Aquatic vegetation, salinity, aquatic invertebrates, and duck brood use at Bowdoin National Wildlife Refuge, Montana
by Kevin Mark Johnson

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

Abstract:
Information on taxa, distribution, and abundance of aquatic vegetation, as well as aquatic invertebrates, is lacking for Bowdoin National Wildlife Refuge, Malta, Montana. Color infrared (CIR) aerial photographs of the refuge were taken in July of 1986. In summer, 1987, a cover map of aquatic vegetation on the 6294 hector refuge was produced and ground truthed. Salinity gradients and their relation to aquatic vegetation tolerances and distribution; shoreline terrestrial vegetation patterns; relative abundance, taxa, and distribution of aquatic invertebrates; and duck brood distributions were then determined during summer, 1988. CIR photos were effective in depicting features such as: shoreline, submergent and emergent vegetation, terrestrial vegetation communities, and salt crust on soil. Specific conductances on the refuge ranged from 540 to 11000 microsiemens per centimeter (uS/cm). Sago pondweed (Potamogeton pectinatus) was the most common submergent species found and hardstem bulrush (Scirnus acutus) the most common emergent species.

Conductivity appears to have some influence on aquatic vegetation and invertebrates. Chironomidae was the most abundant taxa of aquatic invertebrates collected. Species richness for both emergent and submergent plants decreased as conductivity increased. Abundance (#/m3) of invertebrates decreased as salinity increased and a slight negative linear relationship between invertebrate abundance and conductivity existed. High variability was found in invertebrate abundance within and between bodies of water with similar conductance and vegetative growth. Average soil conductivity and pH was highest in the. shrub/grassland and subirrigated/marsh communities and lowest in grasslands around Lake Bowdoin and Lakeside Unit. Terrestrial plant species present and their frequency of occurrence appears to be indicative of soil salinity which in turn is associated with lake water salinity. Occurrence of salt tolerant vegetative species decreased away from shoreline. Low duck production occurred on the refuge in 1988 due to drought conditions and only 81 broods were observed. Brood use was highest in areas of good invertebrate and macrophyte resources. Criteria used for future monitoring of salt accumulations and their effects on waterfowl brood habitat are discussed.

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A thesis submitted in partial fulfillment
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Master of Science

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Fish and Wildlife Management

MONTANA STATE UNIVERSITY
Bozeman, Montana

January 1990

APPROVAL

of a thesis submitted by

Kevin Mark Johnson

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ACKNOWLEDGMENTS

Several people made possible the completion of this study. Great appreciation is extended to my major advisor, Dr. R. Eng for his guidance during the study. Committee members, Dr. R. White, Dr. H. Picton, and Dr. G. Nielsen gave thoughtful evaluations of the manuscript. Dr. G. Nielsen and the Plant and Soil Science Department, MSU, obtained the color infrared aerial imagery, and provided facilities used in construction of cover maps.

I wish to thank G. Sipe, J. Stutzman, F. Prellwitz and the rest of Bowdoin National Wildlife Refuge personnel for friendship, information, suggestions, and use of their facilities. Special thanks are given to P. Byorth and P. Gunderson for their comradery, encouragement, and thoughtful suggestions.

Lastly, I thank my family. My two children, Dustin and Marhya, for trying to understand the late nights when I wasn't home, my wife, Sheila, for supporting us all these years, and my parents, Paul and Dolores, who have taught me more than any textbook could.

This study was funded by the Montana Agricultural Experiment Station and the U.S. Fish and Wildlife Service.

