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WATERFOWL POPULATIONS AS RELATED TO HABITAT CHANGES IN BOG WETLANDS OF THE MOOSEHORN NATIONAL WILDLIFE REFUGE

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WATERFOWL POPULATIONS AS RELATED TO HABITAT CHANGES IN BOG WETLANDS OF THE MOOSEHORN NATIONAL WILDLIFE REFUGE

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ABSTRACT

The response of waterfowl populations to marsh management on the Moosehorn National Wildlife Refuge in eastern Maine was evaluated. The objectives were to: (1) estimate populations of breeding waterfowl in 1974 and 1975 and compare these numbers with trends of the past 30 years and; (2) to interpret these trends in relation to vegetative and other environmental changes that have occurred.

The long-term trend of black duck (Anas rubripes) numbers on the primary study areas was downward. Fluctuating water levels, advanced plant succession and a decrease in the number of open water areas were factors contributing to the decline. Breeding populations of ring-necked ducks (Aythya collaris) generally increased in sedge wetland because of the preference of that species to nest in floating sedge-bog mat which became more available to the birds due to changes in water levels. By contrast, ring-necked ducks decreased throughout the period in shrub wetland because of the adverse effects of plant succession.

INTRODUCTION

Little information exists on the effects of specific waterfowl management techniques of bog habitats common in the Northeast. Certain bog flowages of the Moosehorn National Wildlife Refuge have been managed with varying degrees of intensity for the benefit of waterfowl for more than 30 years. Several techniques have been implemented.

1 U.S. Fish and Wildlife Service, Maine Department of Inland Fisheries and Wildlife, University of Maine, and Wildlife Management Institute, cooperating.
on Refuge wetlands in an attempt to increase waterfowl production. These included water level control, food planting and creation of open water areas. During the present study I evaluated the long-term effects of these techniques on breeding waterfowl populations of Moosehorn Refuge. My objectives were: (1) to estimate populations of breeding waterfowl in 1974 and 1975 and compare these numbers with trends of the past 30 years and; (2) to interpret these trends in relation to vegetative and other environmental changes that have occurred.

STUDY AREA

Barn Meadow and Magurrewock streams on the Moosehorn Refuge comprised the study areas (Fig. 1). These were divided into 7 impoundments which ranged in size from 10-65 ha (25-160 acres) and totaled nearly 200 ha (500 acres). Several successional stages characteristic of bog habitat were present on each impoundment. Conifer and mixed hardwood forests, and mowed fields surrounded them. Each of the study areas: (1) have acidic waters; (2) have been subject to habitat manipulation practices; and (3) have water control structures.

The principal waterfowl species which breed on the Refuge are the black duck (Anas rubripes) and the ring-necked duck (Aythya collaris). Other less common breeding waterfowl include the Canada goose (Branta canadensis), wood duck (Aix sponsa), hooded merganser (Lophodytes cucullatus), blue-winged teal (Anas discors) and American green-winged teal (Anas crecca).

METHODS

Information was extracted from files and reports of the Moosehorn Refuge and the Cooperative Wildlife Unit on waterfowl populations, vegetative changes, water levels, and habitat manipulation practices conducted prior to 1974. Within the Refuge, Magurrewock and Barn Meadow streams were selected as the study areas because habitat descriptions and detailed records of waterfowl populations, water levels and management practices existed. Quantitative vegetative studies had been conducted in 1945 and 1951 on the Barn Meadow area.

During 1974 I initiated field work to gain familiarity with the areas and with the techniques used in earlier evaluations. In 1974 and 1975 I estimated waterfowl populations and measured environmental factors that had been previously examined on the areas. These factors included vegetative changes and water levels. Information on plant composition (frequency of occurrence) was gathered in the field using
the line transect method, which was the same technique as that used in the previous vegetative studies on this area. Full details of this technique are given in Fefer (1976). The wetland classification system used to describe vegetative changes was modified from the system proposed by Golet and Larson (1974). A sedge-bog mat category was added to define bogs more adequately. The system employs life-forms as the descriptor of the vegetative component. Life forms reflect differences in physical structure, habit of growth, and usually differences in ecology. Water levels were determined by recording the readings on the permanent gauges at each control structure. Counts of breeding
pairs and/or territorial males, as well as observations of broods were used to estimate annual populations and production of waterfowl.

Data were analyzed using the correlation analysis program included in the Statistical Package for the Social Sciences (Nie et al. 1975).

RESULTS

Long-term breeding populations:

Some of the recorded differences in the population trends of black ducks and ring-necked ducks on the study areas (Figs. 2 and 3) may be due to variation in coverage and techniques used by numerous observers whose data were examined for these comparisons. I felt that the data were adequate to detect significant numerical changes.

