WATERFOWL MANAGEMENT PLAN – 1985

By

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PREFACE

Second Five-year Update

Waterfowl Management Plan

Revised

1985-86

This plan constitutes a second revision of the original adopted in 1974. As was the case in 1979 when Howard E. Spencer, Jr., updated the first plan, there have been significant changes in Maine's migratory bird population and harvest pressure in the past five years.

This plan includes similar data to the original and first revision and is intended to stand by itself. The format has changed considerably; where specific data has been deleted, reference will be made to the original documents.

Inclusion of the Canada goose in this plan is also a major change from previous years. This change better reflects the magnitude of Canada goose management in Maine and has resulted in the title change from wild duck to waterfowl management plan.

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NATURAL 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 species utilize a wide variety of habitat types based on seasonal preferences which result 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 (Table 1). Thirty-four species have been recorded in Maine as either breeding, migrating, or wintering populations. Appendix I contains a list of scientific names and range maps for Maine waterfowl.

Waterfowl, as with other animals, must meet minimum life requisites for survival. Adequate food, shelter, and water are provided by Maine wetland habitats to different degrees depending on the time of year. In addition, other habitat requirements are essential for successful reproduction. The presence of suitable nest sites in close proximity to brood-rearing habitat are required for a species to flourish in a given area.

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 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.

All waterfowl species 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 predation) result in young gaining flight in September.

Maine's breeding waterfowl may be grouped according to nest site preference into two major categories.

Maine Breeding Waterfowl Nest Site Preference

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

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.

A review of range maps (Appendix I) shows that 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, old squaw, and a few blue-winged teal are from prairie and arctic breeding populations. Canada geese are from locally reared and arctic breeding areas.

Reproductive strategies for Maine's breeding waterfowl are also varied. Certain species form pair bonds for life (Canada geese) while most others form pair bonds annually during the late winter and spring (mallard, wood duck, American black duck). Reproductive age for most dabbling ducks is attained within one year, while many of the diving ducks, 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.

Patterson (1979) states that a species' ability to sustain sport harvests is dependent on their life history characteristics (e.g. rate of natural increase, age at first

breeding, clutch size, and life span). Current ecological theory groups 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, are believed to have evolved in more stable habitats. They tend to have low 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 sport hunting) and the concept of threshold. The threshold level is the point above which sport 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)

suggests 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.

HISTORY

Habitat Trends

Wetland habitats have always been, and continue to be, dynamic systems. In Maine, the importance of our many small, and sometimes ephemeral, wetlands have only recently been documented (Ringelman and Longcore 1982). These studies have shown how our breeding waterfowl utilize these areas heavily for feeding, loafing, and nesting. Unfortunately, inventories of this type of wetland in Maine, so important to breeding waterfowl, are incomplete. Increasing beaver populations since the 1950's have resulted in improved waterfowl breeding habitat.

The dynamic aspect of wetlands is a factor which 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.

Recently completed inventories of Maine wetlands are useful for depicting regional differences in wetland type and acreage, but include only wetlands 10 acres or larger. Other data files on river and stream miles, lake inventories, and shoreline miles also shed some light on the extent of waterfowl habitat. It is safe to conclude, however, that an accurate estimate of Maine's waterfowl habitat has never existed.

Wetland trends in Maine have followed those in other parts of the country. These include losses of habitat due to draining, filling, or flooding. The relative impact has,

however, been less significant in Maine. Currently Maine's wetland protection laws and zoning ordinances have decreased the rate of these losses; however, they do not afford total protection. 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, Federal review authority for major power projects, and section 404 of the 1972 Clean Waters Act have all helped to reduce losses of Maine wetlands.

Population Trends

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 provide 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 may be concluded that the abundance of many species was greater than found today.

During the 1950's, 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.

Since that time, 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 goldeneye were measured.

Statewide populations estimates are not available for Maine waterfowl. An index to breeding populations (species composition of broods) exists as does an index to wintering populations (Mid-winter waterfowl inventory). A measure of annual production (brood counts) is conducted by the Maine Department of Inland Fisheries and Wildlife (MDIFW). There is no current estimate of the migrating populations occurring in Maine.

Use and Demand Trends

During the 1700's and 1800's, migratory birds, their plumage, and eggs were collected and used in interstate commerce for food and millinery trades. These uncontrolled practices decimated 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 1900's, Maine's eider colonies were reduced to a few breeding pairs on more remote islands (Gross 1944).

The 1916, Convention for the Protection of Migratory Birds between the United States and Great Britain was implemented in 1918 when the Migratory Bird Treaty Act was passed by the 64th Congress. Subsequent conventions have brought the United

Mexican States, Russia, and Japan into this comprehensive international agreement. This Treaty, and the laws which implement it, provide for strong involvement of the federal governments in the protection and management of migratory bird populations. Most of the major provisions of the original Act are still in force today.

The Federal Duck Stamp Law went into effect in 1934. Revenues generated from this stamp are used to purchase, develop and manage waterfowl habitat areas in the United States. This stamp is required for all waterfowl hunters 16 years of age or older.

Harvest and hunter use surveys initiated in the 1950's have provided a measure of trends relative to demand. The Federal surveys, which are structured around the sale of duck stamps, have documented increasing use of waterfowl resources since initiation of the surveys.

The estimate of man-days expended on waterfowl hunting in Maine (1961-1984) has ranged from 28,800 in 1961 to a high of 113,500 in 1974 (Table 2).

Harvest Regulations

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 he 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 1880's in spite of this law (Stanley and Stillwell 1886).

A summary of ensuing regulations shows that by the turn of the 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; unfortunately, these problems are still common today. Mendall (1969) summarized Maine's early harvest management strategy and the logic behind these regulations.

Hunter effort, harvest, and regulations are presented for the period 1953-1984 (Table 2). 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.

Harvest Trends

Harvest data are presented in Table 2 for black duck, other ducks, geese, and total waterfowl (1953-1984). The general trends apparent in these data are increasing kills into the mid-1970's and decreasing harvest from that point for both black duck and total waterfowl.

Users

Very little statewide data on waterfowl hunters are available. The National Survey of Fishing, Hunting and Wildlife Associated Recreation-Maine (Anon. 1980) presented data on migratory bird hunters in Maine. This category included woodcock,

snipe, and rail as well as waterfowl hunters. This survey implied that 3 percent of the population hunted migratory birds and annually expended $187 per hunter in the pursuit of this sport. Expansion of these figures by 1980 census data indicate that annually about 33,794 hunters spend $6,319,508. This estimate may be double that spent on waterfowl hunting alone since annual duck stamp sales in Maine average only 14,000-16,000 per year. Regardless of the accuracy of the numbers, it is obvious that waterfowl hunting has considerable economic and social impact in Maine.

