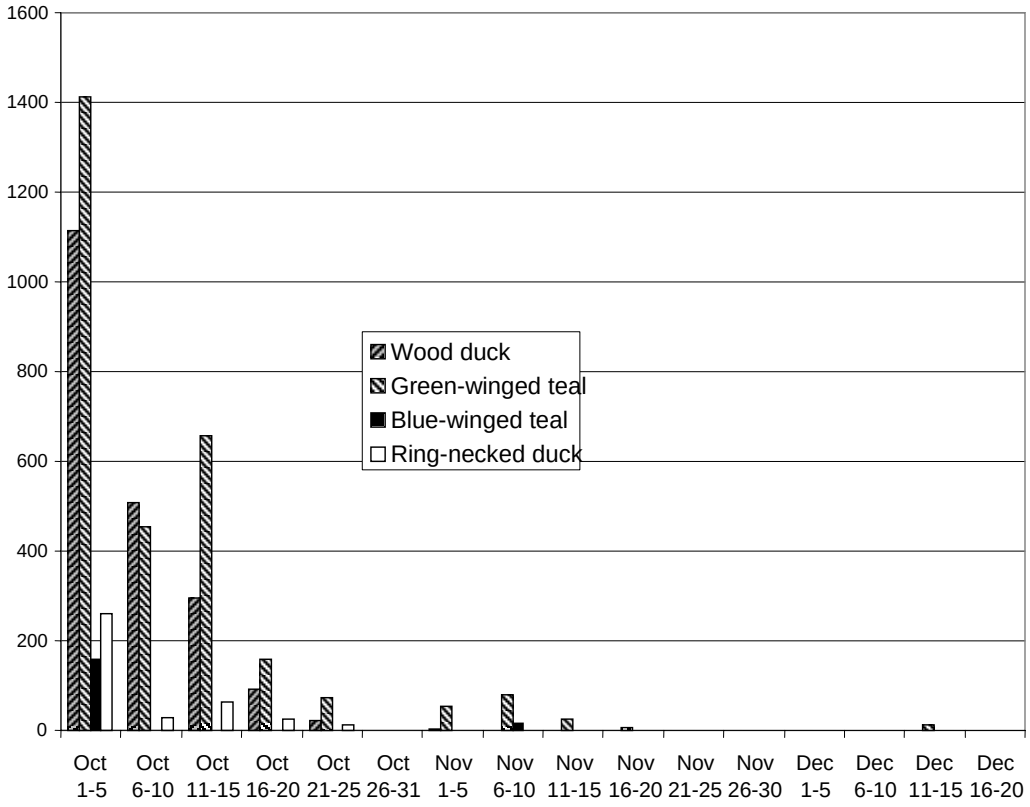

Figure 5. Average daily harvests of wood duck, green-winged teal, blue-winged teal, and ring-necked duck by 5-day increments during 1998 and 1999 regular duck seasons in Maine.

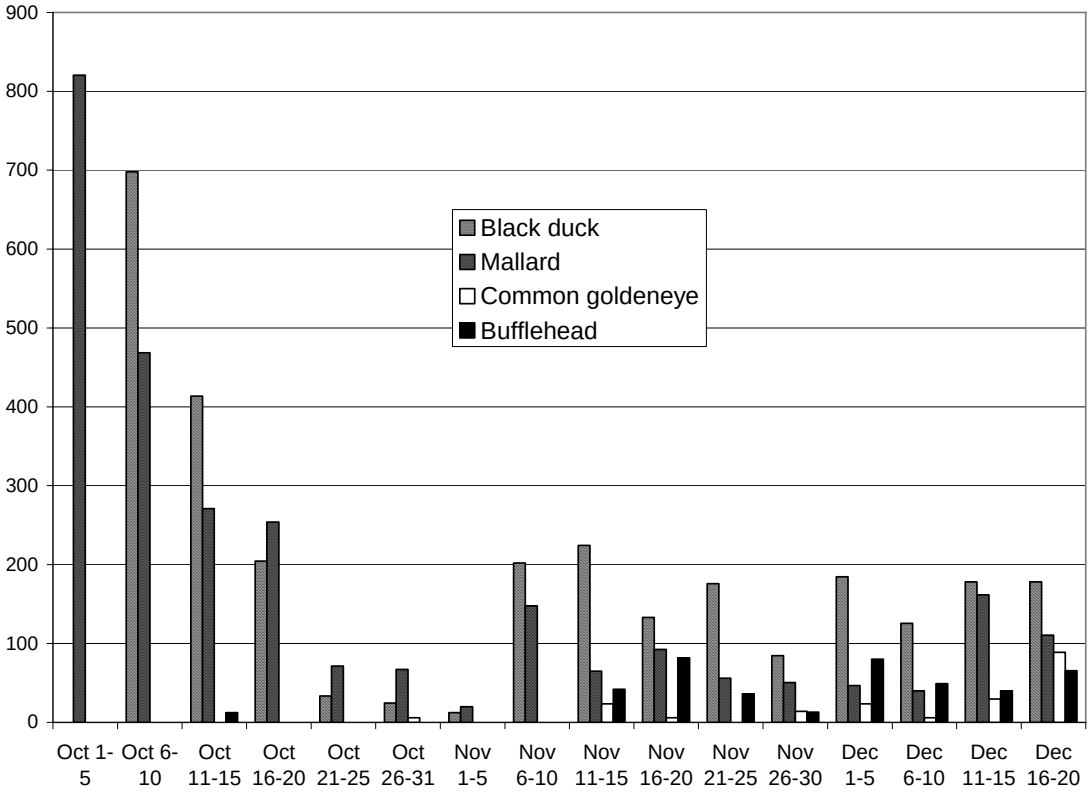

Figure 6. Average daily harvests of black duck, mallard, common goldeneye, and bufflehead by 5-day increments during 1998 and 1999 regular duck seasons in Maine.

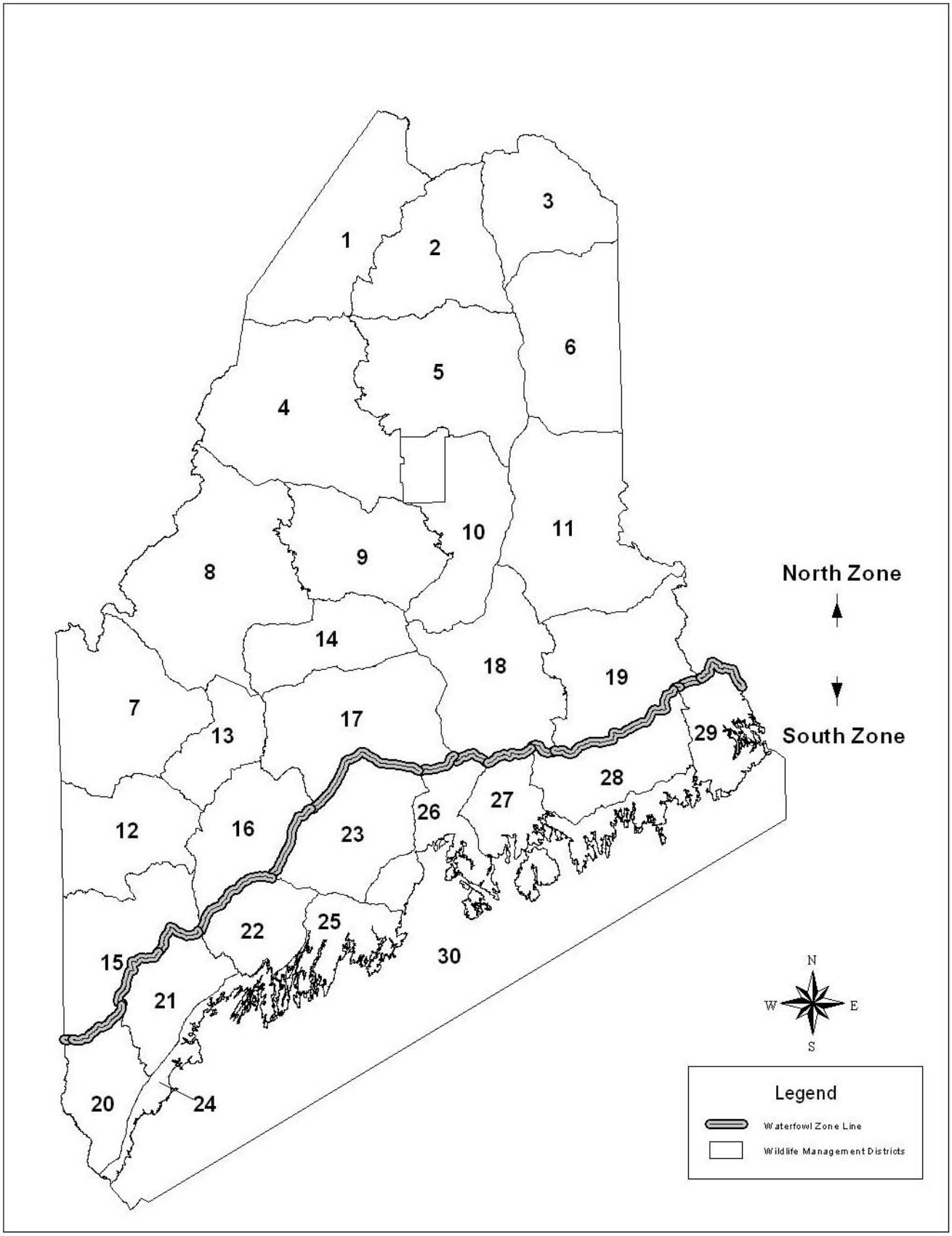

Figure 7. Maine waterfowl hunting zones.

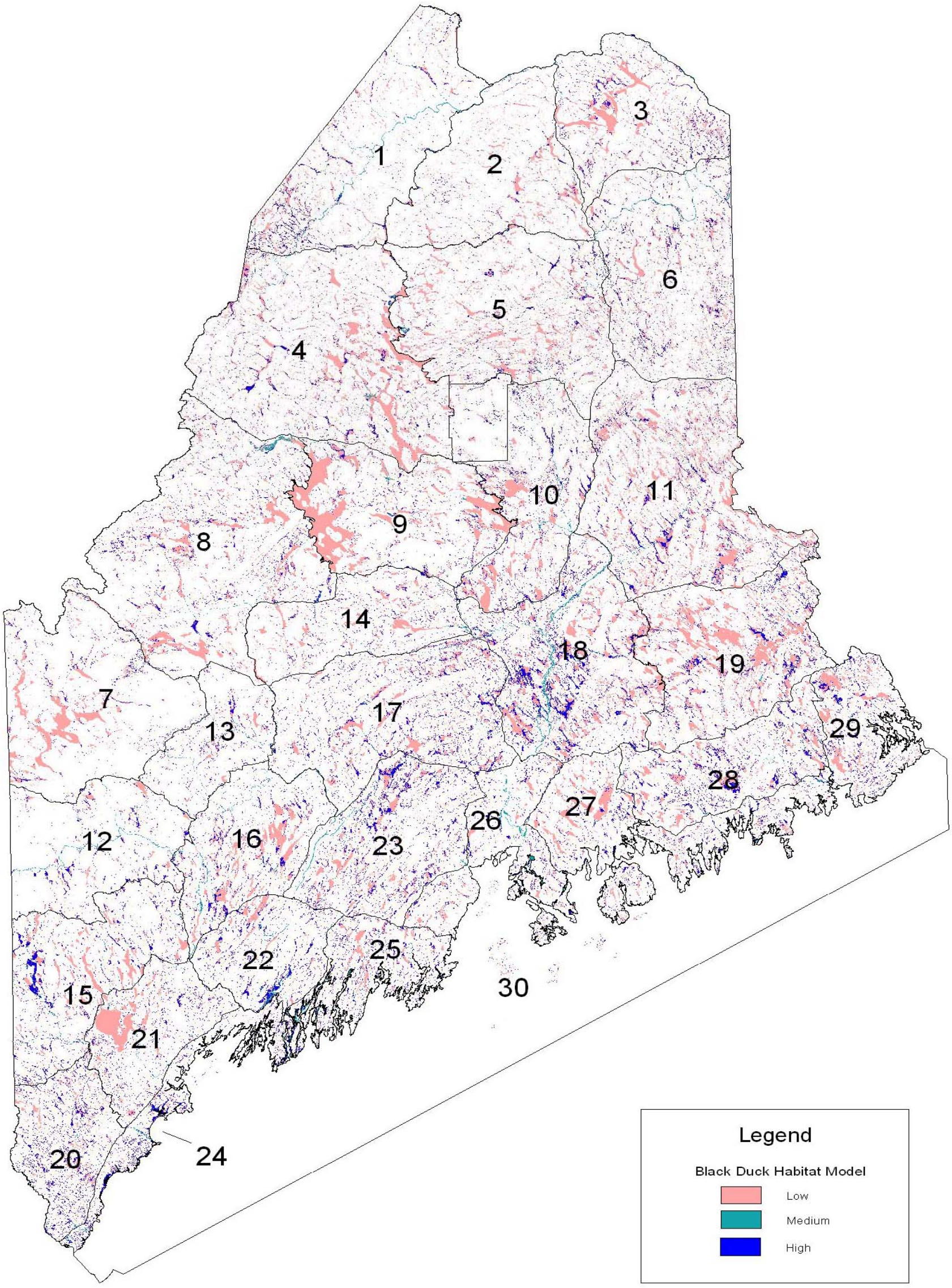

Figure 8. Breeding, migration, and wintering habitat for American black ducks (Anas rubripes) in Maine.

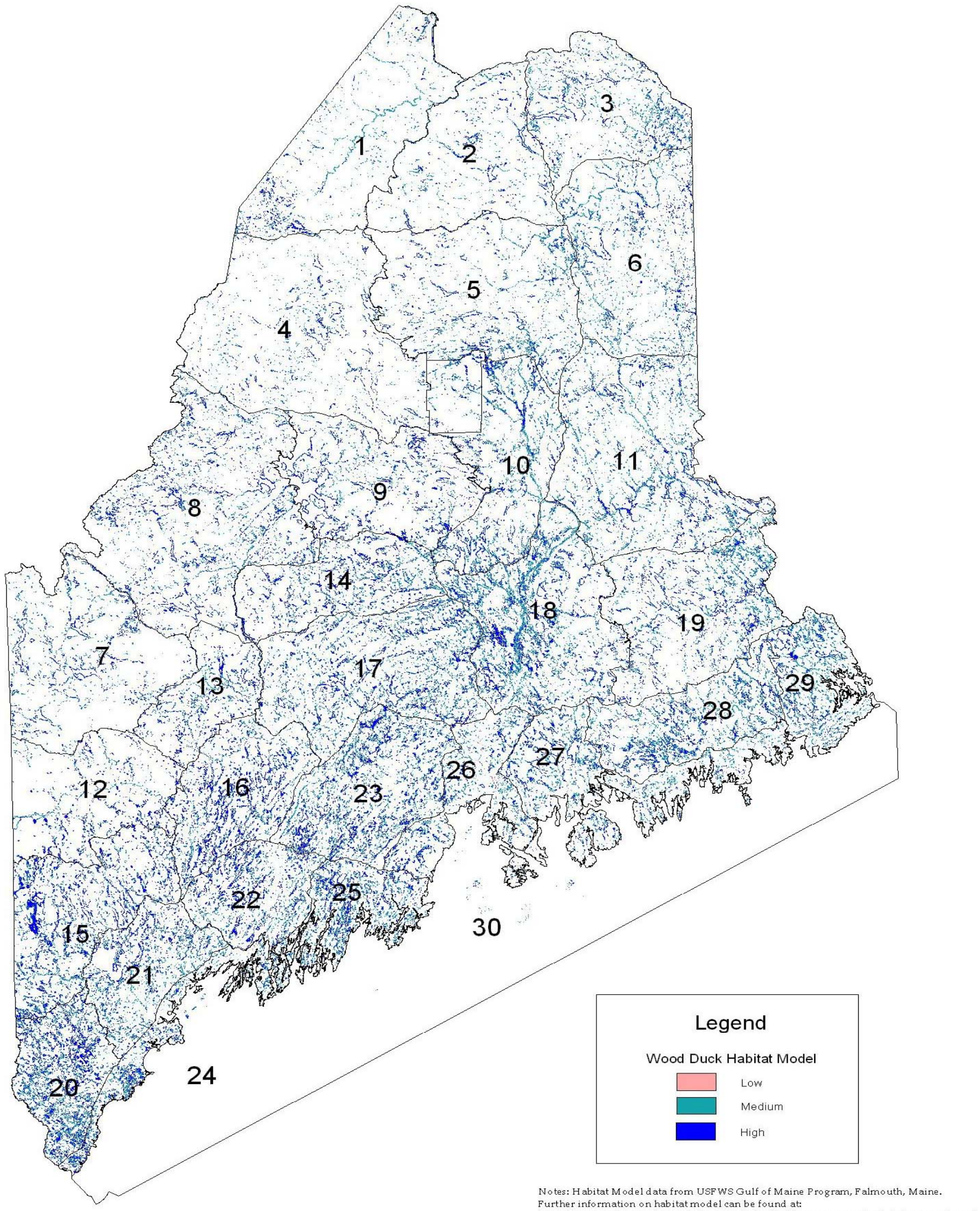

Figure 9. Breeding habitat for wood ducks (Aix sponsa) in Maine.

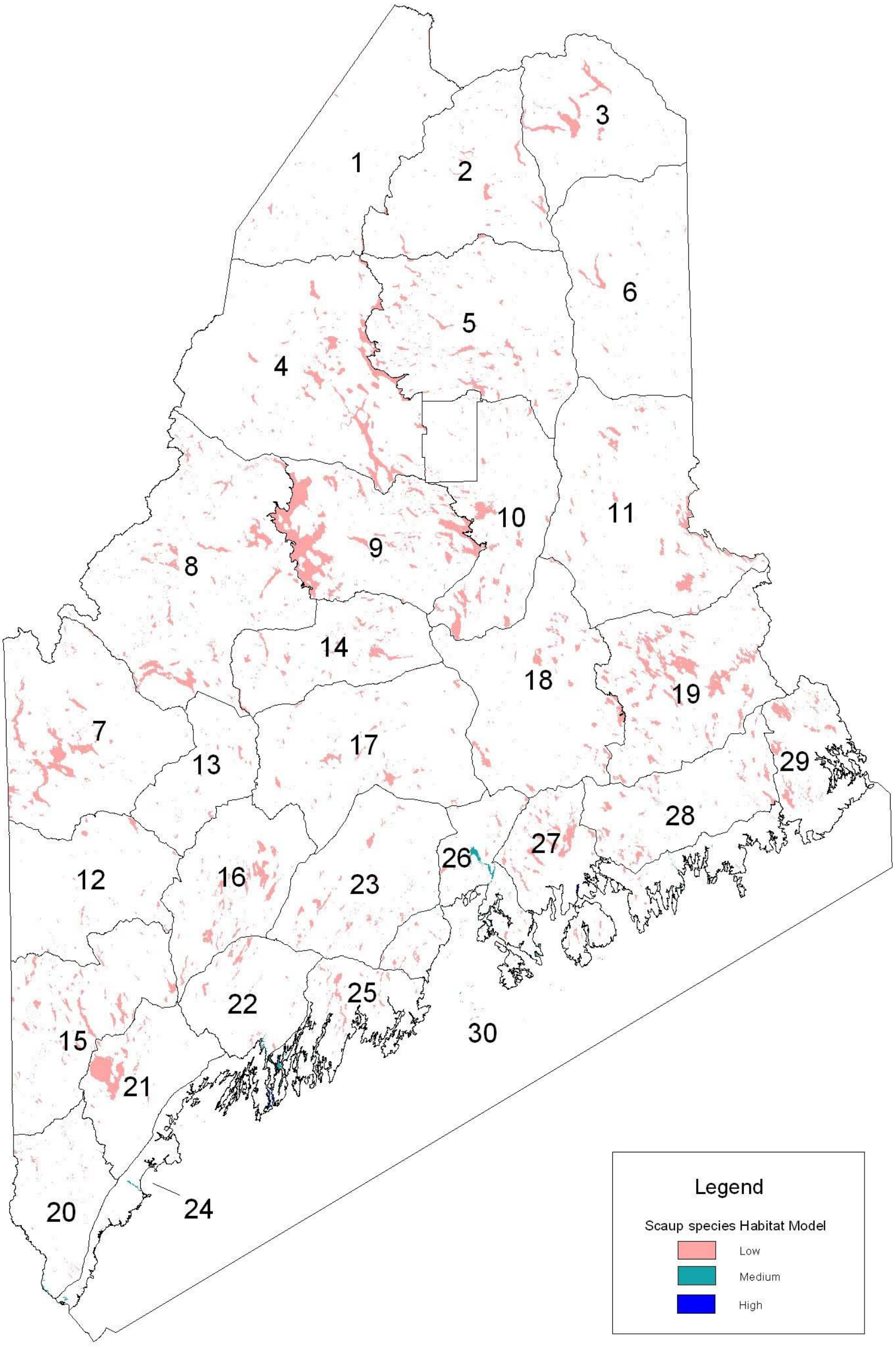

Figure 10. Migration and Wintering habitat for Scaup (Aythya spp.) in Maine. Note: Based on habitat suitability model by Arnold Banner and Sue Schaller, USFWS Gulf of Maine Program, 4R Fundy Road, Falmouth, Maine, 04105. http://gulfofmaine.fws.gov