Black ducks on Barn Meadow fluctuated at relatively high numbers from 1947-1955. Population estimates on this area in 1974 and 1975, however, indicated a substantial decrease from the average numbers during these years of most intensive management. The population apparently has been at or near the 1974-75 low for the past 10-15 years.

Ring-necked ducks increased in the late 1940's with peaks in 1949 and 1950 on Barn Meadow. During the mid-1950's numbers fluctuated at lower levels but again increased in the late 1950's. The 1974-75 population approximated an average for the 1945-1967 period.

On Magurrewock Stream, the larger of the two study areas, black ducks fluctuated at relatively high numbers during the late 1940's and mid-1950's after a decline in the mid-1940's. From 1965-1971 this species occurred in fewer numbers than the long-term average but with frequent year to year changes. The 1974-75 data indicated an increase over the average number of breeding pairs from 1956-1971 but a decrease from the average population during the years of most intensive management, 1945-1955.

Breeding ring-necked ducks on Magurrewock decreased during the mid-1940's and increased in 1949 and 1950. This was followed by a slight decline to a low point in 1953. Slow increases in the mid- and late-1950's were followed by a second general decline in the early 1960's. However, the highest number in 35 years was recorded in 1963. The 1974-75 population approximated the average long-term population found in the area.

Environmental Changes:

Management—Habitat manipulation was started soon after the Refuge was established in 1937 in order to create conditions favorable for waterfowl production. Streams were impounded to create new wetlands. The juxtaposition and characteristics of the wetlands enabled
Figure 2. Number of breeding pairs of black ducks on Barn Meadow and Magurrewock, 1941-1975.
Figure 3. Number of breeding pairs of ring-necked ducks on Barn Meadow and Magurrewock, 1941-1975.
the establishment of different priorities for some areas (Fig. 1.) Middle Barn Meadow has been managed primarily for nesting cover. Dynamiting and ditching created greater interspersion of vegetation and water. A perimeter channel was excavated between the marsh and upland to discourage potential terrestrial predators and to create more open water. The water level in Middle Magurrewock has been managed to provide nesting cover, open water for feeding, loafing sites and brood cover. Aquatic and upland food plants were propagated on or adjacent to the above wetlands. A more detailed description of the habitat manipulation program is available in Fefer (1976).

Vegetation—The major plant species that occurred in Middle Barn Meadow in 1945, 1951 and 1974 were grouped according to their life-form (Fefer 1976). Data on frequency of occurrence are most comparable because of the techniques used. The frequency of occurrence of individual species comprising a life-form was totaled for each of the three years (Fefer 1976). There was a substantial difference between the total percent frequency of the life-form groups found in the 3 sample periods. As Fig. 4 illustrates, each of the major life-form

![Figure 4. Total percent frequency of occurrence of the major life-form groups on Middle Barn Meadow, 1945, 1951, and 1974.](image-url)

groups apparently decreased between 1945-1951. Subsequently, between 1951-1974 an increase occurred in frequency of the life-forms, except for the grass and sedge-like plants.
The decrease in the frequency of the life-form groups noted in 1951 probably is the result of the management program conducted on Barn Meadow in the late 1940's. Raising the water level in 1945-46 very likely flooded certain species of ground layer, herb and grass and sedge-like plant life-forms where they existed on a grounded mat. Shrubs decreased by 1951 due to marsh development work during the late-1940's.

After 1951, the floating sedge-bog mat accumulated organic matter and became thicker. Sphagnum moss (Sphagnum spp.), certain herbs and low ericaceous shrubs, particularly leatherleaf (Chamaedaphne calypculata) and cranberry (Vaccinium macrocarpon), invaded the thicker mat. These shrubs replaced some of the sedges (Carex spp.) in the typical bog hydrosere. Certain small shrub-bog habitats were invaded by larger shrubs, particularly sweetgale (Myrica gale). These areas became grounded, and thus no longer free to float up and down with changing water levels as a result of the large root system of the shrubs.

Cattail (Typha latifolia) has increased in Barn Meadow since 1951. The frequency of occurrence of this plant is underemphasized in the 1974 data because of sampling techniques.

Apparently, vegetative changes were few in Magurrewock when compared to Middle Barn Meadow. The extent of the sedge-bog mat appears unchanged when compared to photographs of the area taken in 1943 (Refuge files). Needle rush (Eleocharis acicularis) formed a dense solid mat of vegetation on the west side of Magurrewock in 1953 (Refuge files). Scattered clumps of pickerel weed (Pontederia cordata) were also present. Pickerel weed and sedge are now abundant in this area.