Past Management Goals

The past management goals and objectives selected for the wild duck and Canada goose management plans were harvest oriented:

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.

Comparison of the latest 5-year mean (1979-83) with past species plan harvest objectives identifies some major deviations (Table 3). Along with the desired reduction in black duck kill, there has been a continued decline in green-winged and blue-winged teal harvests. Of the sea duck group, only scoters have dropped below the quota while eider and old squaw have increased. Wood ducks, ring-necked ducks, mallards, goldeneyes, buffleheads, and miscellaneous waterfowl have all increased above the objective levels established in 1974.

Our State waterfowl kill during the most recent five-year period has ranged from 71,000 to 86,000 birds with a mean kill of 77,528 birds (Table 2). The mid-point harvest

objective of 90,000 birds established in previous wild duck plans was nearly achieved in 1983 but the average is 12,472 birds lower than the objective. The kill of black duck has been reduced through regulation during October and has shifted toward late November and December when immigrant black ducks are suspected to outnumber resident breeders.

The kill during the past 5 years has shifted to other species and the relative proportion of the total kill is different from historical trends. Wood duck, ring-necked duck, and common eider have sustained the greatest increases. Decreased kill of teal relative to projections have been measured. The cause for this may be decreased abundance or reduced hunting effort in October.

Transplants of Canada geese from surplus birds captured in Connecticut have resulted in additional annual production in WMU's 1, 2, 3, and 5. These locally reared geese have been available to Maine hunters (as have the transplanted birds). This has provided increased use opportunity in Maine.

A major accomplishment in waterfowl 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. The original zones used during the experimental study and the zone formally adopted since 1981 were based on Wildlife Management Unit (WMU) boundaries (Appendix II).

A major contribution since the first revision (1979) has been reduction of black duck kill to enhance local black duck populations. It is still too early to evaluate the impact these regulations have had on resource abundance.

HABITAT ASSESSMENT

Statewide

Status

Maine's waterfowl habitat can be characterized almost exclusively as wetlands. Some upland and agricultural habitats are utilized seasonally for feeding and nesting; however, only wetlands will be considered in this analysis. The amount and distribution, but not necessarily quality, of wetland habitat will be analyzed for WMU'S. These WMU's will be utilized for analysis of habitat, harvest and populations throughout this plan. Appendix III provides a description of the wetland classifications used in the Wetland Inventory.

The migratory behavior of waterfowl species requires separation of habitat into three major categories. First, and most important, is that group of wetlands needed for Maine's breeding waterfowl. The second, and largest group, are essentially all wetland types found in Maine. This category reflects habitat for migrating species since waterfowl use all wetlands to varying degrees during the spring and fall period. The third group are wetland habitats utilized by Maine's winter populations.

Breeding Habitat: Combining acreages for shallow fresh marsh,. deep fresh marsh, shrub swamp, coastal shallow fresh marsh, coastal deep fresh marsh, and lakes and ponds under 10 acres by WMU yields an estimate of principle waterfowl breeding habitat (Appendix IV, Tables A-1, A-2, and A-3). WMU's may be ranked based on the amount of these wetlands present (Table 4).

Marine nesting islands are a special habitat type that has not been documented in the previous wild duck management plans. Korschgen (1979) reported 240 nesting colonies and 22,385 nesting pairs of common eider along the Maine coast. Hutchinson (1981, 1983, 1984) further defined common eider breeding habitats from Portland to Rockland. His work has led to an update of the Korschgen report which is currently being compiled by the United States Fish and Wildlife Service (USFWS). The list below summarizes the latest estimates available for eider breeding colonies (MDIFW data).

The Coast of Maine Wildlife Management Area (owned and/or administered by MDIFW) consists of approximately 500 acres on over 275 coastal islands and ledges. These important nesting islands account for over 27 percent of the total common eider breeding population of the State (Spencer et al. 1982). Department ownership and management of these islands insures protection for all seabird nesting populations present.

Migration Habitat: It is possible to rank the WMU's based solely on the amount of wetland habitat available (Appendix IV, Table A-1). Table 4 ranks the importance of the units for migrating waterfowl; however, it does not characterize the quality of these units relative to breeding or wintering habitat.

Wintering Habitat: Combining acreages of salt marsh and intertidal area by WMU yields an estimate of principle waterfowl wintering habitats (Appendix IV, Table A-4). Ranking WMU's (Table 4) shows that Unit 6 provides the greatest amount of wintering habitat followed by Unit 8 (24 percent) and Unit 7 (19 percent). There are also many other factors which affect the quality of wintering habitat which cannot be

adequately addressed here, e.g. the amount of estuarine habitat, extent of average annual ice cover, prevailing winds, and food abundance.

Changes

No comparisons may be made relative to habitat change since the 1979 revision because basically the same database has been used (the Wetland Inventory, MDIFW). Wetland acreages are slightly different, because the data file has been updated, edited, and additional data on intertidal acreage, and ponds (less than 10 acres) have been included in the current analyses. These additions, however, cannot be assumed to indicate changes in habitat quantity. They are refinements of habitat inventories which were not previously available. It is believed that increasing beaver populations have been responsible for improved breeding habitat conditions in the past 30 years.

Projections

Only minor changes in distribution and quality of wetlands are anticipated through the 1990 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. Small hydropower dams may in fact be beneficial to local breeding waterfowl if the annual drawdowns are timed properly. The number expected in the next 5 years will have no major impact on total acreage of available wetlands, however.

Continued coastal development is expected to the year 2000. This activity is likely to impact the quality of this habitat for both breeding and wintering populations. Increased boating, picnicking, and summer residential development will cause disturbance on and around breeding islands. Excesses of these activities are detrimental to colonial nesting seabirds.

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 in Maine may increase as these demands emerge. In order to insure habitat for Maine waterfowl populations, protection, acquisition, and management of wetlands will be increasingly important.

Recent, and significant increases in the commercial landing of blue mussels has altered the local distribution and abundance of this eider duck food resource. The impact of continued exploitation of this commercial fishery on breeding eider and wintering waterfowl populations has yet to be determined.

Conflicts between individuals raising blue mussels to marketable size and common eiders have already arisen. High eider populations in proximity to commercial aquaculture beds will likely result in increased incidents of these depredations.