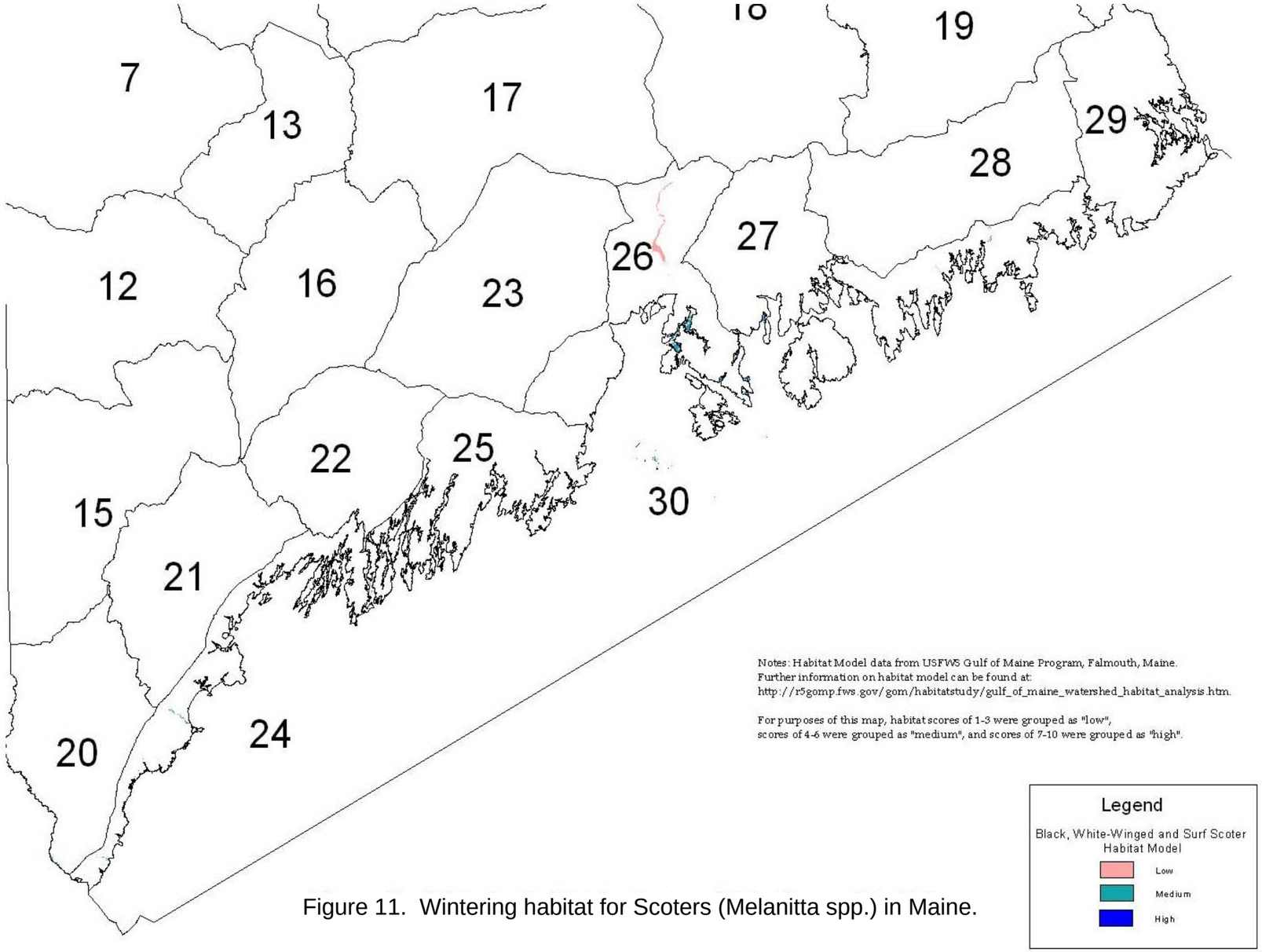

Figure 11. Wintering habitat for Scoters (Melanitta spp.) in Maine.

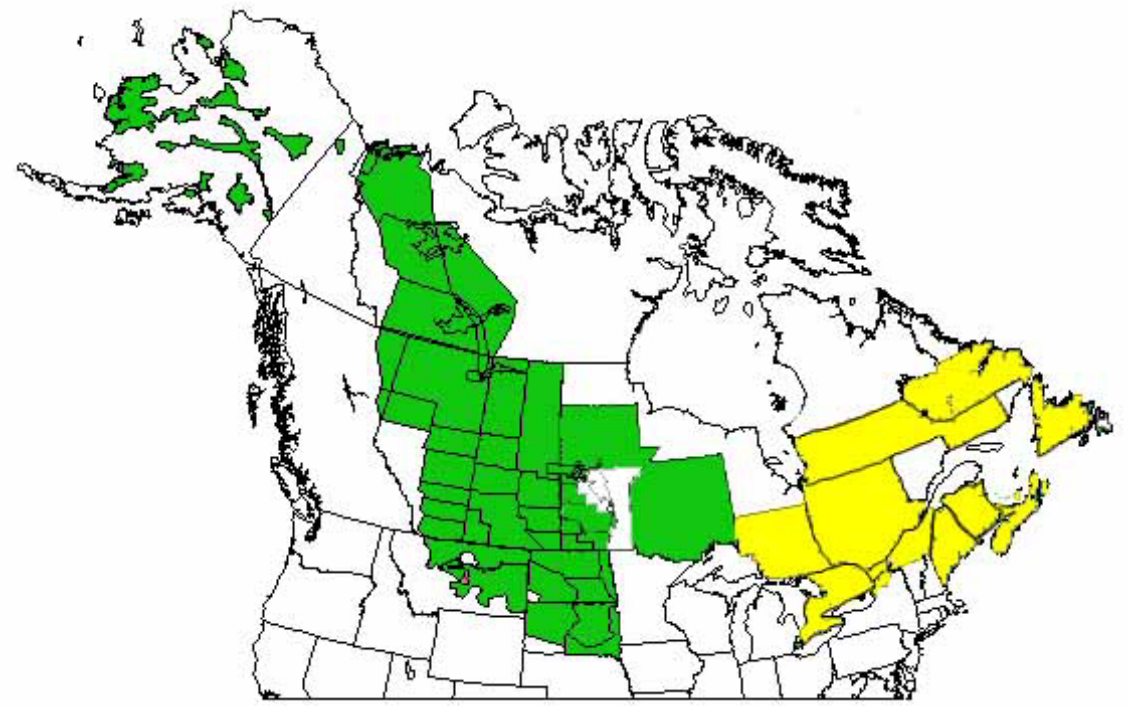

Figure 12. Waterfowl Breeding Population and Habitat Survey areas. Traditional survey area: important waterfowl areas in AK, central Canada, MT, SD, and ND. Eastern survey area: eastern Canada and some northeastern states.

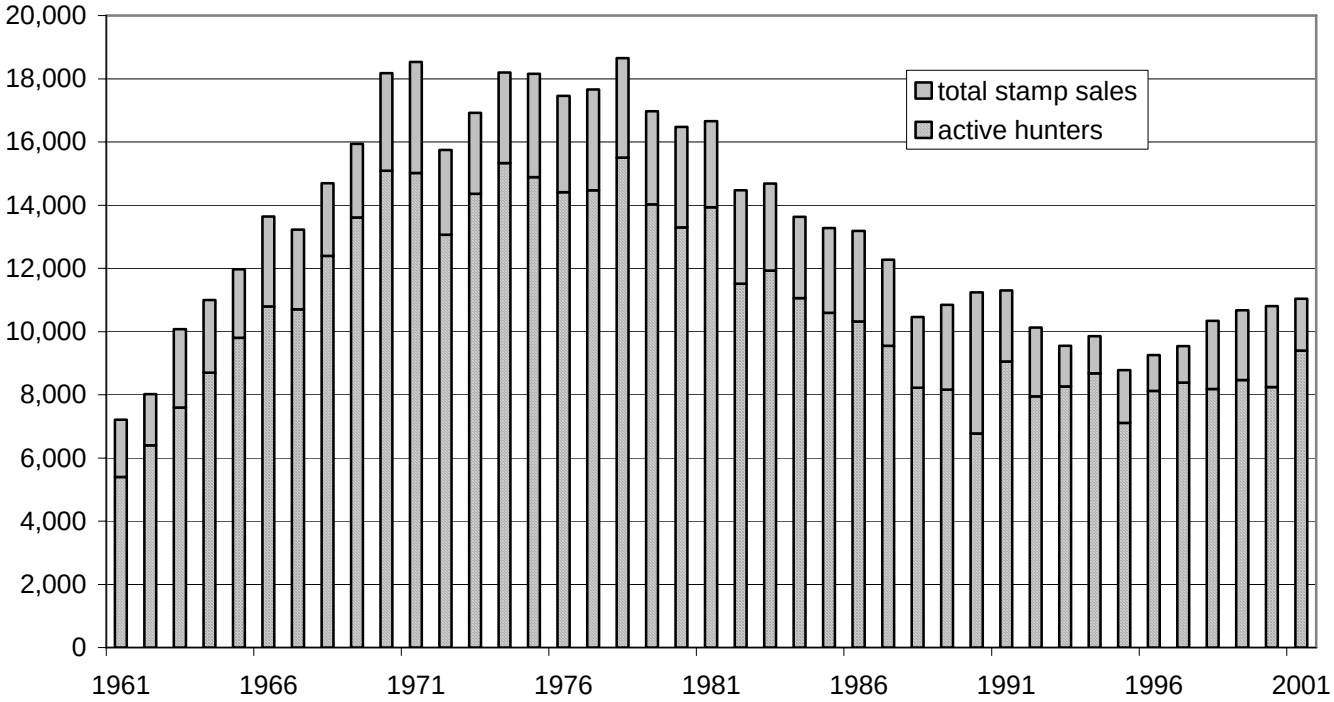

Figure 13. Total sales of federal migratory bird conservation stamps and number of active adult waterfowl hunters in Maine, 1961-2001.

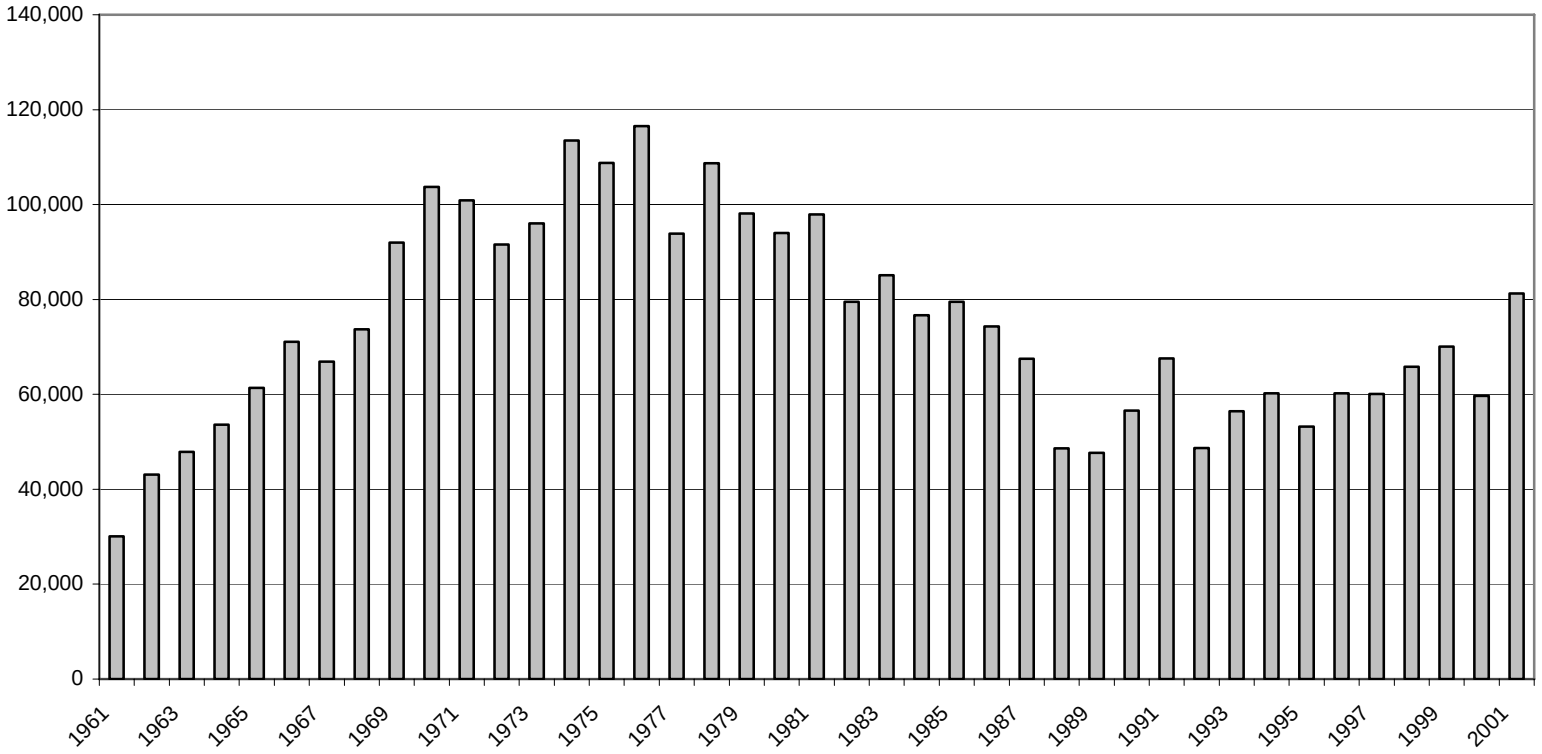

Figure 14. Estimates of hunter days spent hunting waterfowl in Maine, 1961-2002.

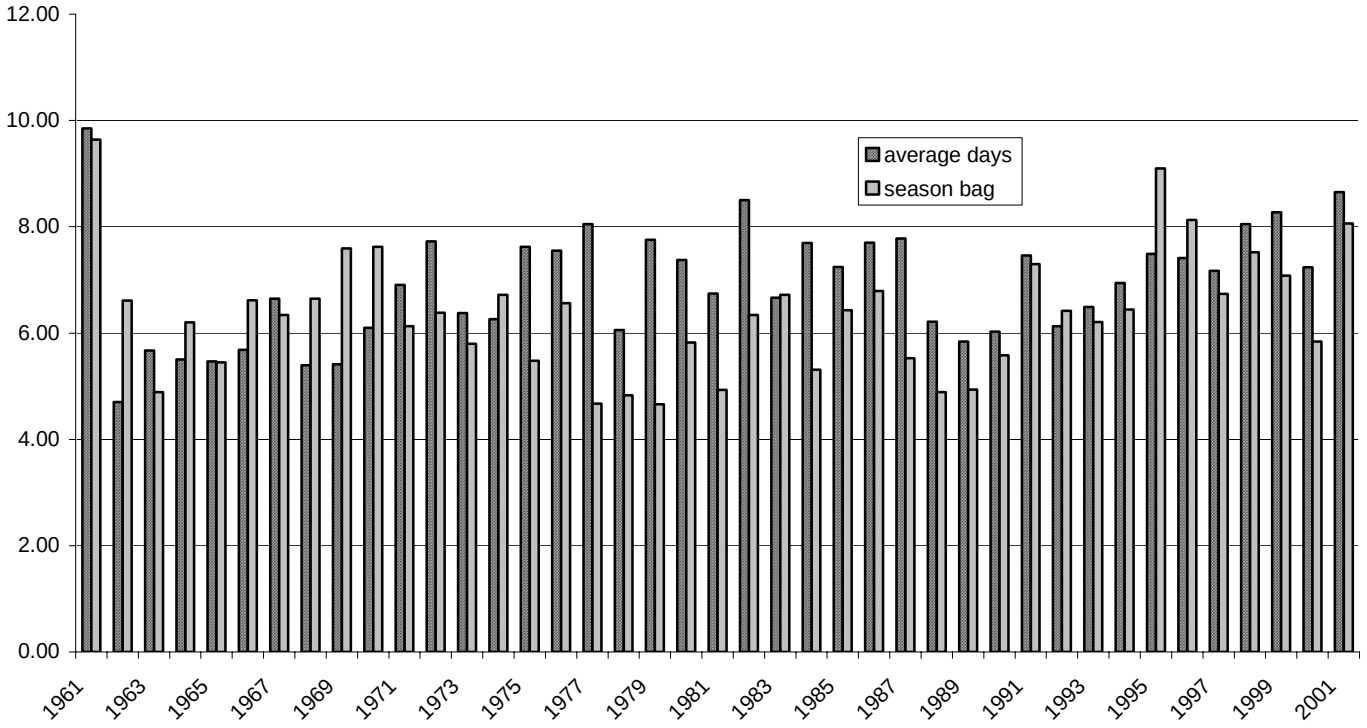

Figure 15. Average days spent hunting and average seasonal bag for waterfowl hunters in Maine, 1961-2001.

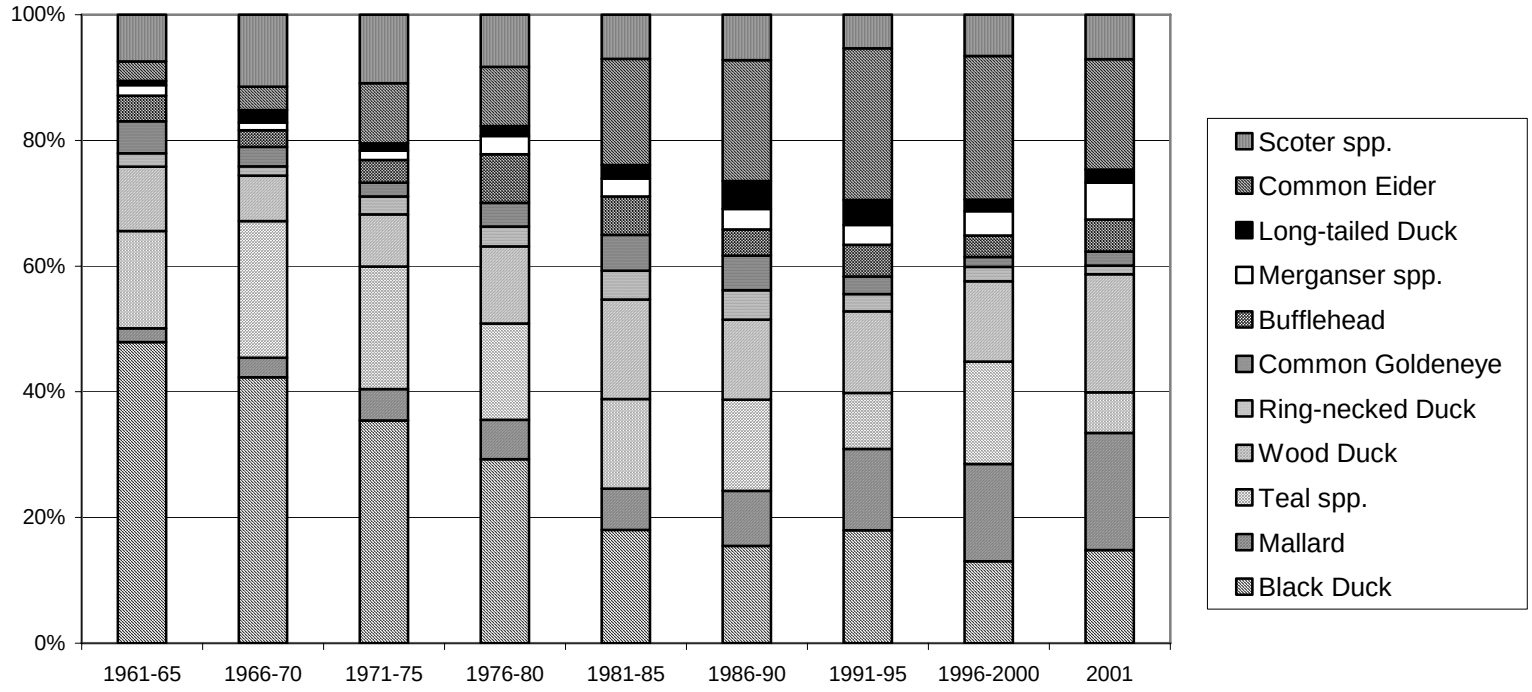

Figure 16. Changes in the species distribution of Maine's duck harvest during 1961-2001.