Changes in the interspersion of vegetation and water have taken place in Middle Barn Meadow. Many of the channels and potholes\(^2\) have become choked with vegetation, particularly pickerel weed, mermaid weed (Proserpinaca palustris) and cattail. In addition, horizontal growth of the peat mat has resulted in the disappearance of certain open water areas and the narrowing of others. Mendall (Unit files) noted as early as 1954 that several areas in the perimeter channels were filling rapidly, and in 1956 he observed that many of the dynamited channels were filling in. A large portion of the open water presently available in Barn Meadow is in the Upper Barn Meadow area which was impounded in 1963.

\(^2\)A "pothole" as used in this publication refers to a small break in the marsh vegetation. This term is in common usage throughout the northeast and has no relationship to true geological "potholes"
DISCUSSION

Waterfowl Populations:

To evaluate the effects of management on Moosehorn populations, it was necessary to first determine whether duck numbers on managed study areas of the Refuge (Barn Meadow and Magurrewock streams) exhibited similar overall fluctuations to the population in the general region (northeastern Maine). The breeding ground surveys conducted annually between 1941-1954 (Unit files) served as the basis for this comparison.

If the fluctuations were of similar magnitude during the period when areas on the Refuge were intensively managed, it would be difficult to determine what, if any, value the various habitat manipulation techniques had on the breeding populations using the Refuge.

Mendall (1958) determined population trends (percent) of ring-necked ducks throughout northeastern Maine based on estimates of breeding pairs. Although the number of sample areas visited annually varied somewhat, he felt that the data were adequate to determine trends for consecutive years. During the period from 1941 to 1954 estimates of breeding pairs on six non-managed marshes in northeastern Maine resulted in essentially the same population trend as the total on 14 to 20 marshes (Fig. 5). Thus, these six areas appear to be representative of the population trend in northeastern Maine.

Similar population trends of ring-necked ducks existed on six non-managed areas and on two managed areas (Barn Meadow and Magurrewock) from 1941-1944 (Fig. 6), before the Refuge wetlands were managed ($r = .95$). Population trends on the managed areas differed significantly when compared to those representing the ring-necked duck (Fig. 6, $r = .20$) and the black duck (Fig. 7, $r = .34$) in northeastern Maine. Thus, during many of these years, environmental factors probably were responsible for the fluctuations of the Moosehorn breeding populations.

Water Levels:

Water level manipulations have had an important effect on the waterfowl populations of the primary study areas. After the control structure was installed at Barn Meadow in 1945, water levels were stabilized and maintained at a level approximately 46 cm (18 inches) higher than the normal midsummer low point. Because of the semi-floating nature of most areas of the bog in 1945, no appreciable amount of nesting cover was destroyed. In 1946, the population of nesting ring-
Figure 5. Population trends (percent) of the ring-necked duck in northeastern Maine, 1941-1954.
Figure 6. Number of breeding pairs of ring-necked ducks in managed and non-managed areas, 1941-1954.
Figure 7. Number of breeding pairs of black ducks in managed and non-managed areas, 1946-1953.
necked ducks was more than double that of the previous year (Mendall 1949). A slight increase occurred among black ducks. Water levels were maintained at this height during the 1947 and 1948 breeding seasons when black duck numbers were more than double the 1946 level (Mendall 1949). During the spring of 1949 the water level was raised more than 7.7 cm (3 inches) to a level of 91.4 cm (3 feet) on Middle Barn Meadow (Unit files). Ring-necked ducks reached their highest number on this area in that year. Black ducks, however, decreased. In 1950, water levels were further raised to 99 cm (3 feet 3 inches). This level was too high for optimum ring-necked duck nesting. Declines in both species were evident. As a result of this experimental water manipulation, Mendall (Refuge files) felt that to optimize the nesting of black and ring-necked ducks on Barn Meadow, water levels should be maintained at 84 cm (2 feet 9 inches). Seventy-six cm (2 feet 6 inches) was considered optimum for the black duck and 91 cm (3 feet) for the ring-necked duck. From 1951-1955 water levels were maintained at or near optimum on Barn Meadow. Black ducks increased and were maintained at a high number during these years. Ring-necked ducks fluctuated at lower numbers.

Little nesting cover was available on Magurrewock after water levels were raised about 91.4 cm (3 feet) in 1945 and breeding pairs of black ducks and ring-necked ducks decreased considerably. From 1946-1948 breeding pairs probably used Magurrewock primarily for feeding and loafing (Mendall 1949). High water levels were maintained on that flowage in 1949 and 1950. Black ducks decreased while ring-necked ducks increased. During the summer of 1952 Magurrewock was drawn down for the construction of the dike that now separates the Middle and Upper Magurrewock flowages. Water levels were maintained as low as possible through the 1955 season when the dike was completed. Black ducks increased on the area in 1953 and 1954, as might be expected, but a decrease in 1955 cannot be explained. Since the fall of 1955, high water levels have been maintained on Magurrewock. This may have contributed to the increase in ring-necked ducks on this area over the long-term, since the availability of floating sedge-bog mat has increased.