POPULATION ASSESSMENT - CARRYING CAPACITY

Statewide

Status

Since there is no comprehensive inventory of waterfowl breeding habitat and no "Habitat Suitability Model" developed for breeding waterfowl, estimates of carrying capacity will not be attempted.

Projections

As better habitat surveys are developed, it may be possible to project breeding waterfowl carrying capacity. This lack of habitat inventory and a Habitat Suitability Model point toward future research needs. Anticipated increases in residential, industrial, and commercial development will continue to cause wetland losses (quantity) and increased disturbance near wetlands will adversely affect breeding habitat (quality).

POPULATION ASSESSMENT - ESTIMATED CURRENT POPULATION

Statewide

Status

As with habitat, it is necessary to deal with populations during three time periods. These again deal with breeding, migrating, and wintering populations.

Breeding Populations: The distribution and abundance of breeding waterfowl varies throughout the State. Although most species occur statewide, there are some exceptions. The common eider is limited to coastal islands of WMU's 6, 7, and 8. The northern limit of breeding range for wood ducks occurs in Maine and the goldeneye reaches its southern limit here. Beyond these range characteristics, populations vary in accordance with the amount, quality and distribution of habitat (Spencer 1979).

Maine's principle breeding species and their relative contribution to the population have varied through time (Table 5). For example, the black duck accounted for nearly 44 percent of all broods found during 1956-1965. Today (1982-1984) they account for only 19 percent of the broods recorded annually.

The acreage of Maine's principle productive wetlands was used to project theoretical breeding populations by WMU for three time periods (Appendix IV, Table A-5).

Methodology used was similar to Spencer (1979), but the basic database was changed slightly because of edited wetland habitat data. Species composition data (Table 5) was used to generate estimated broods by WMU, time, and species.

Minimum estimates were obtained because large acreages of habitat under 10 acres are not included in the wetland inventory database.

It should be noted that the species composition by WMU does not accurately reflect actual breeding populations. Statewide totals were used to obtain percentage species composition; therefore, goldeneye production in WMU 8 and wood duck production in WMU's 1 and 2 are unrealistically high. It has also been assumed that there has been no change in the quantity or quality of breeding habitat over time. Data suggest that the total number of broods produced annually per acre of quality habitat has not changed (Table 5).

There has been a change in the proportion of broods among the various species including decreases in the number of black duck (-57 percent), wood duck (-33 percent), and blue-winged teal (-34 percent) broods (Table 6). Concurrent increases in ring-necked duck (+50 percent), hooded merganser (+43 percent), green-winged teal (+69 percent) and goldeneye (+160 percent) were projected. Large increases in mallard (+409 percent) and common merganser (+915 percent) broods were artifacts of relatively small sample sizes.

Migrating Populations: There are currently no surveys which document the size of spring or fall migrating populations occurring statewide. An older report (Mendall and Spencer 1961) discussed Maine's migrating waterfowl populations. They concluded that no pattern was obvious for most duck species but that Canada goose numbers and mid- and late-season flights of duck through interior Maine were reasonably predictable. Factors governing size and timing of fall population abundance were production from

Maine and eastern Canada, water levels, food conditions, and immediate and seasonal weather patterns.

The marine and estuarine habitat of WMU's 6, 7, and 8 are extremely important during spring (March through April). Thousands of geese, brant, and black duck moving northward at this time stop in Maine to await ice-out on breeding grounds. Some of our islands provide stop-over areas for segments of the Atlantic brant population and Canada geese utilize coastal flats and marshes extensively in the spring.

Fall populations utilize all Maine wetlands and marine environments. Their numbers and distribution are dictated by weather patterns, population size, and time of year. Early migrating species, like the blue-winged teal, peak in mid-September and are generally absent after the first week of October. Hooded merganser, wood duck, and ring-necked duck populations usually depart prior to November or, in some years by early November.

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. Hutchinson et al. (1981, 1983 and 1984) documented spring and fall populations in marine habitats from Portland to Rockland. Current research is extending this data through Penobscot Bay.

Similar assumptions involved in estimating breeding populations are encountered in predicting fall populations. Because of this, these population figures may not accurately represent fall migrating populations. Emigration and immigration from one unit to another, or from and to areas outside of the State, cannot be accounted for.

The total pre-migration population estimates (Table 7) vary greatly from species to species for the three periods. A 57 percent reduction in black duck populations versus a 915 percent increase in common merganser populations, for example. At the same time, assuming no change in total wetland habitat and broods produced per acre of productive habitat, the overall projected change in pre-season population from pre-1963 to present is a 3 percent decline in total population.

Wintering Populations: Maine's Mid-winter Waterfowl Inventory data for 1980-1983 was based on a survey of the entire open coastal water area, including offshore islands and shoals (Table 8). These data, when compared to earlier surveys, permit estimating total wintering population. The approximate boundaries of the original eight survey units used in the winter inventory are shown in Figure 1. Steiner (1984) published a summary of Maine's winter waterfowl inventory data from 1954-1984 and a series of graphs depicting trends in Maine and Atlantic Flyway populations for some key species (see Appendix V).

Changes

Few changes have been documented here since projections of waterfowl populations have been based on similar databases used in previous plans. Until a significantly different wetland habitat inventory exists, this will continue to be the case. Refinement of pre- season population estimates will be possible as species composition of the breeding population is better defined through new surveys or research studies.

Projections

Annual waterfowl production and available breeding habitat may vary considerably. Weather and water availability greatly impact annual production. It is impossible to project these occurrences. Regulatory restrictions on black duck hunting were based on the assumption that breeding populations could be increased. It has since been shown that species specific harvest regulations impact non-target species as well. It is too early to project the impacts of these regulatory actions on the various breeding populations, but some positive response is suspected for the black duck.

Species Profiles

Black Duck

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:

(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.

(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).

(5) Low hunter kill of Maine winter-banded black ducks suggest that additional harvest is possible from this component of the population. (Author's 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).

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 percent or more for a period of 3 to 5 years. Maine initiated harvest restrictions in 1982 and further curtailed hunting regulations in 1983 and 1984.

At this time, some data suggests improved breeding populations in Maine. These trends are weakly exhibited in brood count data which show an increase in observed black duck broods on 37 reference areas. If these preliminary indications are true, then increases in Maine black duck production will result in larger pre-season populations of this important species.

Wood Duck

Nearly 100 percent of Maine's harvest of this popular bird is derived from local breeding populations. Spencer (1979) pointed out that regulations designed to reduce black duck kill would shift pressure to other species. He further stated that current wood duck harvest rates are approximately in balance with replacement capacity of the population.