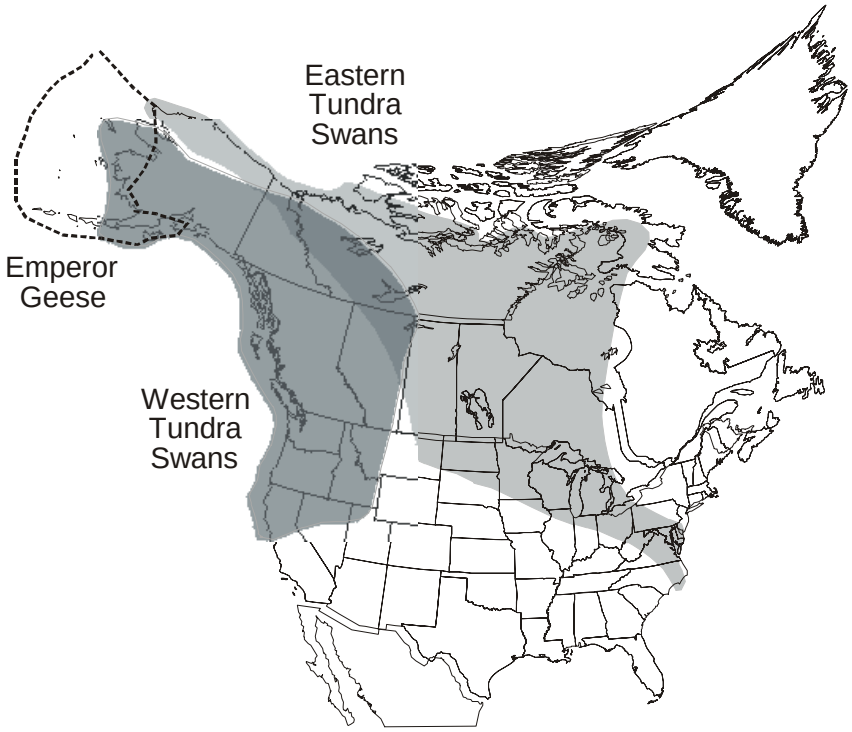

Figure 17. Approximate range of the Emperor goose, and eastern and western swan populations in North America.

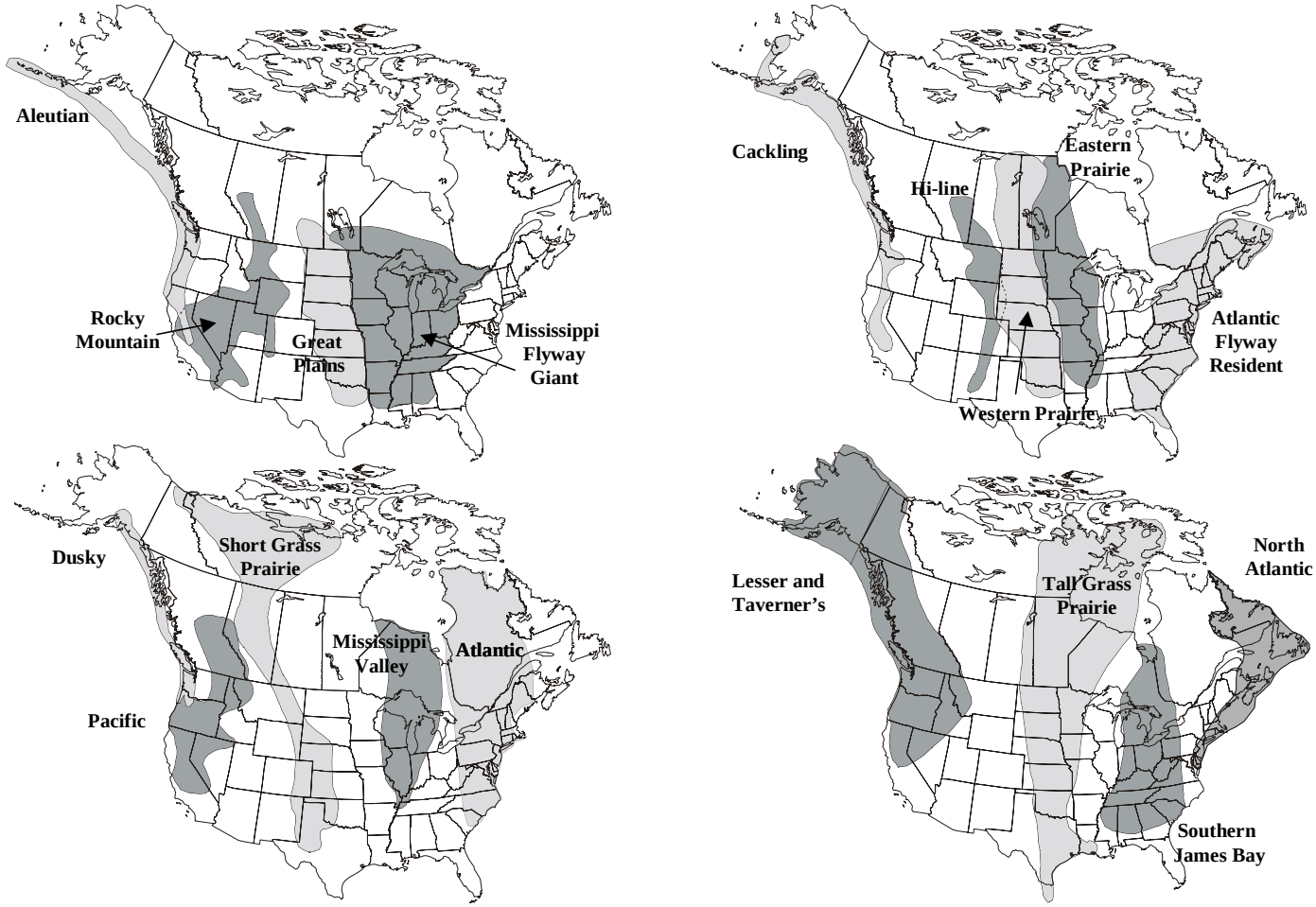

Figure 18. Approximate ranges of Canada goose populations in North America.
Maps courtesy of Graham Smith, Division of Migratory Bird Management, U. S. Fish and Wildlife Service.

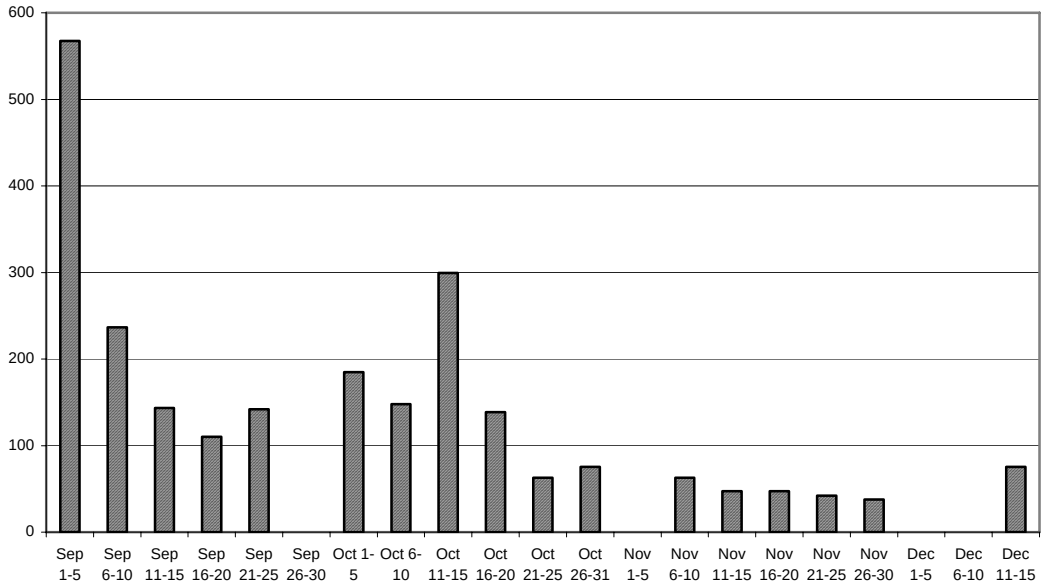

Figure 19. Average daily harvest of Canada geese by 5-day increments during 2001 early (September) and regular Canada goose seasons in Maine.

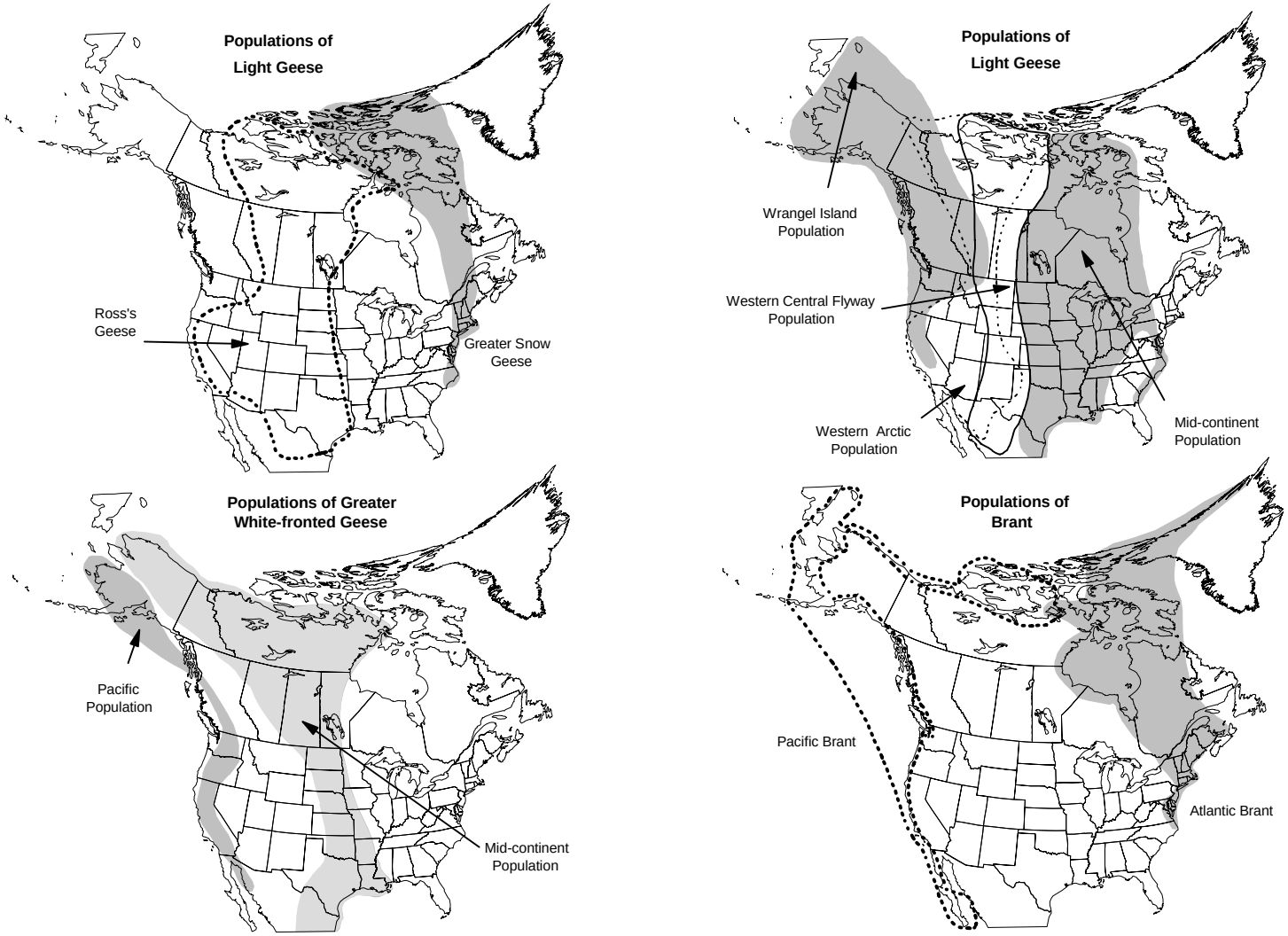

Figure 20. Approximate ranges of selected goose populations in North America.
Maps courtesy of Graham Smith, Division of Migratory Bird Management, U. S. Fish and Wildlife Service.

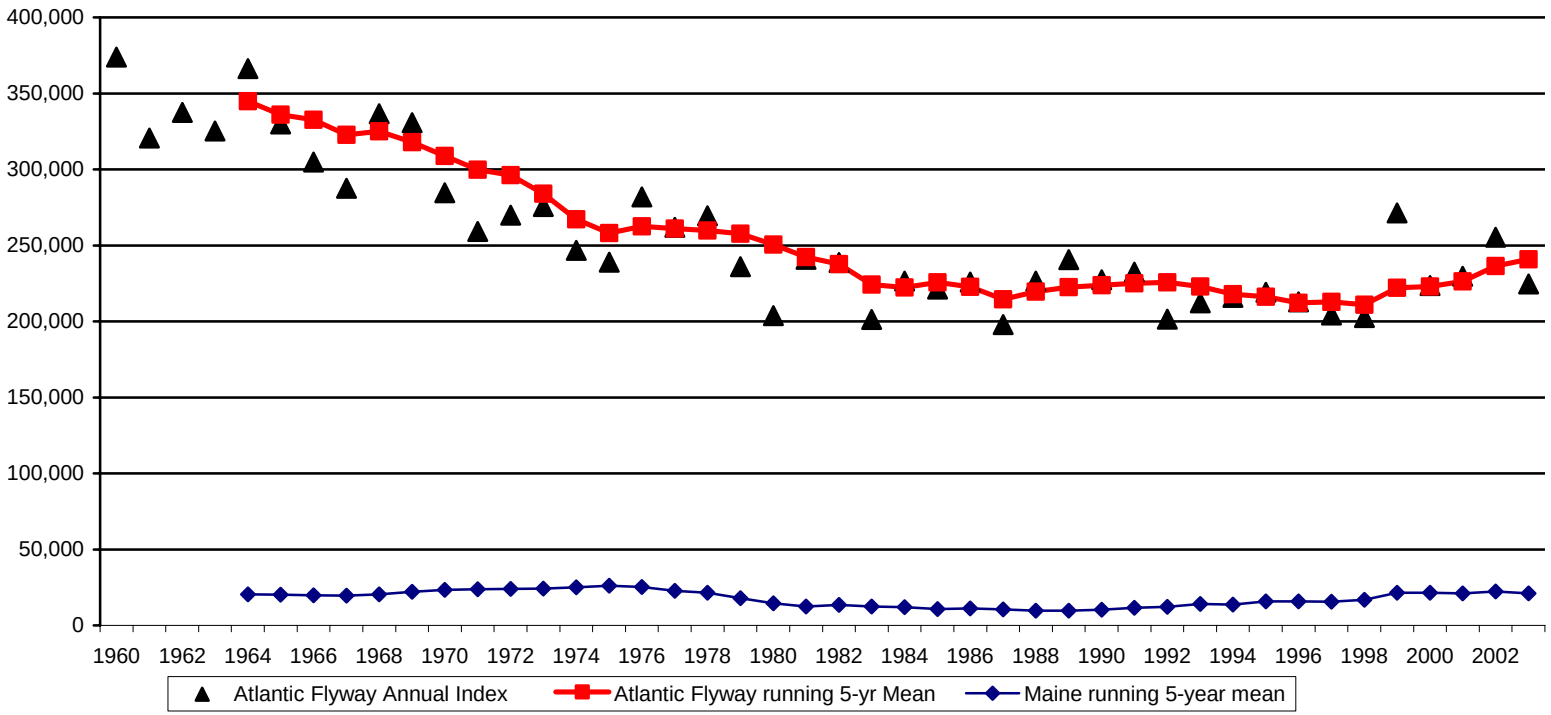

Figure 21. Midwinter Waterfowl Survey index for American Black Duck in Maine and the Atlantic Flyway, 1960-2003.

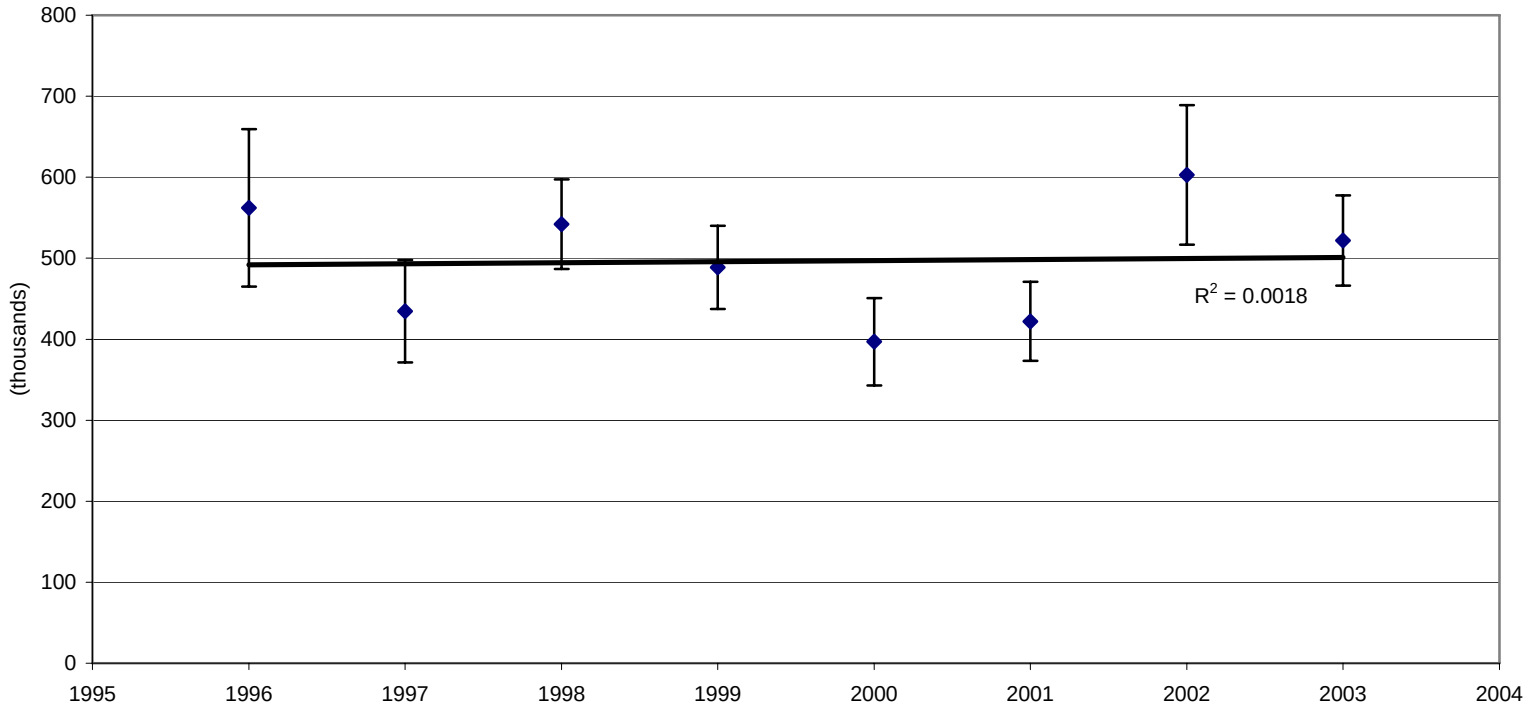

Figure 22. Breeding population index (+/- 1 SE) for American black duck in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

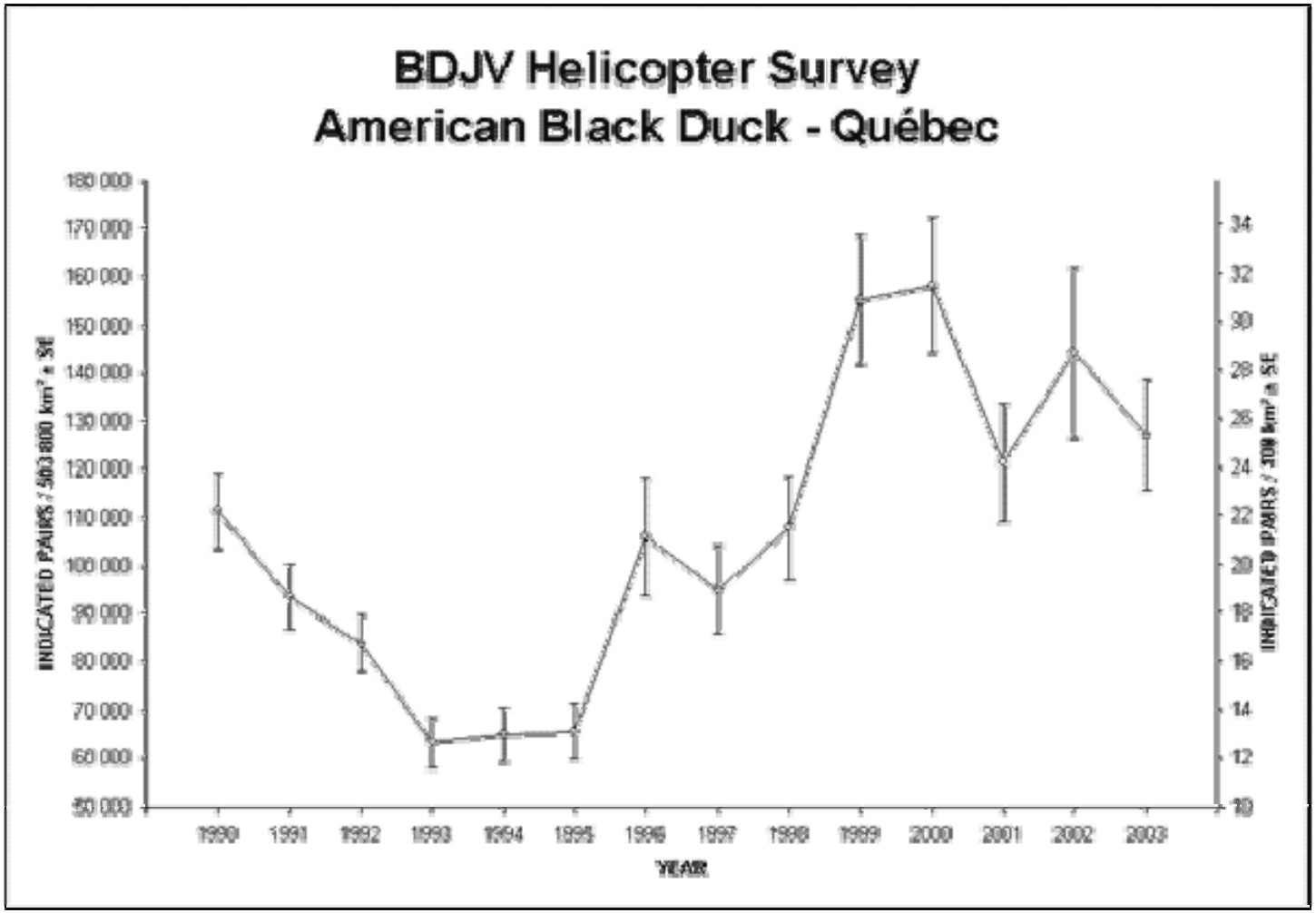

Figure 23. Breeding population estimates of American black duck from the Black Duck Joint Venture helicopter plot survey in Québec, 1990-2003 (Chart from LePage and Bordage 2003).