Mendall (Unit files) noted a decrease in breeding black ducks on the study areas in 1956 and attributed this primarily to the high water levels in spring. Early spring water levels have been high in many years since 1956. This has probably been a major factor in the long-term decline of breeding black ducks on the study areas.

On Middle Barn Meadow fluctuating water levels during the nesting period probably added to the decline in waterfowl. The high water levels
observed in 1974 apparently also occurred in Middle Barn Meadow in other years, because water control has been irregular since 1955 and because the peat mat no longer floats in many areas. This apparently resulted in fewer birds choosing nest sites in the area. Those birds that did nest in Middle Barn Meadow probably chose inferior sites. Nesting success would be expected to decrease in such sites due to predation and flooding.

Ring-necked duck nest success was similar (75%, 47 nests) for 1946-1955 (when Barn Meadow was managed intensively) to the long-term average (69%) for Maine and New Brunswick marshes (Mendall 1958). Nest success of this species declined on Barn Meadow after 1955. There was no significant difference in black duck nest success between the periods 1945-1955 and 1956-1962. However, it is felt that constant water level maintenance prevented loss due to flooding during the nesting season, especially for the black duck.

The relationship of water levels to brood rearing conditions is also important. Levels which were slightly above average in July and August usually resulted in the most satisfactory conditions for raising the young (Mendall 1958). Water levels on Middle Magurrewock, the primary brood rearing area on the Refuge, were above average in 1974 and 1975. Sizes of Class III broods (young nearing the fledging stage) of black ducks and ring-necked ducks (5.5 young) on the study areas were above the long-term average (5.2 young) found in Maine for both species.

Mendall (1949) noted that ducks made use of the open water areas created in Middle Barn Meadow in the late-1940's. In addition, the perimeter ditch may have limited the number of terrestrial predators on the marsh. These include the raccoon (*Procyon lotor*), mink (*Mustela vison*) and red fox (*Vulpes vulpes*). However, the open water areas had largely become filled in by the mid-1950's due to encroachment of aquatic vegetation, resulting in a reduction of courtship, loafing and feeding areas for breeding birds. Less nesting cover was available due to the lack of interspersion of the vegetation and surface water when compared to the late 1940's and early 1950's.

The impoundment of Upper Barn Meadow in 1963 created additional open water and increased the availability there of preferred nesting cover for ring-necked ducks. A majority of the breeding ring-necked ducks on the Barn Meadow study area appeared to shift to the upper flowage.
Vegetation:

Plant succession has undoubtedly affected the use of nesting cover in Middle Barn Meadow. Twelve black duck nests were located by Mendall (Unit files) in typical floating leatherleaf, sweetgale and sedge habitat during 1954-1958. The same general area is no longer a floating mat, however, but seems to be grounded by the roots of large shrubs, primarily sweetgale. Thus, the surface level in this area is rather wet and no longer supports optimum black duck nesting cover. I found no black duck nests there in 1974-75.

Some nesting habitat preferred by the ring-necked duck has been eliminated by stands of cattail. Mendall (1958) indicated that nests of this duck in cattail were less successful than those in bog mat sites.

Planting Programs:

Planting programs for waterfowl may entice spring migrants to remain in the marsh until nesting time. In 1946, Mendall found that the 1944 aquatic planting program in Magurrewock was successful. He mentioned that more ducks utilized the area during spring migration than during the previous 2 years. Breeding populations also increased. However, the aquatic planting program was operational for only a few years.

In 1951, an upland food planting program was established. Good yields of buckwheat (*Fagopyrum esculentum*) were produced and waterfowl were observed utilizing the areas where planting occurred. Upland plantings were continued and expanded on fields adjacent to Magurrewock and Barn Meadow in subsequent years until 1964. In my review of the data available there seemed to be a correlation between the planting yield and the number of migrant and breeding waterfowl during the years of most intensive management of the areas (1945-1955). Despite the planting of grain, however, breeding black ducks and ring-necked ducks decreased on the Barn Meadow area from 1956-1965.

Summary:

Fluctuating water levels, advanced plant succession and an overall decrease in number and distribution of open water areas appear to be at least partly responsible for a general decline in the black duck population on the Moosehorn Refuge. In the case of ring-necked ducks, their numbers have increased on those Refuge wetlands where marsh management favored an increase in floating sedge-bog mat. By contrast, this species decreased on the shrub wetland flowages because of adverse
effects of plant succession. It was concluded that maintenance of optimum water levels is the most important of all factors in marsh management on the Refuge.

LITERATURE CITED