These factors, and an apparent increase in kill associated with reduced numbers of broods in 1983 and 1984, point to the need for closer examination of harvest, banding, and production data for this species.

Eider Duck

Maine's breeding eider population is the only significant population present in the United States (outside of Alaska). The nucleus of this population centers in WMU 7 and decreases eastward in WMU 6 and westward in WMU 8. Spencer (1979) presented data suggesting that harvests were at or above the level supportable by Maine's breeding eider populations. Since that time, increases in eider kill have been measured. This increase appears to be related to reduced black duck hunting opportunity.

Recently, heavy losses from fowl cholera outbreaks have been documented in eider breeding colonies. This natural mortality factor, first recorded in Maine eiders in 1963, has been estimated to reduce some colonies by as much as 90 percent (Hutchinson 1981). These disease-related losses reduce breeding populations in local areas in years following outbreaks. Recovery from these drastic losses can vary greatly

from colony to colony. It has been suggested that cholera outbreaks reflect natural density dependent regulation of eider populations.

Losses to disease, expanding commercial mussel harvesting, increased use of coastal islands for recreation and development, and increased harvest of eider in Maine point toward potential problems in the future. The impact of the above on breeding populations, and the degree to which gull predation may be curtailing population growth need to be documented.

Ring-necked Duck

Ring-necked duck at a national level have been identified by the USFWS as a "Species of special Emphasis". They have developed a specific plan for management of this species. The ring-necked duck has established itself in Maine as a common breeding species and breeding populations are judged to be increasing. Heavy rains during the breeding season can cause delayed and reduced production because of the susceptibility of their nest to flooding.

Current increased harvest pressure has not had a measurable impact on breeding populations at this time. The potential of this occurring in the future needs to be evaluated.

Canada Goose

Maine's Canada goose breeding population has continued to increase. Transplants of excess birds from out-of-state resident flocks have resulted in establishing statewide distribution of breeding geese. Figure 2 shows locations of

confirmed breeding and release sites used since 1965. The emphasis in recent years 1981-1985 has been concentrated in the northern two-thirds of the State.

Objectives of earlier plans have been met in regards to increasing the distribution and abundance of Canada geese in northern Maine. Natural expansion from local breeding pairs is anticipated in future years.

USE AND DEMAND ASSESSMENT - HARVEST

Statewide

Status

During the 1979-1983 period, dabbling ducks accounted for 57.5 percent of the total duck kill, diving ducks 16.2 percent, mergansers 3 percent and sea ducks 23.3 percent (Table 9). This was the lowest percentage recorded for dabblers and the highest ever for the sea duck kill. These data support the conclusion that species-specific regulations (black duck restrictions) have had a definite impact on the harvest of non-target species.

Changes

Significant changes in waterfowl hunting regulations have occurred since the 1979 wild duck plan was completed. These changes were prompted in 1982-84 out of concern for the black duck population decline. In 1985, further restrictions promoted by the USFWS were designed to reduce the U.S. duck kill by 25 percent. Bag limit restrictions and shortened seasons were instituted after record low 1985 indices were measured for continental waterfowl populations.

Comparison of the 1983 harvest to the five-year average shows increased kill of all species except black duck, common goldeneye, bufflehead, scaup, and scoters (Table 9). Current harvest management strategies are likely responsible for this. These increases, particularly eider and wood duck, are indications that additional analyses are

required to determine the long-term impact of these harvests on local breeding populations.

Examination of the five-year means for the 1969-73, 1974-78, and 1979-83 harvests identifies the magnitude of these harvest changes (Table 10). The total duck kill declined from 98,627 to 77,528 (-21 percent) from 1969-73 to 1979-83.

The proportion of dabblers has changed greatly, declining from 73.2 percent in 1969-73, to 66.1 percent in 1974-78 and finally 57.5 percent in 1979-83. The black duck kill dropped by 55 percent during this period, and the kill of two other dabblers, notably green-winged teal and blue-winged teal, declined 54 percent and 64 percent, respectively. Wood duck (+57 percent) and mallard (+49 percent) kills have increased. In total the dabbling duck harvest in Maine has declined by 38 percent from 1969-73 to 1979-83.

Decreases in the dabbling duck harvest have been partially offset by increases in the other categories: diving duck (+32 percent), mergansers (+53 percent) and sea duck (+16 percent). The greatest proportion of these increased harvests have come from ring-necked duck (+59 percent) and common eider (+86 percent) populations.

Projections

As long as black duck harvest restrictions are in place, we can expect Maine hunters to pursue other species which are present in greater abundance. More liberal regulations on other species will direct hunter effort away from black ducks.

If regulations are effective and black duck populations increase in the next five years, there will be more demand for liberalization of hunting regulations. Care must be exercised during this period to insure continued population growth.

Analysis of the impact that increased kills of wood duck, eider duck, and ring-necked duck may have on local breeding populations will determine future regulations for these species. The increased proportion of the Maine harvest represented by diving ducks and sea ducks are of concern particularly for ring-necked duck and eider duck populations. These species exhibit the K-selected characteristics of low threshold levels and slow population response to harvest management. Increased harvests of these important breeders call for greater emphasis on monitoring harvest rate and survival rate.

Wildlife Management Units

Status

In the previous section, waterfowl harvest data were presented from Federal harvest surveys. This section examines waterfowl kill data from the Maine Game Kill Questionnaire (Appendix IV, Table A-6). The Federal Surveys provide the best harvest estimates at the State level but the Maine Game Kill Questionnaire permits examination of harvest data by WMU. The list below ranks WMU's based on total duck kill.

Waterfowl hunter and harvest data (1979-1983 average) were aggregated into north and south waterfowl hunting zones (Table 11). This analysis shows that 23.2 percent of the total harvest occurs in the northern waterfowl zone (WMU's 1-5). The southern waterfowl zone (WMU's 6-8) accounts for the remaining 76.8 percent.

Changes

The proportion of harvest occurring in the northern versus southern waterfowl zones has changed since 1977 when zoning was initiated (Figure 3). Prior to zoning, 18 percent of the harvest came from the northern zone; and 82 percent occurred in the southern zone. The five-year mean harvest since zoning was initiated showed a change to 23 percent of the harvest in the north and 77 percent in the south. This increased proportion of the kill in the northern zone is due to the additional hunting opportunity provided by a straight 45 or 50-day season in this zone.

Species Profiles

Black Duck

The following is an analysis of Maine's black duck harvest strategy since 1982. The regulation was designed to reduce the kill of Maine black duck during October.