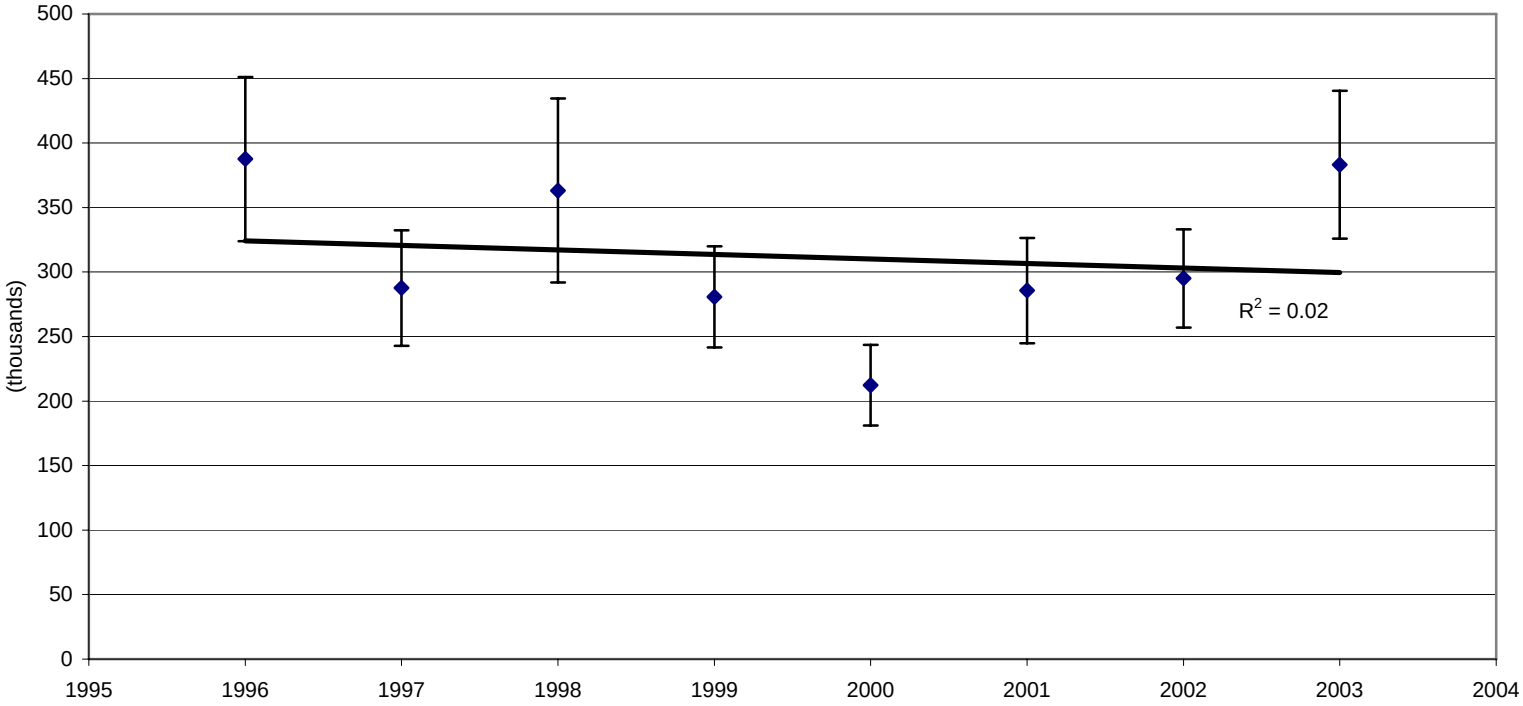

Figure 24. Breeding population index (+/- 1 SE) for mallard in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

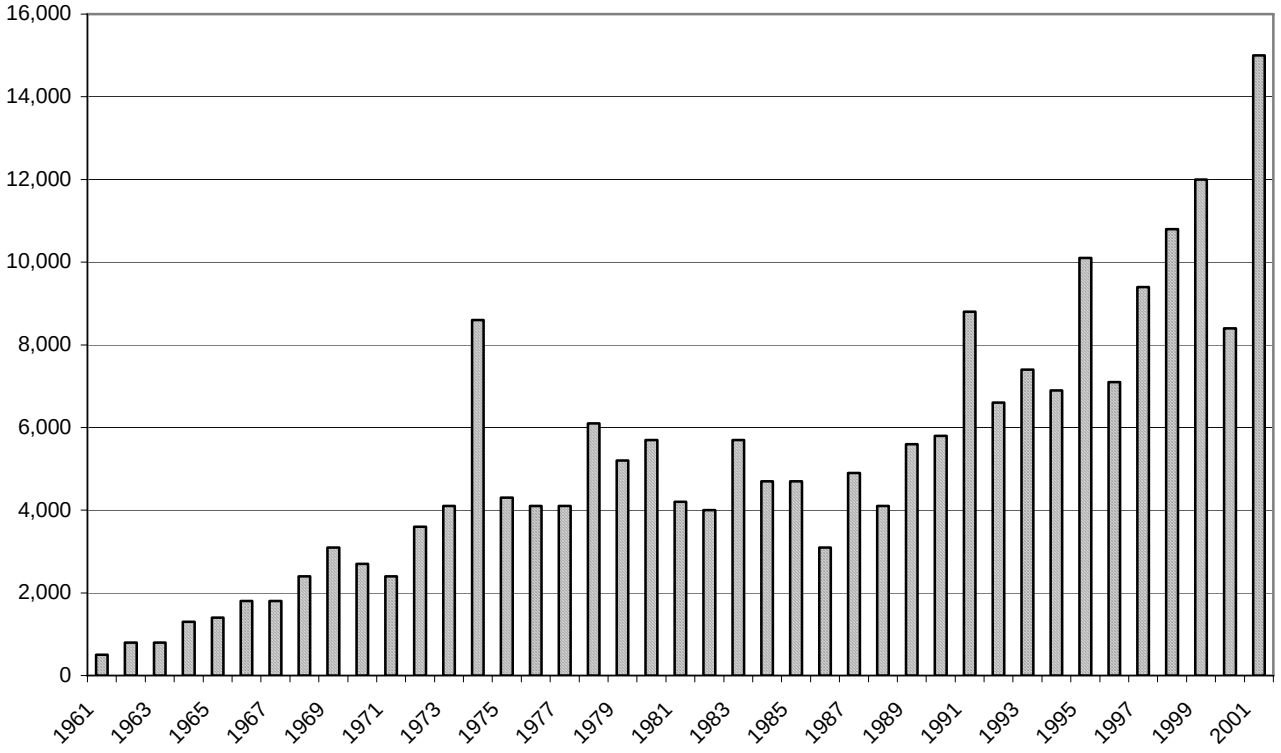

Figure 25. Harvest estimates of mallards in Maine, 1961-2001.

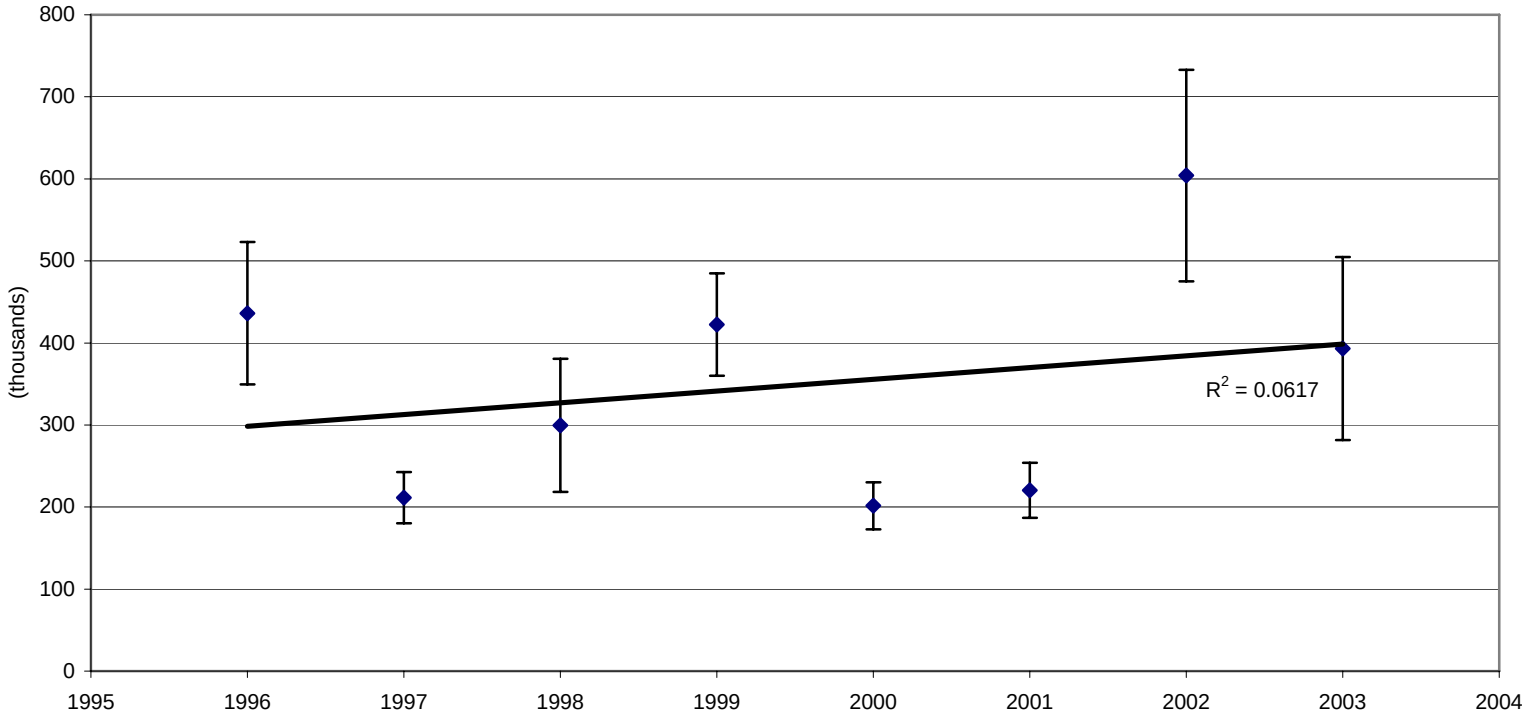

Figure 26. Breeding population index (+/- 1 SE) for green-winged teal in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

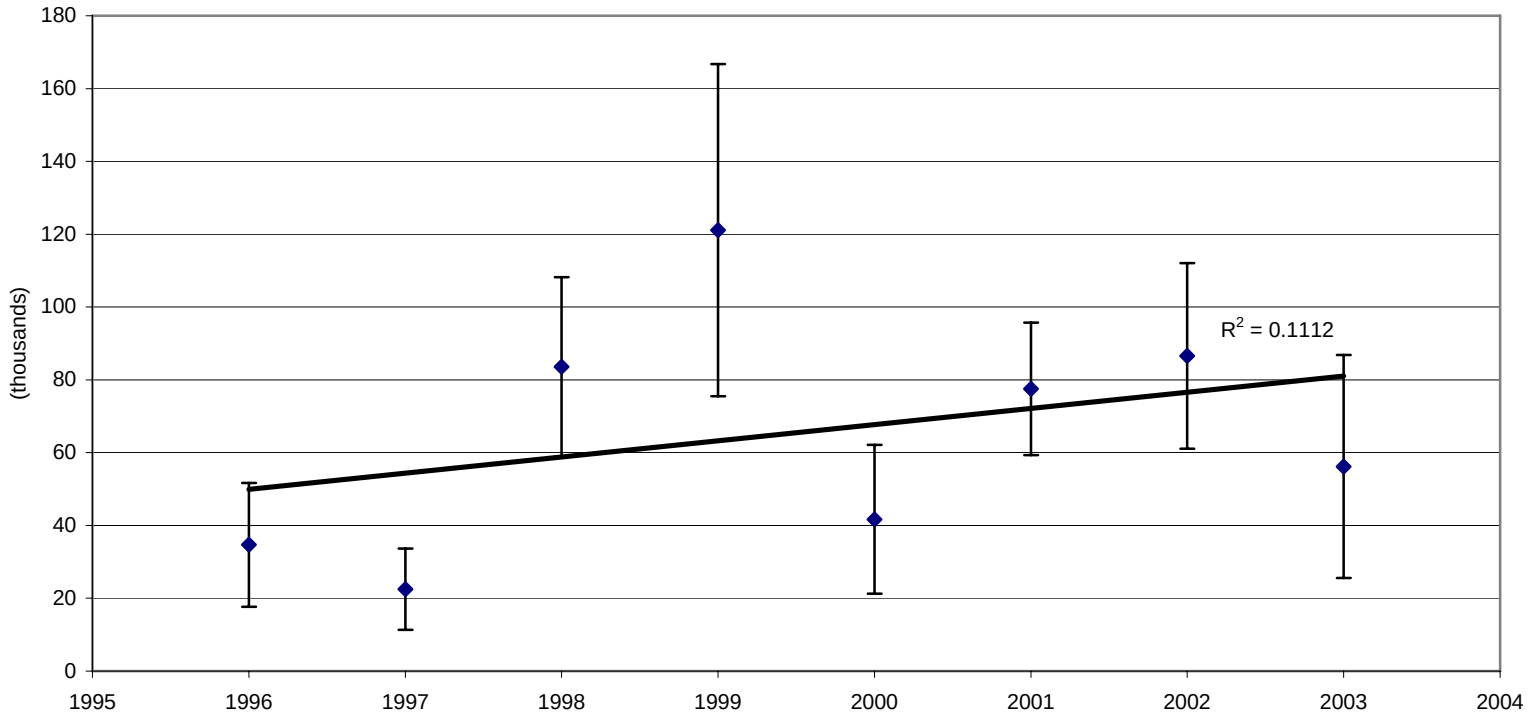

Figure 27. Breeding population index (+/- 1 SE) for American wigeon in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

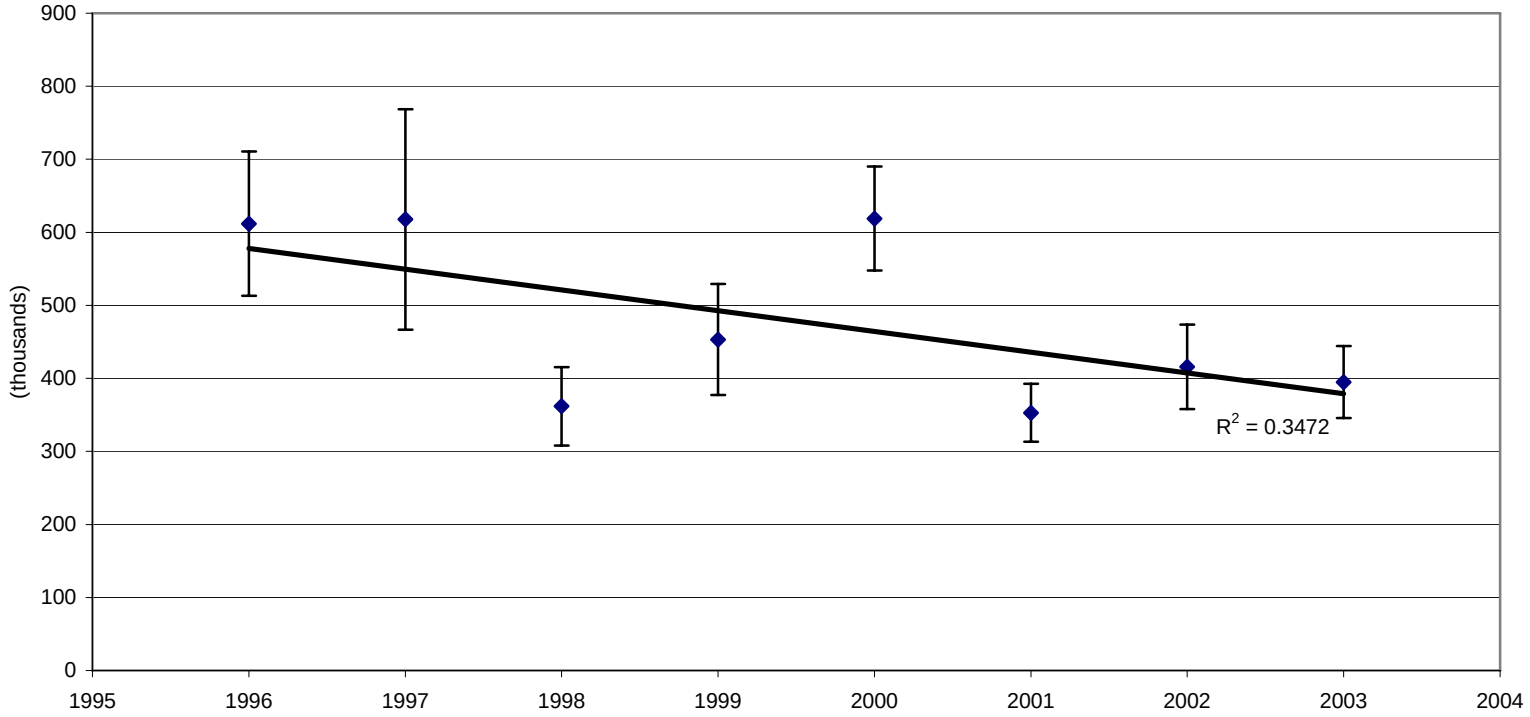

Figure 28. Breeding population index (+/- 1 SE) for ring-necked duck in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

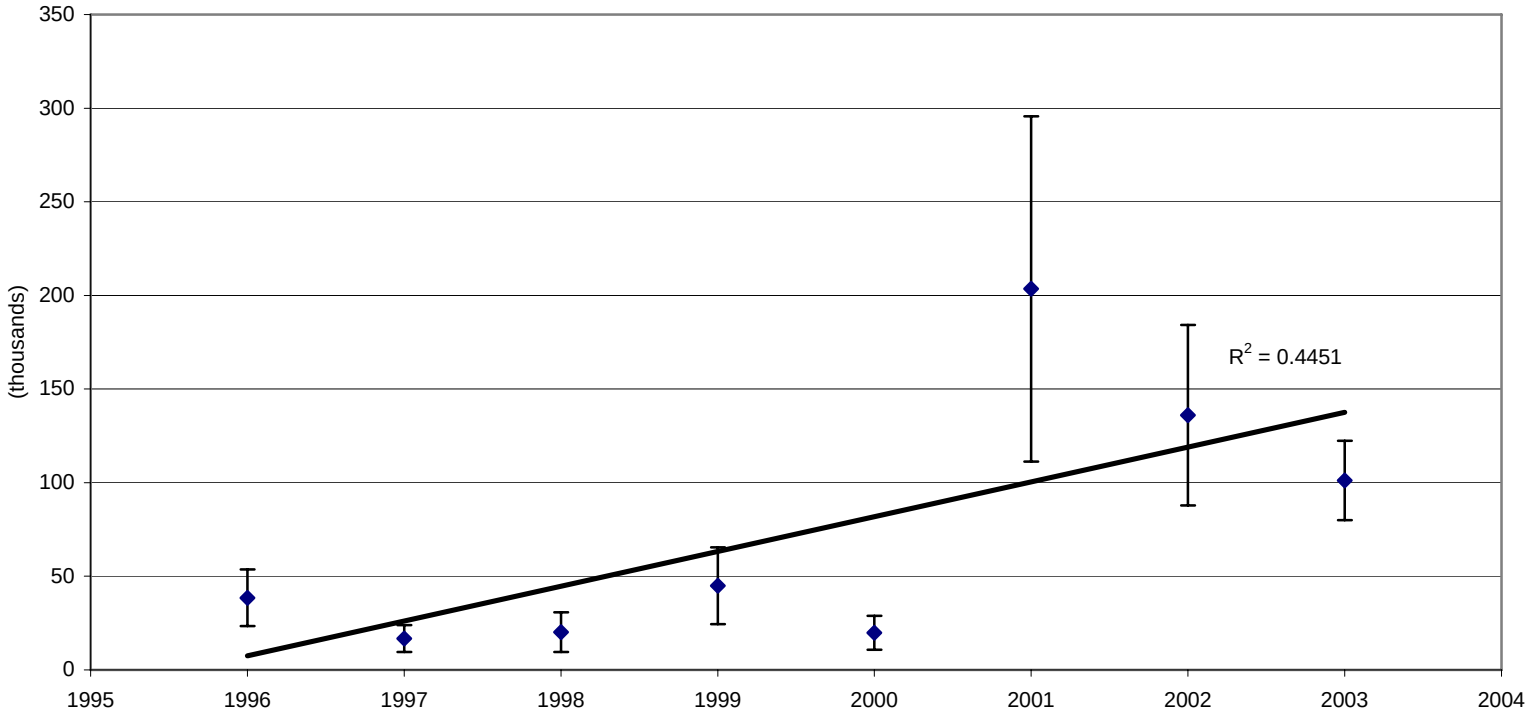

Figure 29. Breeding population index (+/- 1 SE) for lesser scaup in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