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ABSTRACT

Information on taxa, distribution, and abundance of aquatic vegetation, as well as aquatic invertebrates, is lacking for Bowdoin National Wildlife Refuge, Malta, Montana. Color infrared (CIR) aerial photographs of the refuge were taken in July of 1986. In summer, 1987, a cover map of aquatic vegetation on the 6294 hector refuge was produced and ground truthed. Salinity gradients and their relation to aquatic vegetation tolerances and distribution; shoreline terrestrial vegetation patterns; relative abundance, taxa, and distribution of aquatic invertebrates; and duck brood distributions were then determined during summer, 1988. CIR photos were effective in depicting features such as: shoreline, submergent and emergent vegetation, terrestrial vegetation communities, and salt crust on soil. Specific conductances on the refuge ranged from 540 to 11000 microsiemens per centimeter (uS/cm). Sago pondweed (Potamogeton pectinatus) was the most common submergent species found and hardstem bulrush (Scirpus acutus) the most common emergent species. Conductivity appears to have some influence on aquatic vegetation and invertebrates. Chironomidae was the most abundant taxa of aquatic invertebrates collected. Species richness for both emergent and submergent plants decreased as conductivity increased. Abundance ($\#/m^3$) of invertebrates decreased as salinity increased and a slight negative linear relationship between invertebrate abundance and conductivity existed. High variability was found in invertebrate abundance within and between bodies of water with similar conductance and vegetative growth. Average soil conductivity and pH was highest in the shrub/grassland and subirrigated/marsh communities and lowest in grasslands around Lake Bowdoin and Lakeside Unit. Terrestrial plant species present and their frequency of occurrence appears to be indicative of soil salinity which in turn is associated with lake water salinity. Occurrence of salt tolerant vegetative species decreased away from shoreline. Low duck production occurred on the refuge in 1988 due to drought conditions and only 81 broods were observed. Brood use was highest in areas of good invertebrate and macrophyte resources. Criteria used for future monitoring of salt accumulations and their effects on waterfowl brood habitat are discussed.

INTRODUCTION

The national waterfowl refuge program was initially set up to restore, under existing land and land-use conditions, waterfowl breeding habitat and areas where migrating and wintering waterfowl could find food and rest (Salyer, 1945). Hence, northern refuges should be managed to adequately supply cover and a food base for both adult and juvenile waterfowl. Baseline data on taxa, distribution, and abundance of aquatic vegetation have not been available for Bowdoin National Wildlife Refuge (BNWR). Nor has the distribution and relative abundance of invertebrate organisms associated with the aquatic vegetation been documented.

BNWR has several lakes, all of which are closed drainage basins. Its climate is characterized by high evaporation and low precipitation. Because of this, refuge personnel are concerned with a potential salinity problem in the future. Thus, this study was initiated to provide baseline data relative to aquatic and terrestrial vegetation and aquatic invertebrate and duck brood distributions. Changes in wetland vegetation measured from baseline data may provide early indication of environmental contaminants in the wetlands. Information on waterfowl brood distribution may show which areas of the refuge should be targeted for management. Study objectives were:

1. Establish shoreline terrestrial and aquatic vegetation patterns.
2. Determine salinity gradients and relate these to vegetation tolerances and distribution.

3. Determine distribution, relative abundance and taxa of aquatic invertebrates.

4. Determine duck brood distribution in relation to 1, 2, and 3.

DESCRIPTION OF STUDY AREA

Bowdoin National Wildlife Refuge (BNWR) is located in northeast Montana (48° 24'N, 107° 40'W), approximately 11 kilometers (km) east of Malta, Phillips County (Fig. 1). Situated within the eastern glaciated plains of Montana, BNWR lies in the Central Flyway and is on the western fringe of the prairie pothole region. The refuge serves as a major resting area for waterfowl during spring and fall migrations, with up to 100,000 ducks and geese using its wetlands during fall. It also provides nesting habitat for Canada geese (Branta canadensis) and several species of ducks.

The 6294 hectare (ha) refuge was established in 1936 and is managed by the U.S. Fish and Wildlife Service. Its primary objective is to preserve resting, feeding, and nesting habitat for migratory birds. There are five main bodies of water on the refuge: 1) Lake Bowdoin, 1421 ha, 2.7 m deep; 2) Dry Lake, 769 ha, 0.9 m deep; 3) Drumbo Unit, 111 ha, 1 m deep; 4) Lakeside Unit, 100 ha, 3 m deep; and 5) Lakeside Extension, 32 ha, 4.6 m deep (Fig. 1). There is also a series of man-made ponds located throughout the refuge. These are linked through a system of canals which permits management for optimal water levels.

Lake Bowdoin is a remnant horseshoe bend of the ancestral Missouri River channel which originally flowed north to Hudson Bay. Ice sheets from the last glacial activity forced the river from this northerly channel to its present location 80 km south (G. Sipe, pers. commun.).