The 1982 regulations reduced the overall Maine black duck kill by 26 percent from the previous five-year average (Table 12). This reduction, when apportioned between early and late seasons, showed the kill prior to November 10 decreased, but the kill after November 10 increased.

The bag limit reduction in the northern zone in 1982 appeared to produce little change in actual removal from this important breeding population. The restriction on coastal gunning in October shifted more effort into the late season. Because these regulations fell short of the desired goal, further restrictions were implemented in 1983.

The 1983 regulations eliminated 14 days from the northern zone black duck season. This regulation resulted in an 89 percent reduction in black duck kill prior to November 10 (compared to the previous five-year average) and a 73 percent reduction from 1982.

The bag limit in the southern zone during the 1983 late season was cut to one bird per day. Once again, the bag limit change appeared to have little impact on total kill. In fact, the 1983 late season coastal black duck kill was 59 percent above the previous five-year average. However, a statewide overall reduction of 45 percent from the previous five-year average was achieved by the 1983 season, because it significantly reduced the early season harvest.

Although the late season kill was higher than the previous five-year average, the regulations were not changed for the 1984 season, for the following reasons:

(1) Both northern and southern zone hunting opportunity were curtailed by 14 or 15 days.

(2) Bag limits in both zones were identical.

(3) Maine's locally reared birds were offered a degree of protection during October.

(4) The overall state kill was reduced by 45 percent.

(5) Results from this regulation exceeded the minimum established for Maine by the USFWS.

The department's recommendation in 1984 was to continue this harvest strategy for the remaining period established by the USFWS to adequately evaluate the impact of harvest restrictions on black duck populations.

The 1985 Federal waterfowl season framework was reduced to 40 days by the USFWS, opening no earlier than October 5, 1985. This framework resulted in even greater black duck season restrictions being established in 1985. This framework will likely be continued, at least for 1985 and possibly 1987, pending completion by the USFWS of the five-year stabilized regulation study.

One unanswered question remains, has the decrease in black duck kill prior to November 10th actually reduced the harvest rate of Maine black ducks? The increased kill after November 10th may be responsible for maintaining the harvest rate at the high levels found prior to regulation change. Planned analysis of banding data should be able to identify whether or not these regulations have been successful. If the harvest rate has not changed, than we have increased effort and harvest of wood duck, ring-necked duck, and eider duck without relieving the pressure on Maine black ducks.

Other Duck Species

The increased kill of wood duck, common eider, and ring-necked duck, as a result of curtailed black duck seasons, raises the question, "Will these increases adversely impact local breeding populations?"

Increased eider harvests have occurred concurrently with heavy losses to breeding colonies due to fowl cholera in Muscongus and Blue Hill Bays. Have these

natural losses plus increased legal kills been enough to reduce local breeding populations?

These questions will guide future evaluations of hunting regulations.

Canada Goose

USFWS and Maine game kill harvest estimates have fluctuated greatly in past years (Figure 4). However, these two independent surveys frequently differ in regard to relative change from year to year. Most of this variation is due to the small sample sizes used to calculate the estimates.

USE AND DEMAND ASSESSMENT - TYPE OF USERS

Statewide

Status

Users of Maine's waterfowl resource may be broadly split into consumptive (hunters) and non-consumptive (wildlife observers) categories. In many cases there is overlap between these groups. Many hunters are also non-consumptive users during non-hunting periods.

The non-consumptive user group includes all people who derive pleasure from the observation of wildlife during recreational pursuits. Hikers, campers, fisherman, vacationers, photographers, and artists are examples of non-consumptive users. Very little data specific to the number of individuals in this group are available. The National Survey of Fishing, Hunting, and Wildlife Associated Recreation (Anon. 1980) reported that there are 818,800 non-consumptive users of fish and wildlife in Maine (approximately 73 percent of population). Over 59 percent of these non-consumptive users of fish and wildlife did not hunt or fish. This figure implies that nearly 41 percent were either hunters or fisherman. The proportion of these individuals using the waterfowl resource cannot be determined however.

There is more data relative to the consumptive user groups provided by USFWS (Federal) surveys and by the MDIFW Game Kill Questionnaire. There are discrepancies in the actual estimates from these two surveys due to sample size and variation. Because of this fact, the Federal data will be used as the source of hunter

numbers and effort, and the State survey data will be used to apportion hunter numbers and effort by WMU.

The 1979-83 average total hunter days (90,935) expended on waterfowl hunting in Maine has decreased by 16 percent from the 1974-78 time period (Table 13). This drop in hunting effort occurred partially as a result of the drop of 13 percent in the number of adult hunters pursuing Maine waterfowl.

Change

There has been a significant downward trend in the sale of Maine resident hunting licenses and waterfowl stamps during the last five years (Figure 5). The decline of 12 percent in total duck stamps sold and 13 percent in total adult hunters has resulted in an overall decline of 16 percent in total hunting days (hunting effort) for the period 1979-83 (compared to the 1974-78 period).

Spencer (1979) noted that the trend as of 1978 was toward increased hunting effort (man-days), stamp sales, and resident hunting license sales. The decline in Maine duck stamp sales occurred 2 years ahead of the downward trend in resident hunting licenses. He concluded that, in light of increased effort and stable hunting seasons, "present day hunters find reduced success acceptable and will continue to hunt to some unknown point of diminishing returns".

It is now obvious that shortly after Spencer wrote the above, this unknown point of diminishing returns was exceeded. The current downward trends parallel those which occurred between 1958-1965 when short seasons and reduced bag limits resulted in lower harvests and hunting pressure.

However, as Spencer (1979) noted, lower harvest caused by curtailed seasons and reduced hunter numbers does not always result in reduced success rates of those continuing to hunt. The duck kill per man-day from 1969-73, 1974-1978, and 1979-1983 has been 1.04, 0.80, and 0.85, respectively (Table 10).

Projections

It is apparent that current (1985) restrictive regulations will be in place for at least the 1986 and possibly 1987 hunting seasons. This will likely result in a continued decline in measures of hunter numbers and man-days of duck hunting.

An increase in cost of the Federal Migratory Bird Hunting Stamp is also being considered in congress. If this occurs, there will likely be a decline in sales because of resistance of some hunters to the increased cost.

If current restrictive harvest regulations are effective in restoring Maine's populations of black duck, there may be a resulting increase in duck hunters.

The slight growth of Maine's human populations projected for the planning period will not greatly affect the number of waterfowl hunters. Other factors already mentioned (species abundance, regulations, and cost) will have a greater impact on waterfowl hunter numbers than population growth.