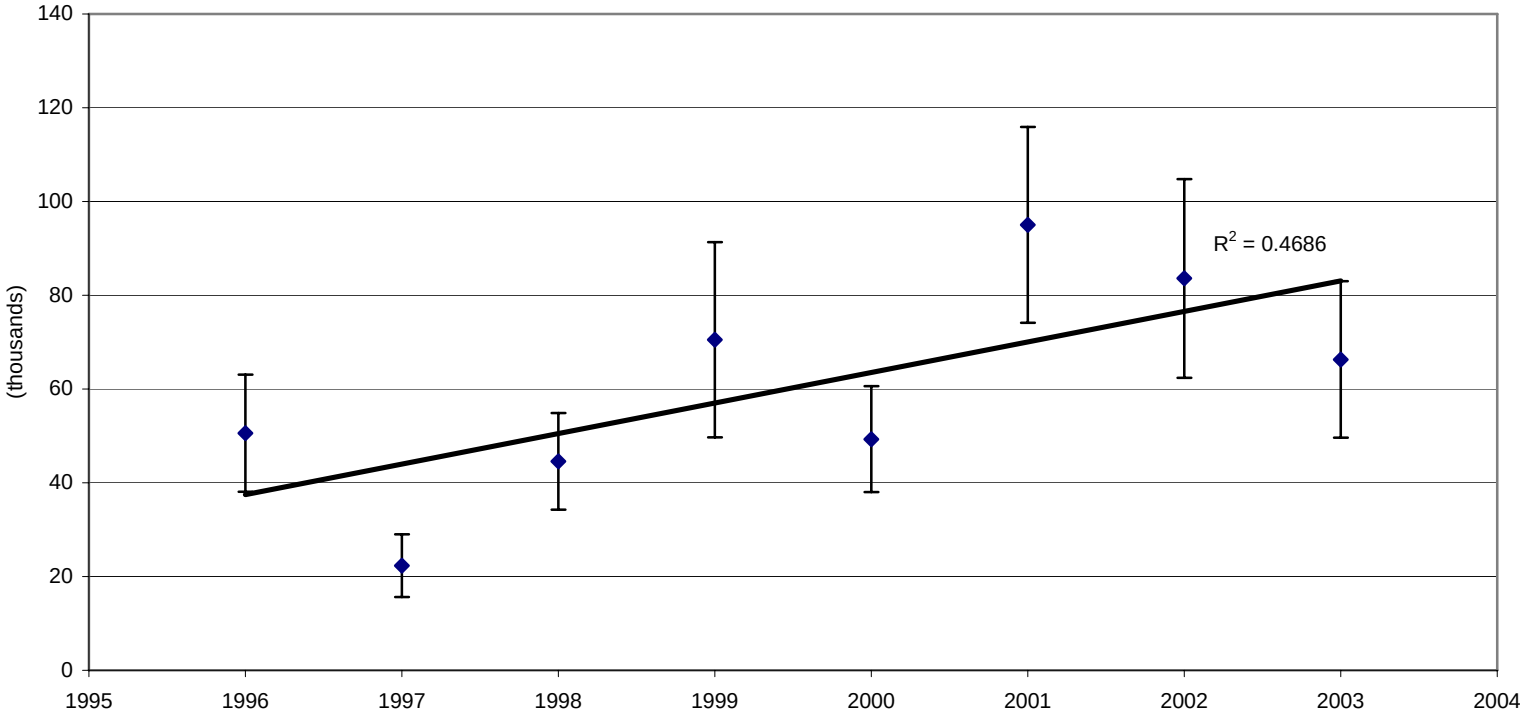

Figure 30. Breeding population index (+/- 1 SE) for bufflehead in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

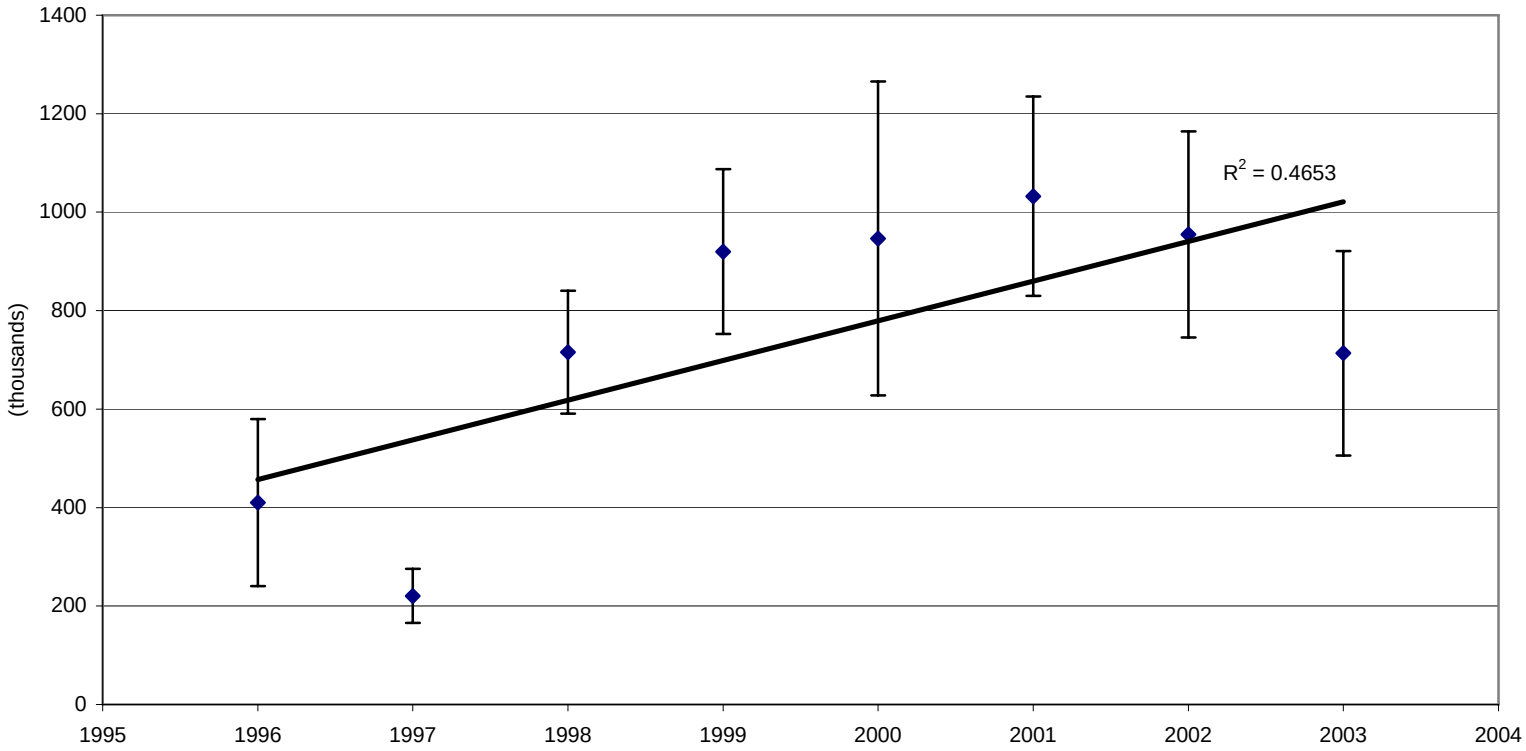

Figure 31. Breeding population index (+/- 1 SE) for goldeneye spp. in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

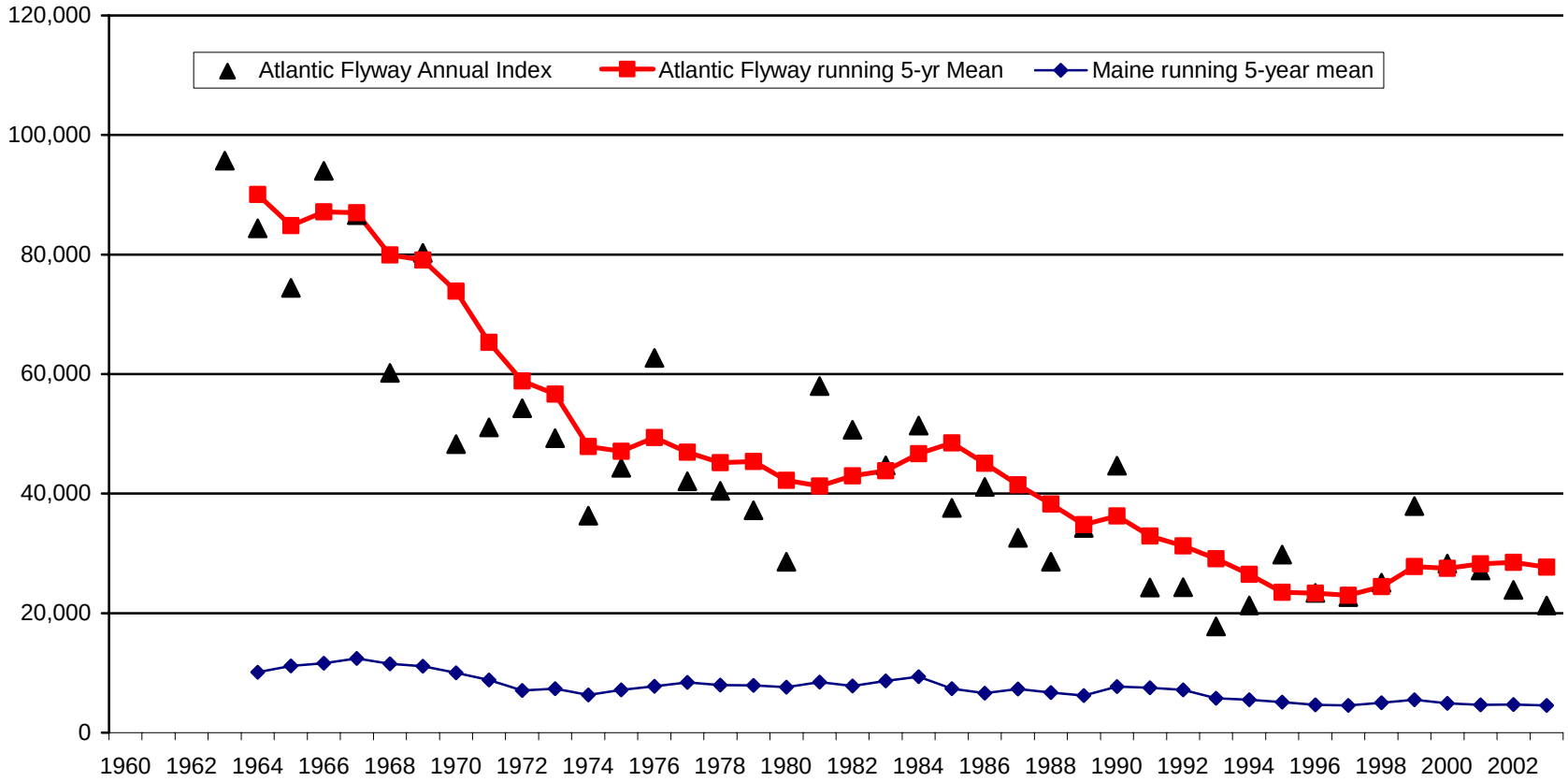

Figure 32. Midwinter Waterfowl Survey index for common goldeneye in Maine and the Atlantic Flyway, 1960-2003.

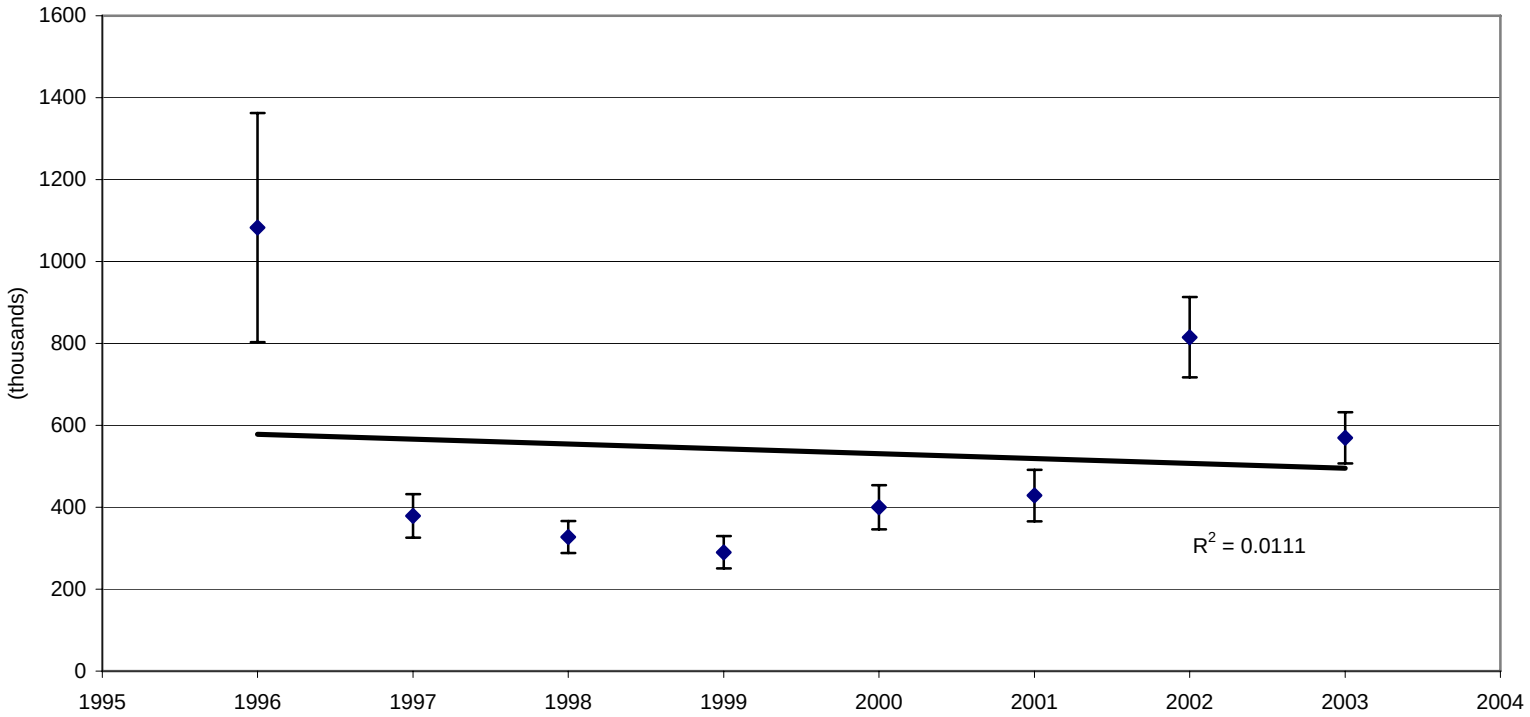

Figure 33. Breeding population index (+/- 1 SE) for Merganser spp. in the eastern survey area (eastern Ontario, Quebec, Newfoundland, Labrador, the Maritimes, and Maine), 1996-2003.

Appendix I – The Birds of North America species accounts citations.

Austin, J. E. and M. R. Miller. 1995. Northern Pintail (*Anas acuta*). *In* The Birds of North America, No. 163 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The Ornithologists' Union, Washington, D. C.

Austin, J. E., C. M. Custer, and A. D. Afton. 1998. Lesser Scaup (*Aythya affinis*). *In* The Birds of North America, No. 338 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

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Appendix II – Waterfowl and Wading Bird Habitat Descriptions

Excerpted from:

GIS-Based Evaluation of Waterfowl and Wading Bird Habitats in Maine

by
Heather L. Rustigian
Department of Wildlife Ecology and
Maine Cooperative Fish and Wildlife Research Unit
University of Maine, Orono

and

William B. Krohn
USGS Biological Resources Division
Maine Cooperative Fish and Wildlife Research Unit
University of Maine, Orono

Final Contract Report to the
Maine Department of Inland Fisheries and Wildlife
Augusta, Maine

June 2002

Appendix II – Waterfowl and Wading Bird Habitat Descriptions

Abstract: The Maine Department of Inland Fisheries and Wildlife (MDIFW) has the authority under the state's Natural Resources Protection Act to identify and conserve high and moderate value waterfowl and wading birds habitats (WWH). While MDIFW has developed a manual system for identifying high and moderate value non-tidal wetlands for waterfowl and wading bird habitat, it is so labor and time intensive that approximately 10% of the state's WWHs have been evaluated. Our objectives are to: (1) automate the existing non-tidal WWH delineation process and evaluation system, (2) compare results for individual WWHs in Kennebec County to determine if the automated system is operating similarly to the manual system, (3)apply the automated system to all mapped wetlands in Maine , and (4) determine if the ratings related to and the predicted presence of wetland birds and other vertebrate groups and the observed presence of wading birds. Boundaries and partially completed manual ratings for 3,448 WWHs in organized towns in Maine provided by MDIFW and digital National Wetlands Inventory (NWI) maps for Maine were used in a Geographical Information System (GIS) to automate the WWH delineation and evaluation process. A series of programs in ARC Macro Language for ARC/INFO GIS were written to analyze WWH wetland composition from the NWI map to evaluate the following 5 WWH criteria: dominant wetland type, habitat size, diversity of wetland types, wetland type interspersion, and percent open water. Over 68% of WWHs rated moderate or high by MDIFW's manual system were also rated moderate or high by the automated system. The automated system delineated over 18,000 WWHs across Maine, 44 % of which were rated high or moderate, and this percentage varied little regionally. Predicted occurrences of vertebrate species regularly breeding in Maine, obtained from the Maine Gap Analysis Project, were used to determine if WWH ratings related to the predicted presence of wetland vertebrates. Species were placed into three groupings differing in level of wetland habitat specialization: wading birds and waterfowl, wetland-associated non-fish vertebrate species (divided into wetland-associated amphibians and reptiles, mammals, and birds), and wetland-using non-fish vertebrate species. Non-parametric methods (Kruskall-Wallis analysis of variance and Spearman correlation) were used to test for a linear relationship between WWH category (i.e. high, moderate, and low) and number of predicted species occurrences. High and moderate wetlands had significantly higher predicted use across all vertebrate classes than those rated low. In addition, high rated WWHs had a significantly higher number of observed wading bird species present than WWHs rated moderate or low. Due to the reliance of the automated system on NWI maps, which are based on interpretation of aerial photographs taken mostly in the mid-1980s, and the dynamic nature of Maine's inland wetlands, especially hydrological modifications by beaver (*Castor canadensis*), we recommend field checking any wetlands rated low or of concern to local biologists.

Appendix II – Waterfowl and Wading Bird Habitat Descriptions

Introduction

Wetlands are increasingly a focus of research, regulation, management, and restoration due to their high productivity, biological diversity and water quality enhancement functions, and the high rate at which they have been modified and developed. In the conterminous United States (U.S.A.) less than half the estimated wetland acreage at the time of European settlement still remains. Wetlands were lost at a rate of 23,700 ha (58,500 acres) annually between 1986 and 1997, with 98% of those losses to freshwater wetlands (Dahl 2000). This is an 80% reduction in the average annual rate of wetland loss compared to the period between 1975 to 1986, attributed to increases in various wetland protection measures (Dahl 2000).

Due to climate and glacial history, water and wetlands make up an unusually high percentage (15%) of land cover in Maine (Krohn et al. 1998). While wooded swamps predominate Maine wetlands, a wide variety of other inland wetland types commonly occur in the state, including fresh emergent marshes, wet meadows and peatlands, the diversity of which is unsurpassed in the United States (Krohn et al. 1998, Davis and Anderson 2001). While rates of wetland loss in Maine have remained below national averages, percent wetland land cover in the state is thought to have decreased from an estimated 30% in the 1780's to the present 15% (Dahl 1990, Krohn et al. 1998).