Probable implementation of nontoxic shot requirements may cause a temporary decline in hunter numbers. As cost of nontoxic shot loads declines and hunters become familiar with its use, the number of hunters is expected to recover to levels found previously.

Wildlife Management Units

Status

In the previous section the harvest by WMU was discussed. Table 11 also contains hunter use data. The percentage values by WMU will again be utilized in this section. This will prevent confusion caused by numbers for man-days that are different from those used in statewide analysis.

The listing below orders and ranks the WMU based on percent of total hunter days for duck hunting.

Combining WMU percentages show that 29 percent of the man-days are expended in the northern hunting zone and 71 percent in the southern zone (Table 11).

Change

The relative proportion of hunter days in the north zone has increased from 22 percent to 29 percent since the 1973-77 period, while the south zone proportion decreased from 78 percent to 71 percent (Figure 3). This change was caused by increased hunting opportunity afforded northern zone hunters since adoption of zoned seasons.

Projections

As with harvest, declines in man-day effort will likely continue in 1986 and 1987 if restrictive harvests regulations continue. Considerable dissatisfaction among waterfowlers with regard to population abundance and restrictive bag limits will also continue.

SPECIAL CONSIDERATIONS

Federal - State Role

Waterfowl Management

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 in the Department of Interior.

In practice, the USFWS works directly with Canada and Mexico as well as with state conservation agencies. State input is through Flyway Councils which administratively organize the 50 states into an Atlantic, Mississippi, Central, and Pacific Flyway. 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 Service has to publish and receive input from outside agencies and the general public. These procedures allow adequate time for public comment and insure stringent review of proposed changes.

Federal migratory bird regulations are separated into basic and general regulations (Rogers et al. 1979). States must select seasons within the Federal proposed guidelines. 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, are frequently subject to annual changes in response to duck population fluctuations and

harvest conditions. Examples of these types of regulations include: hunting season frameworks, season lengths, split seasons, special seasons, zoning, shooting hours and daily bag limits.

Lead Poisoning

Overview

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 continues to be poorly accepted by waterfowl hunters.

This weak acknowledgement of mortality stems from the inherent properties of lead toxicosis in waterfowl. There have been a few large scale die offs caused by lead poisoning, but these 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.

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 comes from sport hunters -- they are the source of toxic pellets (Anon 1984). In order to reduce this toxic loading of our waterfowl habitats, it must be the hunting community that addresses the problem. According to the National Wildlife Federation, "The blame for its (lead poisoning) impact or the credit for its correction cannot be passed on to any other group."

A search for a nontoxic shot substitute began over 30 years ago. Many materials have been tested but only one has proven to reduce toxicity and meet ballistic and economic criteria. This alternative is steel (or soft iron) shot. Many field shooting tests have shown that steel shot equals -- and in some cases outperforms -- comparable lead shot loads for bagging waterfowl (Anon 1984). Improvement in nontoxic shotshell loads have eliminated ballistic and design problems that were prevalent in the early 1970's.

Today, Maine waterfowl hunters have a viable nontoxic alternative to lead shot. The modern steel shotshells are effective in bagging waterfowl, and cost differences between steel and quality lead loads are minimal. Distribution of nontoxic shot loads remains a local problem, however, steel shot loads are available from large sporting goods retail outlets in southern Maine.

Status

Nationally, nearly 3,000 tons of lead are deposited annually in the environment by waterfowl hunters in pursuit of their sport (Hair 1983). Analyses based on the 1979-1983 mean harvest data from Federal and State surveys estimated lead deposition in Maine (Table 14). By assuming 6 shots per duck bagged and 1 1/8 oz. lead per shot fired, an estimate of 16.8 tons of lead deposited annually in Maine is derived. As with the duck kill, the greatest amount [13 tons (77 percent)] is deposited in the southern waterfowl zone (WMU's 6, 7, and 8). The addition of another 2.2 tons deposited in WMU 4 reveals that about 90% of the annual deposition occurs in south and central Maine.

Though there are few documented reports of waterfowl dying of lead poisoning in Maine, there is evidence that waterfowl from Maine have encountered lead during feeding activities. Data from Bellrose (1959) and Longcore et al. (1982) provide a comparison to pre-1954 and 1976-1980 periods (Table 15). Data from gizzards collected from ducks killed in Maine during both time periods, show that overall 4.8 (pre-1954) and 4.0 (1976-1980) percent of the ducks had ingested 1 or more lead pellets. The ingestion rate for black ducks from the two periods increased from 4.8 to 6.9 percent. These rates for black duck ate considered the most reliable for comparison since the sample size from both periods were large (725 and 506, respectively).

In summary waterfowl ingest lead pellets in conjunction with feeding activity. Species utilizing foods occurring in or on bottom sediments are more likely to ingest pellets than those utilizing other foods. Waterfowl feeding anywhere in Maine where hunting has occurred have the potential of ingesting expended pellets from shotshells

used by hunters. Ingestion is a cumulative process and therefore deposition of lead in wetland habitats should be considered potentially lethal to waterfowl. This factor alone should convince hunter's to convert to nontoxic shot as soon as possible.

Projections

Continued resistance to conversion to the use of steel shot is anticipated during this planning period. This points to the need to communicate effectively with sportsmen in order to achieve eventual conversion to nontoxic shot use for waterfowl hunting.

Implementing Nontoxic Shot Use

Overview

Nontoxic shot zones were first implemented in the Atlantic Flyway in 1976 as the result of strong support by the USFWS. Selection of zones was based on county kill per year or waterfowl kill per square mile. This was measured by Federal harvest surveys on a county basis. Few states chose to enforce entire county zones and in many cases arbitrary decisions resulted in establishing smaller zones.

During the early years many problems were encountered. Inadequate public relations prior to implementation, poor justification, in some cases, for selected zones, supply and distribution problems with nontoxic shotshell loads, shotshells available only in 12-guage, reloading components and data were not available, poor understanding of the ballistic differences between lead and steel shot, ineffective loads and poor design of original nontoxic shot loads, barrel damage to some guns, and poor results in field use, etc., were just a few of the problems.

Legislative action in 1978 severely hindered the USFWS ability to enforce nontoxic shot zone regulations. The "Steven's Rider", as it was called, required states to request implementation before Federal agents could enforce the regulations.

Philosophical differences of opinion among leaders of the Department of Interior and the USFWS started in 1981 with appointment of Ray Arnett as Assistant Secretary Fish Wildlife and Parks (Hair 1983). Between 1981 and 1984 the role of the USFWS as primary promoter of nontoxic shot use became extremely weak. Many existing USFWS programs were dismantled and progress toward National implementation slowed. In fact many previously designated zones were deleted.