Currently, two thirds of the U.S.A. lack comprehensive state wetland regulatory programs. Maine is one of the minority of states with wetland laws, including the state mandatory Shoreland Zoning Ordinance (1974) and Natural Resources Protection Act (NRPA), passed in 1988 (Venno 1991). NRPA regulates the human alteration of significant wildlife habitat, defined as: "…habitat for endangered and threatened species,

critical spawning and nursery areas for Atlantic sea run salmon, seabird nesting islands, shorebird nesting feeding and staging areas, high and moderate value waterfowl and wading bird nesting and feeding areas, high and moderate value deer wintering areas and travel corridors, and significant vernal pools" (Venno 1991). Under NRPA, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has the authority to identify and map significant wildlife habitat, including high and moderate value waterfowl and wading bird habitats (Venno 1991).

MDIFW has developed delineation procedures and an evaluation system for the identification and assessment of non-tidal waterfowl and wading bird habitats (WWHs). Since 1993, WWH identification and evaluation have been only partially completed due to the time consuming process of manually deriving the necessary information from aerial photographs, and Maine Wetlands Inventory (MWI) and National Wetlands Inventory (NWI) paper maps. However, newly available statewide digital NWI data allow for the process to be automated using a geographic information system (GIS), potentially increasing efficiency, cost effectiveness, and objective application of the criteria.

Purposes and Objectives

The purpose of this study is to develop an automated, spatially explicit system that identifies high and moderate value waterfowl and wading bird habitats similarly to the manual system developed by MDIFW. This GIS-based system is needed to delineate and evaluate individual wetland complexes across the state. Specific objectives are as follows:

(1) Automate the existing non-tidal WWH delineation process and evaluation system to identify moderate and high value waterfowl and wading bird habitats in Maine.

(2) Compare the results for individual WWHs in Kennebec County to determine if the automated system is delineating and evaluating wetland complexes similarly to the manual system.

(3) Assuming the automated system performs similarly to the manual one, then apply the automated system to wetlands across Maine.

(4) Assess the value of WWH rating system for wading birds, waterfowl, and other species by comparing WWH ratings (i.e. low, moderate, and high) to the numbers of regularly breeding vertebrates predicted to use these wetland complexes and numbers of wading birds observed using these wetland complexes during surveys.

Methods

Manual System

To protect habitats for waterfowl and wading birds, MDIFW must identify high and moderate value WWHs. MDIFW created a set of delineation guidelines and developed a system to rate wading bird and waterfowl habitat value based on wetland characteristics (Figure 1). Delineation guidelines call for combining all adjacent wetlands, with the exception of peripherally located wooded swamps and areas of deep open fresh water of over 100 acres, which are generally not lumped into wetland complexes. However, wetland complexes smaller than 10 acres adjacent to areas of deep open fresh water greater than 100 acres are combined. Furthermore, coves of ponds and lakes may be separated from open water if they are physiographically distinct from the water body or offer visually different habitat.

MDIFW drew on information from Golet (1978), Weller (1978), and Gibbs and Melvin (1990) to create 5 criteria for use in WWH assessment: dominant wetland type, wetland type diversity, habitat size, wetland type interspersion, and amount of open water. In the first phase of WWH assessment, WWHs are assigned scores ranging from 0 to 3 for wetland type diversity and habitat size, and a score ranging from 0 to 6 for dominant wetland type. These 3 scores are then summed and WWHs assigned ratings as follows:

total scores of 10 or greater are high value, scores between 8 and 9 are moderate value, scores ranging from 5 to 7 are indeterminate value, and scores less than or equal to 4 are low value. In the second assessment phase, indeterminate WWHs are assigned to one of three wetland type interspersion categories (Figure 2) by manually comparing maps and photos of the wetland complex to simplified examples of the interspersion types from Golet and Larson (1974). Indeterminate value WWHs are then moved to high, moderate, or low based on interspersion category and percent open water.

Appendix IIIa – American Black Duck Habitat Model

Authors: Arnold Banner and Sue Schaller, USFWS Gulf of Maine Program, 4R Fundy Road, Falmouth, ME 04105 http://gulfofmaine.fws.gov

Draft Date:

June 2001

Species:

American black duck, *Anas rubripes*

Use of Study Area Resources:

Reproductive (breeding pair, brood-rearing), migration, and winter foraging. The following narrative describes how habitat components for each of these 'uses' were mapped, and then combined.

Habitat Requirements - Reproduction:

Breeding Pair. Habitat for breeding pairs includes: (1) nesting cover and substrate (Reed 1970), and (2) high quality foraging areas (USFWS 1988). Since nest sites may be located in any of a wide range of upland to lowland cover types, we assumed that hens could always find suitable nest sites in the vicinity of any suitable inland foraging area. Such areas include land (where seeds and tubers may be consumed), or wetlands and shallow water (where they feed on invertebrates and vegetation).

A variety of wetlands types are used by breeding black ducks. In inland Maine, wetlands selected for pre-laying, laying, and incubation periods, in order of preference, were: palustrine emergent, broad-leaved deciduous forested, and broad-leaved deciduous scrub-shrub types (Ringelman et al. 1982), while ephemeral pools served as important foraging sites. Streams with sandy or stony bottoms interspersed with invertebrate-rich detrital patches also were preferred (Ringelman et al. 1982). In northeastern Nova Scotia, black ducks commonly nest along streams and contiguous freshwater marshes (Seymour 1984). Black

ducks nesting in coastal salt marsh in Nova Scotia foraged in the tidal marsh (Reed and Moisan 1971). Seymour and Jackson (1996) also found that a relatively large proportion of birds nesting throughout a Nova Scotia coastal watershed foraged in the downstream estuarine tidal marsh.

Brood-rearing. Following successful hatching of the eggs, hens move their broods to rearing wetlands, often considerable distances from the nest site (Ringelman and Longcore 1982). In Maine, hens and broods traveled as far as 3.3 km from the nest to an inland rearing wetland (Ringelman and Longcore 1982). In Nova Scotia hens moved broods up to 12 km from inland palustrine wetlands to a tidal marsh (Seymour and Jackson 1996). Streams serve as travel corridors to rearing wetlands (Ringelman and Longcore 1982, Seymour 1984, Seymour and Jackson 1996). Small (<0.02 ha) ephemeral pools are often used by broods en route to rearing wetlands (Ringelman and Longcore 1982).

Habitat requirements for brood-rearing include: (1) cover from predators and weather, and (2) invertebrate-rich foraging sites (USFWS 1988). Palustrine emergent, scrub-shrub and deciduous forested wetlands provide optimal cover and forage conditions (Ringelman and Longcore 1982). In Maine black ducks preferred emergent wetlands over evergreen scrub-shrub wetlands; however, dead scrub-shrub, unconsolidated bottom, and aquatic bed wetlands were not used by broods (Ringelman and Longcore 1982). Wetlands with large areas of open water, submerged aquatic vegetation, or ericaceous shrub vegetation were rarely used by broods (Ringelman and Longcore 1982).

In an estuarine environment along the St. Lawrence River in Nova Scotia, newly hatched black duck broods foraged in widgeon grass (*Ruppia maritima*) pools within the *Juncus* and *Spartina patens* zones of the upper marsh and, as they got older, used portions of the *Spartina alterniflora* zone in the lower marsh. Black ducks may associate with these vegetative and physiognomic features because of a combination of edge, cover, and invertebrate abundance (Reed and Moisan

1971). Seymour and Jackson (1996) noted that a relatively large proportion of ducks nesting throughout the watershed of a tidal estuary took broods to estuarine marsh for rearing. However, mortality of ducklings was significantly higher in broods using tidal compared to interior habitats. This likely is associated with greater predator densities in tidal marshes (Seymour 1984, Ringelman and Longcore 1982). Suitable tidal habitats are limited to depths of one meter or less.

Mapping: The above studies indicated that wetlands were important to black duck reproduction for two general purposes: cover (availability of protective structure), and abundance and accessibility of forage organisms. Therefore scored the relative suitability of various wetland types for each aspect. The "optimum" score, 1.0, was reserved for areas where black ducks had actually been observed. Otherwise, high (.7), medium (0.4) and null (0) scores were assigned on the basis of the relative height and density of structure, and the diversity, abundance and accessibility of forage organisms. The cover and forage scores were averaged to calculate suitability index values (see following table). Our scores were based on the available literature. However, because of differences in wetland classifications, and incomplete information on value of some NWI types for black ducks, we had to interpret factors underlying habitat suitability from the discussions by the authors. In some cases our cover classes included a relatively wide range of conditions, varying in suitability (e.g. palustrine forest encompassing different depths and duration of flooding, wide variety of plant types within the palustrine shrub type), and so these general classes were assigned lower scores than a specific subset might have merited. and the values were checked for conformance with the relative preferences indicated in the literature.

Habitat Requirements - Migration

Black ducks migrate into and through the study area from southern wintering habitats around March through mid-April. During the Fall migration they pass back through from northern areas around October through November.

Appendix IIIa – American Black Duck Habitat Model

North of Chesapeake Bay, black ducks feed on tidal flats and use emergent wetlands, ice-free bays, rivers, and coastal reservoirs as rest areas. Eelgrass, widgeon grass, and smooth cordgrass are important plant food items, while snails, mussels, and clams are important animal foods in coastal bays and marshes (Lewis and Garrison 1984). Migrating birds have greater flexibility in use of resources than do brooding birds; they can use forage and cover separated by relatively great distances. Cover is widely available in the form of emergent, forested, or scrub/shrub wetlands, or even large water bodies, and so only feeding areas were mapped for migration use.

Mapping: We scored interior wetlands as feeding areas base on the NWI types (see below). Scores were assigned to reflect the probable abundance and accessibility of forage organisms. Coastal wetlands were scored on the basis of forage resources, water depth, and known level of use (see 'Mapping of Coastal Migration and Wintering Habitats', below).

General Wetland Suitabilities for Black Ducks *(0 - 1 scale)*

NWI Designations (wetlands only)	Cover Types	reproduction: structure	reproduction: forage	reproduction: (average of structure, forage values)	migration (forage value)	winter (surveys, forage value)
PEM, L2EM	**Lake/pond, emergent vegetation**	0.7	0.7	**0.7**	**0.7**	
PFOcon	**Palustrine forest, conifer**	0.7	0	**0.3**		
PFOdec	**Palustrine forest, deciduous**	0.7	0.7	**0.7**	**0.4**	
PSSdec	**Palustrine scrub shrub, deciduous**	0.7	0.7	**0.7**	**0.4**	
PSScon	**Palustrine scrub shrub, conifer**	0.7	0	**0.3**		
PAB, L2AB	**Lake/pond, aquatic vegetation**	0	0.7	**0.3**	**0.4**	
L1UB, PUB	**Lake/pond, unconsolidated bottom**	0	0.4	**0.2**		
L2US	**Lake, unconsolidated shore**	0	0.7	**0.3**	**0.4**	

L2RS	**Lake, rocky shore**	0	0.5	**0.2**		
R1UB	**Riverine subtidal unconsolidated**	-	-		*	*
Rper	**Riverine perennial**	0.4	0.4	**0.4**	**0.4**	
R1US	**Riverine intertidal unconsolidated shore**	0	0.7	0.3	0.7	*
E1AB	**Estuarine subtidal vegetated**	-	-		*	*
E1UB	**Estuarine subtidal unconsolidated bottom**	-	-		*	*
E2AB	**Estuarine intertidal algae**	0	0.7	**0.4**	*	*
E2EM	**Estuarine intertidal emergent**	0.4	0.4	**0.4**	**0.7**	*
E2RS, R1RS	**Estuarine, tidal river rocky shore**	-	-		*	*
E2SS	**Estuarine intertidal shrub**	-	-			
E2US	**Estuarine intertidal unconsolidated shore**	0	0.7	**0.4**	**0.4**	*
M1AB	**Marine subtidal vegetated**	-	-		*	*
M1UB	**Marine subtidal unconsolidated bottom**	-	-		*	*
M2AB	**Marine intertidal algae**	-	-		*	*
M2RS	**Marine intertidal rocky shore**	-	-		*	*
M2US	**Marine intertidal unconsolidated shore**	-	-		*	*
NOTES	* Of use, but scored on basis of forage resources, depth, and observed level of use; see table, below - not used					

Habitat Requirements - Wintering

Food availability, freedom from disturbance, protection from severe weather, and

presence of large bodies of open water are interrelated factors that appear to affect habitat use by black ducks in winter (Lewis and Garrison 1984). North of Chesapeake Bay, black ducks forage primarily on tidal flats and rest in emergent wetlands, or remaining ice-free bays, rivers, and coastal reservoirs (Lewis and Garrison 1984). During winter storms and in response to hunting pressure, ducks use estuarine emergent wetlands, and estuarine and marine open waters. The southeast side of islands and peninsulas are used as loafing and feeding areas to achieve thermal advantages from maximum sunlight exposure and protection from the wind (Albright 1981 *in* Lewis and Garrison 1984). The lee side of land forms was used during low temperatures (< 0 degrees C) and by flocks of > 50 black ducks in coastal Maine during a severe winter (Longcore and Gibbs 1988).

Animal foods make up between 65 and 96% of the winter diet (Mendall 1949, Hartman 1963, Grandy 1972, Jorde and Owen 1990), with snails, amphipods, blue mussels, and clams as the primary foods (based on volume). For the purposes of this analysis, we assume cover requirements are met where suitable food resources occur (Hartman 1963).

Mapping of Coastal Migration and Wintering Habitats:

Snow and ice cover most interior and some estuarine wetlands during winter, and so coastal habitats may be critical for survival of black ducks in the study area. Coastal foraging habitats can be delineated by the occurrence of shellfish beds, and utilization of open coastal habitats by black ducks is directly apparent from aerial surveys.

Shellfish availability. Beds of a variety of bivalve molluscs were identified using previously developed data for coastal New Hampshire (Banner and Hayes 1996), a Maine DMR shellfish coverage, and the NOAA 1995 National Shellfish Register coverage, characterizing shellfish growing areas by state. The latter described shellfish abundance within relatively large coastal segments, and so the information was of lower resolution and given less weight than the other sources.

Observed use areas. The data from annual USFWS mid-winter waterfowl surveys, 1985 through 1999 (through 1994 in Maine), were processed by taking the maximum counts per segment polygon (or sub-segment, where available), and calculating nominal number of birds per unit area. Maine's Coastal Wildlife Concentration Areas (Maine Department of Inland Fisheries and Wildlife) counts were similarly converted to birds per unit area, and used to supplement the mid-winter counts.

Foraging habitat (having suitable depth and shellfish) was scored 0.5 for higher resolution ("apparent foraging habitat") and 0.3 for lower resolution ("potential foraging habitat") shellfish data. Where these foraging habitats coincided with the occurrence of one or more black ducks per 10 ha, they were scored 1.0 and 0.6, respectively. Areas having black ducks and suitable depth, but without mapped forage were scored 0.5 (see table, below).

COASTAL HABITAT SUITABILITY SCORING	forage not documented	apparent foraging habitat	potential foraging habitat
black ducks abundant	0.5	1.0	0.6
black ducks uncommon	0	0.5	0.3

Habitat Suitability Scoring:

Habitat suitability of interior wetlands was scored as the maximum of the NWI suitability values for reproduction and migration (first table, above). Scores for coastal habitats were based on use for migration and during the critical winter period (table just above). The overall habitat suitability score was the maximum from the interior and coastal components.

Testing of Results (winter habitat): The winter habitat model was tested using 1999 winter waterfowl count point data for Maine. We created a bounding polygon encompassing all waterfowl observations for the survey, and created a randomly distributed set of 70 points within it. We then compared the presence of habitat near the random points to that for sites at which black ducks were

observed. Of the 1001 sites with black ducks, 984 had mapped habitat, while only 47 out of the 70 randomly distributed sites had habitat. The Chi-square was highly significant, indicating that the overall model does indicate localities useful to black ducks.

Testing of Results (breeding habitat): interior (breeding) habitat use was tested using year 2000 breeding transect counts across Maine (aerial flights by John Bidwell, USFWS). We compared the occurrence of habitat within 100 m of points having black ducks, along the aerial transects, to habitat occurrence at random sites. Of 38 sites with black ducks, 25 coincided with our mapped habitat, while 239 of 798 random sites had habitat. The difference in proportion (0.66 vs 0.30) was highly significant.

Testing of Results (overall habitat): Maine Department of Inland Fisheries and Wildlife marsh bird survey data (courtesy of T. Hodgman) also were used to test the habitat map. We compared the distribution of mapped habitat around a random set of 798 upland points to that for marsh bird survey stops at which black ducks were observed in 1998 through 2000. Of the 60 sites with birds, all had mapped habitat, while only 156 sites out of the 798 randomly distributed sites had habitat. The Chi-square was highly significant, indicating that the overall model predicts localities useful to bitterns. Restricting the test to habitats scored above 0.4 gave even an higher probability of association, supporting our premise that more highly scored areas have a higher suitability for this species.

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Appendix IIIb – Wood Duck Habitat Model

Authors: Arnold Banner and Sue Schaller, USFWS Gulf of Maine Program, 4R Fundy Road, Falmouth, ME 04105 http://gulfofmaine.fws.gov

Draft Date:

July 2001

Species:

Wood duck, *Aix sponsa*

Use of Study Area Resources:

Reproduction occurs throughout the study area (Adamus 1984, Breeding Bird Survey information); wintering is limited to southern Massachusetts and south through the Gulf Coast (Christmas Bird Count information). Wood ducks occur throughout the eastern United States and also the Pacific coastal region.

Habitat Requirements:

In the Northeast wood ducks use forested wetland complexes year round, including swamps, floodplains, bottomlands, beaver flowages, riparian corridors, oxbows, and scrub-shrub wetlands (Drugger and Fredrickson 1992, Hepp and Bellrose 1995). They favor “shallow quiet inland waters in or near deciduous or mixed woodland” (Palmer 1975). On migration (not mapped here) they can be found on fresh and brackish waters, and rarely on sheltered salt water areas (Palmer 1949).

Breeding and brood rearing cover: Suitable habitat includes nest trees in wetland complexes having floating or emergent vegetation with a ratio of 50-75% cover to 25-50% water (Sousa and Farmer 1983). Shrubby wetlands of willow, alder, buttonbush, and downed timber provide good cover and are used extensively, as are wetlands with shallow water and dense emergents such as bur-reed, arrow arum, duck potato, smartweeds, and American lotus (Hepp and Bellrose 1995). Preferred water depth is between 7 and 45 cm deep (Boone web page, Drugger

and Frederickson 1992). Suitable trees for nesting are at least 40 cm dbh, with relatively large cavities 5 to 50 feet above the ground, and standing in or within a few hundred yards of water (Palmer 1949, Grice and Rodgers 1965 *in* Sousa and Farmer 1983, Palmer 1975). Conifers rarely provide suitable cavity structure (McGilvrey 1968 *in* Sousa and Farmer 1983). Wood ducks nest near human habitation if wetlands habitat is present (Bent 1923, Palmer 1975). Wildlife managers often place artificial nest boxes in suitable wetlands where regenerating forests are too immature to provide nest cavities (Clugston 1999).

Wood ducks raise one brood a year. Hatchlings are precocial, and leave the nest within a day of hatching. Ducklings leap from the nest with downy wings extended and have been known to jump as much as 89 m to the ground without injury, after which hens lead them to brood-rearing sites (Hepp and Bellrose 1995). Drugger and Fredrickson (1992) noted that broods may move up to 4 km to foraging sites, averaging 1.3 km. Travel is mostly along waterways, but also overland. Survival of broods is associated with the distance of ground travel; broods that moved less than 0.8 km had higher survival rates than broods that moved greater distances (Sousa and Farmer 1983).

Broods are led to shallowly flooded wetlands with a heavy understory of emergent vegetation or shrubs, small open water passages, and some woody debris (Drugger and Fredrickson 1992, Palmer 1975). Such areas offer concealment, forage, movement routes, and resting sites; similar sites are used by the adults during the flightless period of late summer molting (Palmer 1975).

Foods: "Wood duck foraging varies seasonally and between the sexes. Their winter diet is almost entirely plant based, “of which 75% may be acorns. An increase in animal foods ... (to about 35%) occurs in both sexes in early spring. This percentage remains constant for the male wood duck through summer and fall while undergoing ...molts, but increases to about 80% for the female during egg laying. Female wood ducks increase the amount of invertebrates in the diet

to meet daily protein needs during egg laying. After egg-laying, animal foods compose less of the female's diet, while consumption of high energy seeds increases to meet the daily dietary requirements of incubation (Drugger and Fredrickson 1992)." Foods commonly include acorns, seeds of beech, maple, elm, ash, sedges, bur-reed, pickerel weed, wild rice, sedges, grasses and small invertebrates, mostly insects (Palmer 1975, Clugston 1999, Drugger and Fredrickson 1992). Young feed especially on insects, aquatic invertebrates and small fishes (USGS 1999). Preferred water depth for foraging is less than 20 cm; deeper waters can be used for roosting and loafing (Drugger and Fredrickson 1992)

Wintering: Wintering wetland complexes ideally are centered on a permanent water body, and offer some persistent emergent vegetation (Sousa and Farmer 1983). These areas are similar to reproductive habitat, including bottomland hardwoods, beaver ponds, flooded forests, swamps, openings in marshes, and upper ends of tidal creeks (Palmer 1975, Drugger and Frederickson 1992), flowages, river oxbows, meanders and backwaters (USGS 1999). Wood ducks also winter in persistent herbaceous vegetation - cattails, soft rush, bulrush, bur-reed.

Area Requirements: Minimum habitat size for brood rearing is about 10 acres of wetland in contiguous units or in isolated parcels separated by no more than 100 feet of upland (McGilvrey 1968 *in* Sousa and Farmer 1983, USGS 1999). The distribution of naturally occurring nest cavities in forested wetlands ranged from 1 per 24 acres to 1 per 13 acres; in upland forest the density was about 1 per 5 acres, with an average of about 1 per 5.2 acres for all types (Sousa and Farmer 1983).

Limiting Factors: Adults may be preyed upon by great horned owls, raccoons, foxes or mink. Young may be taken by any of these, as well as by large

predacious fish, bullfrogs, or snapping turtles. Eggs may be destroyed by raccoons, rat snakes, squirrels, mink, woodpeckers and starlings.

Model:

Cover suitability. Cover types suitable for wood duck foraging and resting (adults and broods) include marsh, near-shore open water, forested and shrub wetlands (see nominal scores in the table, below). Cover types for nesting include wetland and upland deciduous and mixed forest.

NWI Designations (wetlands only)	Cover Types	Cover Suitability (0 - 1 scale)
	Upland deciduous forest	**0.8***
	Upland coniferous forest	
	Upland mixed forest	**0.5***
	Grassland	
	Upland scrub/shrub	
	Cultivated	
	Developed	
	Bare ground	
PEM, L2EM	**Lake/pond, emergent vegetation**	**1.0****
PFOcon	**Palustrine forest, conifer**	
PFOdec	**Palustrine forest, deciduous**	**1.0**
PSSdec	**Palustrine scrub shrub, deciduous**	**1.0****
PSScon	**Palustrine scrub shrub, conifer**	
PAB, L2AB	**Lake/pond, aquatic vegetation**	**1.0****
L1UB, PUB	**Lake/pond, unconsolidated bottom**	**1.0**,*****
L2US	**Lake, unconsolidated shore**	**0.5****
L2RS	**Lake, rocky shore**	
R1UB	**Riverine subtidal unconsolidated**	
Rper	**Riverine perennial**	**0.5****
E1AB	**Estuarine subtidal vegetated**	

E1UB	**Estuarine subtidal unconsolidated bottom**	
E2AB	**Estuarine intertidal algae**	
E2EM	**Estuarine intertidal emergent**	
E2RS, R1RS	**Estuarine, tidal river rocky shore**	
E2SS	**Estuarine intertidal shrub**	
E2US/R1US	**Estuarine, Riverine intertidal unconsolidated shore**	**0.3****
M1AB	**Marine subtidal vegetated**	
M1UB	**Marine subtidal unconsolidated bottom**	
M2AB	**Marine intertidal algae**	
M2RS	**Marine intertidal rocky shore**	
M2US	**Marine intertidal unconsolidated shore**	
NOTES	* if adjacent to wetlands **if adjacent to deciduous or mixed forest ***exclude open water > 30 m from shore	

Area Suitability. Wetland areas less than 10 acres in size were regarded as unsuitable for brood rearing, although they may be suitable for migration and breeding. Therefore, these smaller areas were given a reduced (½) habitat score overall. Patches of nesting cover smaller than 5.2 acres were regarded as unsuitable because of the reduced likelihood of having a naturally occurring suitable cavity.

Interspersion of nesting and foraging cover: Suitable reproductive habitats occur where foraging and nesting components are adjacent (within 180 m of each other), or in sites having both elements (e.g., wooded swamp). It was assumed that brood rearing habitat would be available within range (2+ kilometers) of any suitable reproductive/foraging complex.

HSI value = cover suitability x area suitability x interspersion suitability

Validation. The model was tested by comparing the proportion of Breeding Bird Survey occurrences having mapped habitat (17 of 20) to the proportion of a random set of points having mapped habitat (447 sites out of total of 798). The difference in relative proportions was significant (0.009). Modeled habitat was also found to correspond well with central Maine sites identified by MDIF&W biologist Allen Starr for placement of wood duck nest boxes (corresponding to 71 of 72 sites). Nest boxes had been placed in wetlands or open water having adequate brood rearing habitat.

Maine Department of Inland Fisheries and Wildlife marsh bird survey data (courtesy of T. Hodgman) also were used for testing. We compared the distribution of mapped habitat around a random set of 798 upland points to that for marsh bird survey stops at which wood ducks were observed in 1998 through 2000. Of the 97 sites with birds, 83 had mapped habitat, while only 174 sites out of the 798 randomly distributed sites had habitat. The Chi-square was highly significant, indicating that the overall model predicts localities useful to wood ducks. Restricting the test to habitats scored above 0.5 gave even an higher probability of association, supporting our premise that more highly scored areas have a higher suitability for this species.

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Appendix IIIc – Scaup Habitat Model

Authors: Arnold Banner and Sue Schaller, USFWS Gulf of Maine Program, 4R Fundy Road, Falmouth, ME 04105 http://gulfofmaine.fws.gov

Draft Date:

June 2001

Species:

Scaup; greater (*Aythya marila*), and lesser (*Aythya affinis*)

Use of Study Area Resources:

Wintering and migration. Greater scaup breed in Alaska and Canada (Terres 1980). Lesser scaup breed north of the U.S., and also in the mid-West. Both use coastal, riverine, and lacustrine open water and wetlands during migration. Lesser scaup are more prone to winter south of the Gulf of Maine and, more commonly, inland (Cottam 1939, Palmer 1975, Bellrose 1980). Data from hunter surveys show about 60% of the scaup taken between Maine and Massachusetts are greater scaup (Bellrose 1980).

Habitat Requirements:

In migration lesser scaup seem to prefer smaller lakes, ponds, and coastal marshes (Cottam 1939, Bellrose 1980, Terres 1980), resting on flats, mudbars, ice, and other areas with little or no emergent vegetation (Mulholland 1985). Greater scaup frequent larger lakes (Palmer 1975), using both fresh and saltwater bodies depending on availability, time of year, and tide stage (Burger 1983). Wintering scaup often are found in mixed flocks on large saltwater bays, harbors, sounds and estuaries (Terres 1980, Mulholland 1985).

In coastal New England both scaup feed primarily on molluscs, commonly blue mussels, dwarf surf clams, and oysters (Cottam 1939, Cronan 1957, Bellrose 1980, Terres 1980). Those in tidal freshwater areas also ingest plant material (Cronan 1957, Bellrose 1980). Scaup have the capability to feed in water 6 to 7

m deep, but seem to prefer a depth of 1-3 m (Cottam 1939, Cronan 1957, Palmer 1975, Bellrose 1980, Terres 1980, Mulholland 1985).

Human activity in the forms of boating, hunting, and fishing may disturb scaup (Cronan 1957). Also, ice formation in bays and harbors redistribute scaup away from otherwise preferred areas (Bent 1923, Palmer 1949, Burger 1983).

Habitat mapping. We modeled inland and coastal marsh migratory habitat, and coastal wintering resources for both lesser and greater scaup.

Migration. Lakes and ponds over 1 ha in area, and regularly flooded coastal marshes both were scored as indicated in the first table (below). Portions of these within 180 m of development were given a score of 0. The relatively low score (0.3 out of possible 1.0) reflects the lack information on specific use.

NWI Designations (wetlands only)	Cover Types	Cover Suitability (0 - 1 scale)
	Upland deciduous forest	
	Upland coniferous forest	
	Upland mixed forest	
	Grassland	
	Upland shrub, regenerating forest	
	Cultivated	
	Developed	
	Bare ground	
PEM_L2EM	**Lake/pond, emergent vegetation**	
PFOcon	**Palustrine forest, conifer**	
PFOdec	**Palustrine forest, deciduous**	
PSSdec	**Palustrine scrub shrub, deciduous**	
PSScon	**Palustrine scrub shrub, conifer**	

PAB_L2AB	**Lake/pond, aquatic vegetation**	
L1UB_PUB	**Lake/pond, unconsolidated bottom**	**0.3*, ****
L2US	**Lake, unconsolidated shore**	
L2RS	**Lake, rocky shore**	
R1UB	**Riverine subtidal unconsolidated**	
Rper	**Riverine perennial**	
E1AB	**Estuarine subtidal vegetated**	
E1UB	**Estuarine subtidal unconsolidated bottom**	
E2AB	**Estuarine intertidal algae**	
E2EM	**Estuarine intertidal emergent**	**0.3***
E2RS_R1RS	**Estuarine, tidal river rocky shore**	
E2SS	**Estuarine intertidal shrub**	
E2US	**Estuarine intertidal unconsolidated shore**	
M1AB	**Marine subtidal vegetated**	
M1UB	**Marine subtidal unconsolidated bottom**	
M2AB	**Marine intertidal algae**	
M2RS	**Marine intertidal rocky shore**	
M2US	**Marine intertidal unconsolidated shore**	
NOTES	* if at least 180 m from developed landcover ** if lake or pond 1ha or larger	

Wintering. Winter foraging habitat was identified as those estuarine and marine areas having both suitable depths (+1 to - 25 feet mean low water) and food resources for scaup (shellfish).

Beds of a variety of bivalve molluscs were identified using previously developed data for coastal New Hampshire (Banner and Hayes 1996), a Maine DMR shellfish coverage, and the NOAA 1995 National Shellfish Register coverage, characterizing shellfish growing areas by state. The latter described shellfish

abundance within relatively large coastal segments, and so the information was of lower resolution and given less weight than the other sources.

The data from annual USFWS mid-winter waterfowl surveys were processed by taking the maximum counts per segment polygon (or sub-segment, where available), and calculating the number of birds per unit area. Maine's Coastal Wildlife Concentration Areas (Maine Department of Inland Fisheries and Wildlife) counts were similarly converted to birds per unit area. Potential foraging habitat (having suitable depth and shellfish) was scored 0.5 for higher resolution and 0.3 for lower resolution shellfish data. Where these potential foraging habitats coincided with the occurrence of one or more scaup per 10 ha, they were scored 1.0 and 0.6, respectively. Where water depth was suitable and scaup were present the area was scored 0.5 (see table, below).

COASTAL HABITAT SUITABILITY SCORING	forage not documented	apparent foraging habitat	potential foraging habitat
scaup abundant	0.5	1.0	0.6
scaup uncommon	0	0.5	0.3

The migration and wintering maps then were combined, retaining the highest value per grid cell from the two maps.

Model Testing: The scaup occurrences from the Winter Waterfowl Surveys for 1999 and 2000 in Maine were used to test the wintering habitat map. We created a bounding polygon encompassing all waterfowl observations for those surveys, and created a randomly distributed set of 70 points within it. We then compared the presence of habitat near the random points to that for sites at which scaup were observed. Of the 19 sites with scaup, 17 had mapped habitat, while only 18 out of the 70 randomly distributed sites had habitat. The Chi-square was highly significant, indicating that the overall model does indicate localities useful to scaup.

Appendix IIIc – Scaup Habitat Model

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Appendix IIId – White-winged, Black and Surf Scoter Habitat Model

Authors: Arnold Banner and Sue Schaller, USFWS Gulf of Maine Program, 4R Fundy Road, Falmouth, ME 04105 http://gulfofmaine.fws.gov

Draft Date:

March 2001

Species:

Surf scoter (*Melanitta perspicillata*), black scoter (*Melanitta nigra*), and white-winged scoter (*Melanitta fusca*). Inventories showed populations of all 3 scoter species declined in the period 1954 to 1994 (Kehoe et al. 1994). Because all 3 winter in the study area, have similar feeding habits, and often are grouped in winter surveys, a single model was developed for all three species.

Use of Study Area Resources:

Wintering. Surf scoters and white-winged scoters breed in northwest and north-central Canada (Savard et al. 1998). Black scoters breed in western Alaska. Along the Atlantic coast, North America populations winter from Newfoundland to Florida (Palmer 1975, Savard et al. 1998). Maine sea duck harvest data show largest numbers are surf, followed by white-winged, then black scoters (MDIFW www page).

Habitat Requirements:

Food resources. In the Northeast, highest densities of scoters occur in areas of abundant, preferred foods (Cottam 1939, Stott and Olson 1973, Vermeer and Bourne 1982). In coastal areas, animal foods make up most (> 80%) of their diet, primarily molluscs and crustaceans (Cottam 1939, Brown and Fredrickson 1997). Blue mussels and short yoldia (*Yoldia sapotilla*) were the most important foods of birds collected in Massachusetts, while Atlantic razor clams (*Siliqua* spp.) were the most important food for birds collected in Long Island Sound (McGilvrey 1967). Arctic wedge clam (*Mesodesma arctatus*), Atlantic razor clam, and blue mussel accounted for the majority of food volume for scoters collected along the

New Hampshire and Massachusetts coasts (Stott and Olson 1973). Arctic wedge clams and Atlantic razor clams occur in sandy substrates along these coastlines (Stott and Olson 1973). Scoters feed in open water, including the regularly flooded portions of the intertidal zone, and subtidal areas (Vermeer and Bourne 1982, Bordage and Savard 1995).

Cover. Along New Hampshire and Massachusetts coastlines scoters prefer sandy beaches to rocky headlands (Stott and Olson 1973), although they are found off rocky shores on the west coast of North America (Savard et al. 1998) and Newfoundland (Goudie 1984). Scoter foraging depth is usually < 10 m (Cottam 1939, Vermeer and Bourne 1982, Sanger and Jones 1984, Bordage and Savard 1995, Goudie et al. 1994 *in* Savard et al. 1998).

Habitat Model:

Habitat suitability for these species is scored according the likelihood of use by any of the 3 scoters. Habitat was mapped using distribution information on scoter food resources (shellfish), supplemented with known scoter occurrence locations. Data on shellfish availability that was regarded as of a 'general' nature was used to map "potential foraging habitat"; more specific information on suitable shellfish beds was used to map "apparent foraging habitat". The latter, by implying a higher likelihood of suitable conditions, was assigned higher scores.

"Potential foraging habitat" was identified as relatively shallow (lower-intertidal to < -10 m) marine and estuarine areas either 1) having sandy substrates that are associated with occurrences of Atlantic razor clam and Arctic wedge clam, or 2) within the relatively large coastal segments of the NOAA 1995 National Shellfish Register. Substrate data was derived from Banner and Hayes (1996), Barnhardt et al. (1996), Knebel and Circe (1995), Brown et al. (in press) and Butman and Lindsay (1999). The NOAA 1995 National Shellfish Register coverage,

characterizing general shellfish growing areas by state, was provided by Kenneth Buja, NOAA SEA Division.

"Apparent foraging habitat" was mapped as waters in the lower-intertidal to < -10 m depth range and having mapped concentrations of blue mussels or other shellfish. Beds of a variety of bivalve molluscs were identified using previously developed data for coastal New Hampshire (Banner and Hayes 1996) and a Maine DMR shellfish coverage (provided by Seth Barker, MEDMR).

Available occurrence information included the data from annual USFWS mid-winter waterfowl surveys (general abundance, polygon data), 1985 through 1999. These were processed by taking the maximum counts per segment polygon (or sub-segment, where available), and calculating nominal number of birds per unit area. Data from a second source, Maine's Coastal Wildlife Concentration Areas (Maine Department of Inland Fisheries and Wildlife) counts, were similarly used to calculate birds per unit area.

"Potential foraging habitat" was scored as 0.3 on a 0 to 1.0 scale. "Apparent foraging habitat" was scored 0.5. Where these foraging habitats coincided with the occurrence of one or more scoters per 10 ha from either of the above survey data sets, they were scored 0.6 and 1.0, respectively. Areas having scoters and suitable depth, but without indications of shellfish beds were scored 0.5 (see table, below).

SUITABILITY SCORING (scale 0 - 1.0)

scoter abundance:	**forage not documented**	**apparent foraging habitat**	**potential foraging habitat**
scoters abundant	**0.5**	**1.0**	**0.6**
scoters uncommon	**0**	**0.5**	**0.3**

Model Testing: The specific scoter occurrences (point data) from the Winter Waterfowl Surveys for 1999 and 2000 in Maine were used to test the habitat

map. We drew a bounding polygon encompassing all waterfowl observations for those surveys, and used a random point coverage which had 70 points within the bounding polygon. We then compared the presence of habitat near the random points to that for sites at which scoters were observed. Of the 349 sites with scoters, 261 had mapped habitat, while only 24 out of the 70 randomly distributed sites had habitat. The Chi-square was highly significant, indicating that the overall model does indicate localities useful to scoters.

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BARROW'S GOLDENEYE ASSESSMENT

February 5, 2002

Amy Meehan

Maine Department of Inland Fisheries and Wildlife

Wildlife Division

Resource Assessment Section

650 State Street

Bangor, Maine 04401

NATURAL HISTORY

Description

Barrow's Goldeneye is a medium-sized diving duck with sizes averaging 45 oz (1, 278 g) for males and 29 oz (818 g) for females (Eadie et al. 2000). Adults are strongly dimorphic in both size and plumage. Breeding males have an iridescent, purplish-black head with a white crescent patch between the eye and bill. They have white sides, breasts, bellies and secondaries, which are contrasted with the black back, wings and tail (Eadie et al. 2000). Females have dark chocolate-brown heads, slate-gray backs, wings and tails, and white flanks, bellies and breasts. Immature and eclipse (non-breeding plumage) males resemble females but are heavier (Eadie et al. 2000). The iridies (colored portion of the eye), which are bright amber in adults, are more brownish in juveniles. May easily be confused with Common Goldeneye (see Eadie et al. 1995 and 2000 for differences).

Distribution

More than 90% of the world's population of Barrow's Goldeneye (*Bucephala islandica*) breeds from central Alaska to northern California (Robert et al. 2000). The species also breeds in Iceland, where the population is estimated at approximately 2000 birds (Robert et al. 2000). There has also been a small population associated with eastern North America, however, historically, breeding records have been sparse and, in many cases, unconfirmed (Bellrose 1980). Robert et al. (2000) documented the first record of Barrow's Goldeneye breeding in eastern North America from surveys conducted from May 1990 to 1998. They observed Barrow's Goldeneye on 137 lakes

and 5 rivers, 95.2% of which were along the north shore of the St. Lawrence estuary and Gulf. Nearly all breeding pairs were observed within 100 km of the St. Lawrence River. Four different broods were recorded. This area may represent a core breeding area for birds wintering along the St. Lawrence River (Robert et al. 2000).

Wintering Barrow's Goldeneye in eastern North America have been reported as far south as Long Island (Bellrose 1980). The wintering distribution in this area is highly local, with wintering concentrations of > 100 individuals only recorded in 3 areas of Quebec (Eadie et al. 2000). Wintering birds have also been reported around Anticosti Island, Gaspe Peninsula and in the Maritimes and eastern coastal U.S. but always in small numbers. Maine and Atlantic Canada likely have fewer than 500 wintering birds (Eadie et al. 2000).

Barrow's Goldeneye also frequent the Pacific coast from Washington northward. They occur inland around the Montana-Wyoming border and in southern Idaho, northern Nevada and Utah (Root 1988). See Eadie et al. (2000) for more detailed distribution information.

Taxonomy

Goldeneyes are two of three species in the genus *Bucephala*, which also includes the Bufflehead (*Bucephala albeola*). Barrow's and Common Goldeneye are sometimes classified in the subgenus *Glaucionetta* apart from Buffleheads (Eadie et al. 2000). Hybrids have been recorded only between Common and Barrow's Goldeneye. Of the 17 records of hybrids, 13 were males of alternate (breeding) plumage (Martin and DiLabio, 1994).

Habitat and Diet

Barrow's Goldeneye are found in alkaline to freshwater lakes in parkland areas as well as subalpine and alpine lakes, beaver ponds and small sloughs (Eadie et al. 2000). Lakes that are devoid of fish and are at least 1 m deep are preferred. The ducks avoid large, deep lakes with steeply sloping shorelines as well as lakes with dense emergent vegetation. They tend to select lakes with high productivity (abundant invertebrates). During the breeding season, both goldeneye adults and juveniles feed almost exclusively on aquatic insects, with vegetative matter making up only about 20% of the diet (Eriksson 1983, Eadie et al. 2000). In Sweden, the number of goldeneye and the density of fish populations were negatively correlated (Eriksson 1983). This was not the case for two dabbling ducks (mallard and teal). In lakes with high densities of fish, the pelagic populations of insects are reduced and insects become restricted to the shallow areas of the lakes with high abundances of emergent vegetation. Because of their feeding habits, dabblers are able to take advantage of the insects in the littoral areas of the lakes. Because goldeneye feed in the pelagic areas of lakes, they must compete with fish for prey items. When fish are present, goldeneye prefer lakes with a high shorelength to surface area ratio (Eriksson 1983). Breeding lakes are also restricted to areas with suitable nest sites. Nests are located in cavities in dead or dying trees (Eadie et al. 2000).