During this lull in support for conversion to use of nontoxic shot on the part of the Department of Interior and officially the USFWS, other government agencies and private organizations continued to work toward this goal. The National Wildlife Federation, and approximately 26 state fish and wildlife agencies, formed the "Cooperative Lead Poisoning Control Information Program" which continued to work toward eliminating the prevalence of lead poisoning in our waterfowl populations.

In 1984, with the appointment of William Clark as Secretary of the Interior, the Department of Interior once again shifted toward assuming a stronger role in implementing use of nontoxic shot for waterfowl hunting in the United States. Requirements established by current programs are now being addressed by individual states.

The current National initiative by USFWS is to implement use of nontoxic shot zones based on two fronts. First is the annual losses to waterfowl from ingested lead and lead poisoning. Second is the increased, or at least now documented, losses to

bald eagle populations resulting from lead poisoning. Eagles consume lead pellets while feeding on crippled or dead waterfowl containing imbedded or ingested lead pellets . Recent court decisions have supported the implementation of nontoxic shot zones for waterfowl hunting based on the potential impact on the endangered bald eagle.

Status

In Maine, the overall Patterns and problems encountered were similar to those in other Atlantic Flyway states. Sagadahoc County was identified as a nontoxic shot zone in 1976 based on total County Kill (over 10,000 ducks and geese) and kill density greater than 10 ducks and geese per square mile). Negotiations resulted in implementing nontoxic shot use in the legally defined area of Merrymeeting Bay. The information below tracks the history of Maine's only nontoxic shot zone.

Year	Regulation
1976	Sagadahoc County Selected - Merrymeeting Bay approved as compromise zone - nontoxic shot required in 12 gauge or larger guns - possession of lead shotshells in nontoxic shot zone not illegal - regulation weakly enforced.
1977	Merrymeeting Bay Nontoxic Shot Zone – Nontoxic shot required in 12 gauge guns only - possession of lead shotshells in nontoxic shot zone illegal - enforcement stronger.
1978	Merrymeeting Bay Nontoxic Shot Zone.- regulations as in 1977 - Steven's Rider approved just prior to opening day - Commissioner requested enforcement - great public confusion about regulation resulted in lenient enforcement.
1979	Merrymeeting Bay Nontoxic Shot Zone - Regulations as in 1977 and 1978 - requested by Commissioner - Enforced.
1980	Merrymeeting Bay Nontoxic Shot Zone - First year no legal use of lead shot in any gun Enforcement requested by Commissioner.
1981	Merrymeeting Bay Nontoxic Shot Zone - defined by USFWS but State Regulation Repealed - use of lead shot in all gauges illegal in Federal regulation but not enforced by state - Enforcement on Rachel Carson National Wildlife Refuge was not supported by Commissioner.
1982	Commissioner requested repeal of Merrymeeting Bay Nontoxic Shot Zone - Approved by USFWS - No nontoxic shot zone in Maine since this time.

Nontoxic Shot Zones – Bald Eagles

Maine has two counties which are being evaluated based on the impact of lead poisoning on bald eagles. Hancock and Washington County have significant wintering eagle populations and substantial waterfowl harvests. These two measures have been used to select counties where nontoxic shot must be used for waterfowl hunting. These minimum criteria (in effect 1985) have not been exceeded as yet. If, in the future the minimums are lowered, Hancock and Washington County will likely be identified as nontoxic shot zones for waterfowl hunting for the following reasons:

(1) High number of wintering eagles

(2) Substantial waterfowl kill

(3) Confirmed deaths of bald eagles due to lead poisoning.

Nontoxic Shot Zones – Waterfowl

The USFWS has developed a system to evaluate areas for selection as nontoxic shot waterfowl hunting zones. These criteria based on waterfowl kill are being applied in all states. The USFWS believes the guidelines provide a systematic, scientific, and logical approach to phased in implementation of nontoxic shot in the United States. Counties with 5 or more ducks and geese killed per square mile are triggered. Decision criteria for lead ingestion rate (greater than 5 percent of gizzards with one or more pellets) and blood lead (greater than 5 percent of sample over 2 ppm) or liver lead (greater than 5 percent of sample over 2 ppm wet weight) must be exceeded in order to determine the need for nontoxic shot requirements.

Seven Maine counties have been triggered based on the 1981-1983 mean kill per county (Figure 6). The USFWS guidelines as they apply to these counties are summarized in Table 16. Monitoring of the kill from these areas was started in 1985 and is in progress. Collection of paired gizzard and liver samples from Primarily black duck, mallard, ring-necked duck and pintails are now being taken. An alternative schedule for monitoring these counties has been submitted and approved. The area west of the Penobscot River in the south zone is being monitored during 1985/86 and 1986/87 waterfowl season (implementation 1987/88). Monitoring east of the Penobscot River in the south zone will begin in 1987/88 and continue in 1988/89 (implementation in 1989/90).

Projections

During the planning period it is likely that nontoxic shot use will become necessary in some parts of Maine. A review of the issue leads many to believe that widespread adoption of its use is demanded. Department policy on use of nontoxic shot or all waterfowl hunting supports Atlantic Flyway conversion to the use of nontoxic shot by 1987-1988 (Appendix VI).

Small "hot-spot" zones will not be considered because of their inability to affect widespread conversion. Future zones in Maine should be considered only at the WMU level or larger areas. Only through zones of this size will supply and distribution problems of nontoxic shot be solved.

Mandated use of nontoxic shot on a broad scale will result in increased production and reduced cost. Hunter acceptance will be more rapid as required use will

force experimentation with new loads. Any difference in crippling rates will decrease as hunters become proficient in the art of wing-shooting with steel shot.

Environmental Pollution

Overview

An in-depth discussion of this topic is not possible in this document; however, because of their potential for impact, certain items will be briefly mentioned. Pollutants such as chemicals and heavy metals may affect waterfowl either directly (toxic or sublethal dosage) or indirectly (impacting food supply). Deaths due to chemicals are possible, however, the more likely result is sublethal damage that reduces individual survival or reproductive ability. Longcore and Stendell (1982) summarized the impact DDE had on black duck reproductive success in the late 1950's and 1960's. They showed how the population seemed to be recovering from the sublethal loading which caused significant egg shell thinning and poor hatching success.

Three broad categories of environmental pollution which are frequently accused of being the cause of reduced waterfowl populations in Maine are acid rain, spruce budworm spraying (insecticides), and herbicides. Each of these has been the stimulus for much past and current research. The impact of each on waterfowl has only begun to be measured.

Insecticides: Most persistent insecticides are no longer used in the United States because they produce harmful physiological and behavioral effects in wildlife (Brown and Hunter 1985). Those currently being used are usually short-lived, and relatively nontoxic to vertebrates at normal application rates, but many are highly toxic to aquatic

invertebrates. As a result (depending on the timing of the application), spraying of wetland ecosystems could potentially reduce aquatic invertebrate food supplies of waterfowl.

Growth rates of ducklings on ponds sprayed with carboryl (an insecticide used in control of spruce budworm) were proven to be significantly lower than ducklings reared on control ponds (Hunter et al. 1984). The cause was lowered aquatic invertebrate food resources.

Brown and Hunter (1985) speculated on the potential impacts the extensive use of insecticides in wetland habitats could have on waterfowl reproduction. Their conclusions were that any event that significantly reduces the food supply of breeding female dabbling ducks and growing ducklings will have dramatic effects on reproductive potential and duckling survival. These conclusions must be weighed heavily in decisions relative to widespread mosquito and/or black fly control as well as future spruce budworm spray programs.

Acid Precipitation: The impacts of this pollution are currently being documented through extensive international research. The affects of acid rain on waterfowl in Maine have recently been studied by Longcore et al. (1985) and Hunter et al. (1985).

Species directly impacted by acid rain appear to be aquatic invertebrates and fish. Changes in these populations will affect waterfowl through their food supply. Longcore et al. (1985) describes waterfowl most likely to be affected in Maine. Head water ponds (which are most susceptible to acidification) support reduced populations of fish when affected. Therefore, fish eating species (loons and mergansers) sustain direct impact as their food supplies are reduced or become absent. The opposite is true

for waterfowl species reliant on aquatic invertebrates for food (Hunter et al. 1985). As fish populations in acid ponds decrease, the biomass of aquatic invertebrates increases. Hunter noted improved growth of ducklings reared on acid ponds compared to those reared on ore neutral ponds which indicated that fish were direct competitors for food supplies of ducklings. These results need to be further tested. However, based on this study a negative association between dabbling duck species and acid rain is not apparent. In contrast, current studies in Canada appear to implicate acid rain as being detrimental to dabbling and diving ducks (CWS field studies in Progress).

Herbicides: Most research with these chemicals has centered on terrestrial ecosystems. However, there is little to implicate the use of these agents as being detrimental to aquatic environments. The impact on waterfowl food supplies and nesting and brood rearing habitats is thought to be negligible. If future research contradicts this conclusion, then the impacts will have to be addressed.

Sensitive Species

Two species of waterfowl found regularly in Maine deserve special mention since each occur annually during migration and wintering. Each is subject to liberal daily bag limits (5 each) during the regular duck season. They occur in small numbers and, in at least one case, in discrete locations. These factors may subject these populations to risk from local overharvest situations.

The harlequin duck originates from a very small eastern population which breeds in coastal Labrador, Quebec, and arctic regions. These rare waterfowl can be found traditional areas used regularly during fall and winter.

Currently, the harvest and demand for these birds is unmeasured but believed to be low. Because of their restricted range in Maine, the potential for over exploitation exists.

The Barrow's goldeneye is in a similar situation. They originate from an even smaller eastern population with a limited breeding area of coastal Labrador. Their occurrence in Maine's fall and winter population is regular but the size and distribution of their populations is not well defined.

Both of these species require study to define the size and distribution of their populations in Maine. If localized concentrations are identified, it may be possible, and desirable, to regulate the sport harvest in local areas to insure that these unique populations are not jeopardized by hunting or habitat alteration.

SUMMARY AND CONCLUSIONS

Past, Present and Future

Maine's waterfowl populations vary seasonally with respect to species composition and abundance. Of the 34 waterfowl species observed in Maine during migration periods, 15 of these breed in Maine and 18 are found in Maine during winter months.

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.

Although there are no measures of Maine's total breeding populations, indices to production have been measured since the mid-1950's. These indices have shown major change in regard to species composition of Maine's breeding waterfowl populations. Maine is the geographic division for a number of breeding ranges. The wood duck reaches it's northern limit and the 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.

Maine's average annual harvest (79,079 ducks and geese 1979-83) accounted for approximately four percent of the Atlantic Flyway harvest. This kill was measured from roughly 17,800 hunters and 108,000 man-days (1979-83). The trend in hunter numbers and man-days during the last five years has been decreasing. These

decreases appear to be related to reduced population abundance, increasingly restrictive harvest regulations, and increased license costs.

A decline of nearly 57 percent in the projected number of black duck broods in Maine has caused us to reduce the Maine kill of this important breeder. Concern for North American black duck populations has resulted in international (US and Canada) efforts to reduce total black duck kill since 1984.

Increased kills of wood duck, ring-necked duck and common eider (all important Maine breeders) since implementation of black duck harvest restrictions are of concern. The impact of the increased annual legal kill of these species on their breeding populations has yet to be determined.

There is a lack of survey data on migrating waterfowl populations (particularly fall populations). This lack hinders evaluation of harvest survey data. Adequate estimates of the size and composition of the breeding population are also lacking.

The magnitude of lead ingestion rate and the potential for lead poisoning in Maine has not been well documented. Current Federal emphasis is toward implementation of nontoxic shot zones for waterfowl hunting where the need is greatest. Difficulties in instituting flyway wide ban on use of lead shotshells are expected to delay this beyond the planning period of 1990. During the next five years, lead shot restrictions will likely be required in parts of Maine based on concern for lead poisoning in waterfowl and bald eagles.

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.

In closing this plan I will paraphrase Spencer's (1979) conclusions (reprinted here for your convenience).

1979 - In summation, it appears that the breeding population of black ducks is declining and needs protection, the wood duck is increasing (probably thanks to nest box programs in central Maine) and can perhaps stand a moderate increase in harvest. Eiders, mallards, and ring-necked duck populations are in good condition and are currently being harvested at safe levels. Hunting pressure is at, or close to, the maximum acceptable level spelled out in the original objectives.

1985 - In summation, restrictive regulations in effect since 1982 have been designed to reduce kill of local black duck while providing some opportunity for a legal harvest. A shift of the kill toward the late season has occurred, hopefully at the expense of immigrant populations present during migration. Increased kills of wood duck, ring-necked duck and eider duck since 1982 make Spencer's assessment of harvest at a "safe level" more questionable today. Hunting
pressure continues at a high level in spite of more restrictive regulations.

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