For birds that winter on salt water, mollusks make up most of the diet (78% by volume) (Eadie et al. 2000). Those wintering on fresh water consume insects, salmon eggs and parr, mollusks, crustaceans and vegetation (Eadie et al. 2000).

Breeding Biology

Pairs form during winter-early spring. Savard (1985) found evidence of long-term pair bonds in this species and believes that most pairs reunite on the wintering ground. Fidelity to wintering areas may be as strong as fidelity to breeding areas (Savard 1985). Males perform courtship displays on the wintering grounds (Nov-Jan) and pairs migrate to breeding areas in late March or April (Eadie et al. 2000). Females return to the same breeding area each year and may use the same nest sites (Savard 1985).

Nest parasitism occurs frequently in this species, particularly where nest boxes are provided (Palmer 1976, Eadie 1989, 1991). In British Columbia between 1984 and 1994 the intraspecific nest parasitism rate ranged from 30%-64%. The level of nest parasitism was influenced by nest-site availability. Average nest success was not different from un-parasitized nests, however nest success did decrease when parasitized clutches exceeded 16-20 eggs (Eadie et al. 2000). Average clutch size for un-parasitized nests ranges from 6.1-11.7 (Eadie et al. 2000). Interspecific brood parasitism has also been recorded with mixed clutches from Common Goldeneye, Bufflehead, Hooded Merganser, Wood Duck and Red-breasted Merganser (Eadie et al. 2000).

Brood amalgamation in this species is frequent (22% of 91 broods in British Columbia) with females with 10 day old or younger ducklings more likely to accept foreign offspring (Eadie et al. 2000). Brood survival in British Columbia averaged 37.7% $\pm$ 3.3 SE and the average brood size was 9.2 $\pm$ 0.2 SE ducklings at hatching. Duckling mortality was highest during the first week (Eadie et al. 2000).

Territoriality

Barrow's Goldeneye defend three different territories: 1) breeding, 2) wintering and 3) brood. During the breeding season, females spend twice as much time as males feeding, probably because of greater energy requirements. Therefore, males defend breeding territories to provide an undisturbed feeding area for the female (Savard 1988). Pairs exclude conspecifics from their breeding territories, which average 0.44 ha (1 acre) (British Columbia) (Savard 1982, 1988). This territory defense enhances the foraging efficiency of the female, reduces interference from conspecifics and reduces food depletion (Savard 1988). Males defend the breeding territory even when the female is absent.

Only paired Barrow's Goldeneye defend territories on the wintering grounds. In his study in British Columbia, Savard (1988) found that all wintering territories included some shoreline (i.e.: there were no territories on open water). He surmised that winter territory defense may also be food related, as other species that feed on similar food are also excluded by the pair.

Females defend distinct brood territories, which also appear to be food related. Defense of a brood territory may provide better feeding opportunities for the young (Savard 1988). Brood territories average twice the size of breeding territories (0.91 ha in British Columbia) (Savard 1988). Pair and brood territories rarely coincide, probably because brood territories are established on the lake closest to the nest site. This minimizes overland travel and exposure of the young to predators and loss of energy reserves (Savard 1988).

Survival and Longevity

Annual survival for females banded and recaptured on nest boxes is estimated at 64.1% ± 2.2 SE in British Columbia (Eadie et al. 2000). Little information on survival of males is available, however return rate to Riske Creek, BC was 67% ± 11SE (Savard and Eadie 1989).

Longevity records include two males of 15 years and a female of 12 years (band recovery data; Canadian Wildlife Service). The maximum longevity record was 18 years for a bird of unknown sex. The oldest known breeding female was 10 years.

MANAGEMENT

Regulatory Authority

In order to implement International treaties for the protection of migratory birds, the federal government has the overriding responsibility for establishing migratory bird hunting seasons. State input is through Flyway Councils, which administratively organize the 50 states into an Atlantic, Mississippi, Central and Pacific Flyway. States must select seasons within the federal proposed guidelines.

Past and Current Management

Special mention of Barrow's Goldeneye was made in the 1986 MDIFW Waterfowl Management Plan, noting that their occurrence in Maine's fall and winter waterfowl population was regular but the size and distribution of the population was not well known. It was suggested that further study was needed to define the size and distribution of the Barrow's Goldeneye population in Maine and that if localized concentrations were identified, regulation of harvests in local areas may be desirable.

The eastern North American population of Barrow's Goldeneye is thought to be composed of approximately 4,500 birds, most of which winter in Quebec and along the Gulf of St. Lawrence (Canadian Wildlife Service 2000a). The number of Barrow's Goldeneye wintering in all of Atlantic Canada and Maine rarely exceeds 400 birds (Daury and Bateman 1996, Canadian Wildlife Service 2000a). Important wintering areas in Atlantic Canada and Maine include: Annapolis, Pictou and Pugwash, Nova Scotia; Cocagne, Dalhousie and Shediac, New Brunswick; Oyster Bed Ridge, Roxbury,

and West River, Prince Edward Island; and the lower Penobscot River, Kennebec River, Belfast and Freeport, Maine. Dalhousie, New Brunswick has been identified as the most important site in New Brunswick, followed by Shediac (Daury and Bateman 1996).

Recent studies and surveys by the Canadian Wildlife Service have shown that some of the Barrow's Goldeneyes wintering along the St. Lawrence corridor breed along the north shore of the St. Lawrence Estuary and Gulf (Canadian Wildlife Service 2000a, Robert et al. 2000). Breeding pairs are surveyed annually in Quebec during surveys conducted by the Black Duck Joint Venture (Bordage 2001). Trends in the number of breeding pairs have been variable (Appendix I).

Currently the Barrow's Goldeneye is listed as a species of special concern by MDIFW in Maine. This species was also designated a species of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November, 2000. Quebec has hunting regulations designed to protect Barrow's Goldeneye during the hunting season. The season has been shortened (closes October 21 in District E) and the daily waterfowl bag limit is 6, but only 3 can be goldeneyes (Canadian Wildlife Service 2000b).

HABITAT ASSESSEMENT

Wintering areas need to be studied in terms of physical structure and food availability and use of wintering sites needs to be documented in relation to tide and ice conditions (Savard and Dupuis 1999).

Fishless lakes have been identified as an important habitat for both breeding Barrow's and Common Goldeneye. Maine has approximately 5,782 lakes totaling 987,299 acres. MDIFW recently surveyed 1,892 lakes in Maine, totaling 926,173 acres (approximately 1/3 of the total number of lakes) and has identified 32 fishless lakes/ponds in the state (Appendix III). Given that Barrow's Goldeneye have recently been found to be breeding in Quebec, it is not inconceivable that they may be breeding in northern Maine, or could someday expand their breeding range into northern Maine. Conservation of fishless ponds potentially could benefit both Barrow's and Common Goldeneye.

Continued coastal development is likely to impact the quality of habitat for both wintering and breeding waterfowl populations. Maine's shoreland zoning ordinances should help reduce impacts of timber harvesting on potential Barrow's Goldeneye breeding habitat in Maine.

POPULATION ASSESSMENT

From 1977 to 1994, 585 wintering Barrow's Goldeneye were recorded in Maine, for an average of 33 birds per year (Daury and Bateman 1996). In 1999 (Moore et al. 2001) and 2000 (Hodgman et al. 2002), MDIFW conducted surveys for wintering Barrow's Goldeneyes at 303 coastal and riverine sites. Forty-eight coastal sites and 26 riverine sites were surveyed in 1999 and 172 coastal and 57 riverine sites were surveyed in 2000. A total of 30 Barrow's Goldeneye were seen at 7 sites in 1999 and 99 Barrow's Goldeneye at 12 sites were seen in 2000 (Appendix IV). Densities at each site appear to change during the season. Sites in Freeport, Belfast, and Orono were identified as concentration areas. Subsequent observations since 2000 yielded flock sizes up to 60 birds on the Penobscot River during fall migration, and a flock of 15-25 birds in outer Jericho Bay (A. Weik pers. commun.).

Nearly all of the eastern population of Barrow's Goldeneye winter in Quebec (approximately 3,500 – 4,000 individuals). There are no consistently collected data to document a trend, but Canadian biologists speculated the population declined during the last century and that it could still be declining (Savard and Dupuis 1999, Canadian Wildlife Service 2000a). Because this population concentrates in a few wintering areas, it may be vulnerable to oil spills or other disasters. In addition, because the population is low, even a small continuous harvest could impact the population (Canadian Wildlife Service 2000a) if the harvest *rate* (i.e., proportion of the population that is killed) is sufficiently high. Potential recovery of local populations could be slow because females do not breed until their second year or later, they are single brooded, and they are

highly philopatric to their natal area (Eadie et al. 2000). In addition, availability of nest sites could be a limiting factor.

USE AND DEMAND ASSESSMENT – GOLDENEYES

Estimates of annual Common Goldeneye harvests in Maine have stayed relatively stable, with a slight drop since 1996 (Appendix V). Mid-winter inventory numbers appear to be stable as well (Appendix VI). Numbers of Barrow's Goldeneye wings from Maine submitted to the USFWS' Waterfowl Parts Surveys (1962-1996) have ranged from 0-7 birds per year, with an average of 1.5 birds per year. In contrast, Common Goldeneye submissions during 1961-2000 ranged from 12-111 birds per year, with an average of 43.8 birds per year. These differences could be attributed to differences in population sizes.

In 2000, MDIFW conducted a survey of migratory bird hunters. 272 people responded to the survey. Of these respondents, 118 (43%) hunted primarily ducks. Of those that hunted primarily ducks, 41 (34%) said they hunted goldeneye. Only 14% (6) of goldeneye hunters indicated that they shot 1-3 Barrow's. Ten (24%) people did not know if they had shot any Barrow's Goldeneye. Unfortunately, this survey did not target primarily waterfowl hunters, so these estimates of demands for goldeneye hunting could be low.

SUMMARY AND CONCLUSIONS

The Barrow's Goldeneye is a medium-sized diving duck that is one of three species classified in the genus *Bucephala*. More than 90% of the world's population of Barrow's Goldeneye breeds from central Alaska to northern California, however there is a small population (≈4,000 birds) that is concentrated along the St. Lawrence estuary. Barrow's Goldeneyes breed on alkaline and freshwater lakes as well as subalpine and alpine lakes, beaver ponds and small sloughs. Fishless lakes are preferred. Pairs form during winter-early spring and may reunite on the wintering grounds. Pairs migrate to breeding areas in late March or April. Males defend breeding territories and females defend brood territories, both of which appear to be food related. Breeding in eastern North America has only recently been confirmed in Quebec. Barrow's Goldeneyes are not known to breed in Maine but a small proportion of the Canadian population winters along the Maine coast. The Barrow's Goldeneye is listed as a species of special concern in both Canada and Maine.

There is much that we don't know about the eastern population of Barrow's Goldeneye. Studies in Canada are beginning to identify important breeding, molting and wintering areas. Further information on wintering populations, particularly philopatry and movements between wintering areas, needs to be gathered in the southern wintering range, including Maine.

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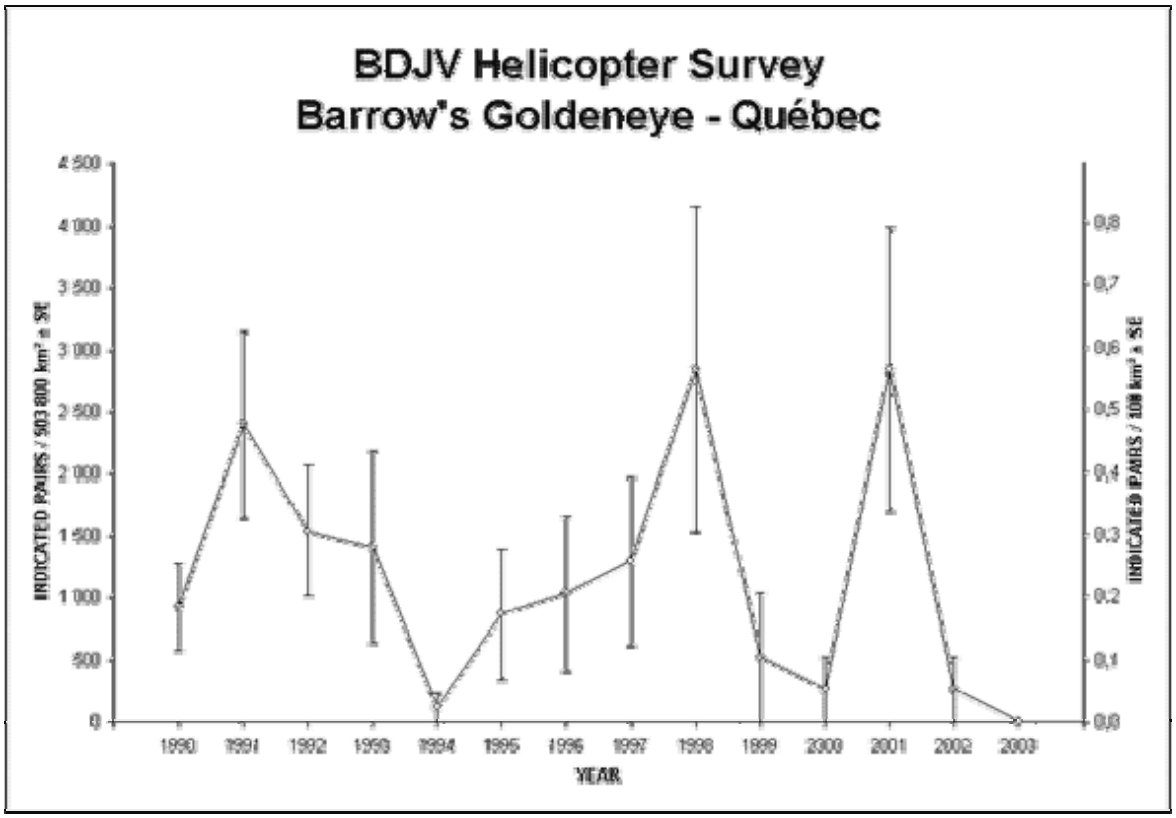
Appendix I



Trends in Common and Barrow's Goldeneye breeding populations in Southern Quebec.

Figure from Bordage (2001)

Appendix II

Fishless lakes and ponds in Maine.

Lake Name	**Lake Code**	**Town**
Cole Pond	3782	Paris
Dead Pond	9691	Poland
Hubbard Pond	3162	Porter
Little Pond	5580	Fryeburg
Speck Pond #1	3490	Norway
Speck Pond #2	3492	Norway
Sunken Pond	9679	Sanford
Silver Lake	5676	Phippsburg
Caesar Pond	5258	Bowdoin
Mud Pond	5788	Turner
Pike Brook Pond (East)	9819	T18 MD BPP
Horseshoe Pond	9823	T18 MD BPP
Duck Pond	4474	T22 MD
Unnamed Pond	9633	Aurora
Kerosene Pond	0219	T20 MD BPP
Dead Pond	1180	T25 MD BPP
Rocky Lake	1182	T25 MD BPP
Black Brook Pond (1st)	1188	T19 MD BPP
Black Brook Pond (2nd)	1189	T19 MD BPP

North Pond	3284	Grafton TWP
Fernald Pond	0100	Pierce Pond TWP
Douglas Pond	5044	Kibby TWP
Hill Pond	2460	T04 R05 NBKP
Crater Pond	0468	TB R11 WELS
Lake Cowles	2030	Mt. Katahdin TWP
Davis Pond	2032	Mt. Katahdin TWP
Chimney Pond	2046	Mt. Katahdin TWP
Klondike Pond	2050	Mt. Katahdin TWP
Unnamed Pond	8385	T03 ND
Saddlerock Pond	9662	TB R11 WELS
Mud Lake	1866	Caswell PLT
Johns (Jones) Pond	9468	T12 R13 WELS

Sample	**Mean Size (acres)**	**Std Deviation**
All Lakes	170.10	1364.66
Surveyed Lakes (minus Region G)	474.11	2407.45

Appendix III

Barrow's Goldeneye observed during surveys of coastal and riverine sites in Maine (1999, 2000).

Year	Visit 1	Visit 2	Visit 3	Total
1999	9	12	9	30
2000	44	50	5	99
Totals	53	62	14	129

Sites occupied:

1999

Bradley/Orono – Penobscot River

Fairfield – Kennebec River

Harrington – Pleasant River

Jonesboro – Chandler River

Jonesport – Englishman Bay

Lamoine – Jordan River

Roque Bluffs – Englishman Bay

2000

Brooklin

Stockton Springs

Belfast

Phippsburg

Harpswell

Freeport

Yarmouth

Naples

Falmouth

Biddeford

Kennebunk

Wells

Appendix IV

Maine Waterfowl Harvest Statistics (1961-2000)

Year	Maine Harvest of Common Goldeneyes
1961-65 (mean)	2240
1966-70 (mean)	2380
1971-75 (mean)	2040
1976-80 (mean)	3040
1981-85 (mean)	4040
1986-90 (mean)	2940
1991-95 (mean)	1720
1996	2000
1997	830
1998	775
1999	889
2000	655 (preliminary)

Appendix IV – Barrow's Goldeneye

Appendix V

Mid-winter Waterfowl Survey data for Common Goldeneye in Maine (1995-2001)

Year	Total Recorded by Year
1995	6424
1996	3776
1997	5429
1998	4543
1999	7416
2000	3392
2001	2510

SPECIES & AREA	SEASONS		LIMITS	
	FIRST DAY	FINAL DAY	DAILY BAG	POSSESSION
CROWS WMD's 1-6	15 Feb. 1 Aug.	15 Apr. 30 Sept.	NO LIMITS	
WMD's 7-30	1 Feb. 1 Aug.	31 Mar. 30 Sept.		
COMMON SNIPE	1 Sept.	16 Dec.	8	16
RAILS (Sora & Virginia)	1 Sept.	9 Nov.	25	25
MOORHENS & GALLINULES	CLOSED SEASON			
WOODCOCK	1 Oct.	30 Oct.	3	6
CANADA GOOSE (EARLY)	7 Sept.	25 Sept.	4	8
CANADA GOOSE (REGULAR):				
NORTH ZONE	4 Oct.	11 Dec.	2	4
SOUTH ZONE	4 Oct. 15 Nov.	30 Oct. 25 Dec.	2 2	4 4
SNOW GEESE (including Blue Geese)	4 Oct.	31 Jan.	15	No limit
BRANT	4 Oct.	30 Nov.	2	4
SEA DUCKS (Scoter or sea coot, Eider, and Long-tailed duck)	1 Oct.	31 Jan.	7* *(Shall not include more than 4 scoters or 5 eiders)	14* *(Shall not include more than 8 scoters or 10 eiders)
REGULAR DUCKS:				
NORTH ZONE	4 Oct.	11 Dec.	4*	8*
SOUTH ZONE (Including Black Ducks, mergansers and American coots)	4 Oct. 15 Nov.	30 Oct. 25 Dec.	(EXCEPTIONS TO THESE LIMITS ARE LISTED)	
BLACK DUCKS				
NORTH ZONE	4 Oct.	11 Dec.		
SOUTH ZONE	4 Oct. 15 Nov.	30 Oct. 25 Dec.		
PINTAILS & CANVASBACKS:	4 Oct.	30 Oct.	1	2
HARLEQUIN DUCKS	CLOSED SEASON			

****SPECIAL ONE DAY YOUTH WATERFOWL HUNT: September 25** (ALL duck species except harlequins may be hunted on this day. Daily bag limits as specified apply except that 1 black duck may be taken - see other restrictions below).

EXCEPTIONS*

BLACK DUCKS: Only 1 black duck may be taken as part of the daily limit; possession limit: 2. One black duck may be taken on Sept. 25 (Youth Waterfowl Hunt).

AMERICAN COOTS: Hunters may take 5 American coots in addition to the daily limit on regular ducks. It is unlawful to possess more than 10 American coots at any time.

FULVOUS WHISTLING DUCKS: It is unlawful to take more than 1 fulvous whistling duck in any one day or to possess more than 2 fulvous whistling ducks at any time.

MALLARDS: It is unlawful to take more than 2 hen mallards in any one day or to possess more than 4 hen mallards at any time.

MERGANSERS. Hunters may take 5 mergansers in addition to the daily limit on regular ducks, however only 1 may be a hooded merganser. It is unlawful to possess more than 10 mergansers at any time (only 2 of which may be hooded mergansers).

MOTTLED DUCKS: It is unlawful to take more than 1 mottled duck in any one day or to possess more than 2 mottled ducks at any time.

REDHEADS: It is unlawful to take more than 2 redheads in any one day or to possess more than 4 redheads at any time.

SEA DUCKS: Within the Sea Duck Hunting Area defined below, hunters may take 7 sea ducks in addition to the limits on regular ducks (but not more than 4 scoters or 5 eiders).

TEAL: In addition to the daily limit of 4, two (2) additional teal may be taken per day (either blue-winged teal or green-winged teal). A possession limit of 12 ducks is permitted providing that it includes 4 or more teal.

WOOD DUCKS: It is unlawful to take more than 2 wood ducks in any one day or to possess more than 4 wood ducks at any time.

SCAUP: It is unlawful to take more than 3 scaup in any one day or to possess more than 6 scaup at any time.