Introduction

The Great Plains region of North America is part of one of the most intense and most productive agricultural efforts in the world. Vast acres of corn, soybeans, hay, and wheat dominate the landscape. Drive for an hour on a county road in any direction and you are likely to pass at least one grain elevator. At various times during the year, you will also pass (or be passed by) millions of dollars worth of agricultural machinery, highly specialized to till, plant, spray, or harvest. Great Plains farmers feed much of the world. The grains produced in this region feed untold numbers of livestock, and are also used in the production of ethanol, oils, fertilizers, and a host of other products. The effort, ingenuity, and technology that have gone into this production make it truly one of the great accomplishments of the human race.

Along with agricultural developments of the last century, a way of life has developed on the Great Plains. It is based on the relationship of people with the land, particularly through the production, processing, and marketing of food. Scattered among the acres of corn and beans are clusters of homes, sometimes numerous enough to form towns or cities. Necessarily tied to the land and the process of agriculture, most citizens of these towns are conscious of the weather, the current agricultural economy, the recent growing conditions, and the lay of the land. These communities are not without their problems, but they are the backbone of a nation.

This incredible production and this reliance upon the land have been forged at a considerable ecological cost. Indeed, if this region is known for anything, it is known for (1) agriculture, (2) the rural way of life, and (3) the ecosystems that used to exist here. The tall-grass and short-grass prairies that must have seemed endless to early European settlers have been all but lost to cultivation, and many areas that have managed to evade the plow are grazed by livestock. This region, although it generally receives less rainfall than eastern North America, was also home to a great number of small depressional wetlands, termed prairie potholes in the northern Great Plains. Potholes are freshwater marshes, many of which may be small and ephemeral. North America's Prairie Pothole region includes 300,000 square miles extending from Eastern Alberta to Western Manitoba in Canada, south to the Dakotas and Southwest Minnesota. Potholes are particularly important for migratory waterfowl; although this region contains only about 10 percent of the waterfowl nesting habitat on the continent, it produces 50 to 75 percent of all North American waterfowl. Prairie wetlands may have fared better than uplands in the early stages of European settlement, but as population density increased and drainage techniques were improved and encouraged, many potholes were incorporated into the agricultural effort. The prairie wetlands that remain, like the remnant prairie grasslands, are tiny islands in a sea of agriculture and are invariably influenced by the surrounding land management practices.

Background

Prairie Wetland

The story of the prairie wetland is a story of progress and hindsight. As a representation of the demise of these seemingly inconsequential lowlands, we will focus on the northern edge of the Great Plains, the tall-grass prairie region of what is now southwest Minnesota.

The earliest European explorers found wetlands abundant, at times a hindrance, and at times lucrative in the northern Great Plains. The abundance of potholes is a result of geologic history. Retreating Pleistocene glaciers left moraines, kettles, and deep, often poorly drained till in southwest Minnesota (Figure 1). By some estimates, Minnesota contained some 10 million acres of wetland after the
latest glaciation, and there may have been 20 million acres of prairie wetlands scattered across the Great Plains. These surface waters and runoff from precipitation feed streams and rivers that once served as conduits for the travels of the early explorers throughout the region. One particular region in southwest Minnesota, which is now Murray County, is drained by three major watersheds: the Redwood and Cottonwood River systems, which drain into the Minnesota River; the Des Moines River, which flows to the Mississippi; and the Rock River, which winds south to join the Missouri River. J.B. Franquilian mapped the Des Moines River in 1688, and was one of the first European explorers to survey the area. This region, known as the Coteau des Prairies, was described as an "elastic prairie" of wet, spongy ground by the geographer and explorer Joseph Nicollet in 1838. The landscape of this watershed confluence was dotted with surface water: shallow lakes, marshes, and ephemeral wetlands. The seasonal nature of the prairie wetland was not lost on the early explorers, nor was the area’s importance as a breeding ground for potentially valuable numbers of waterfowl, muskrat, and beaver.

Figure 1

The vegetation of the pre-settlement prairie wetlands is not well documented, although Nicollet noted bluejoint grass, hairy stargrass, slough grass, Culver’s root, purple meadowrue, and golden

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Alexander in the wet prairie areas. Marschner's "Original Vegetation of Minnesota" notes marsh grasses, flags, reeds, rushes, wild rice, willow, and alders in the southwest wet prairie areas, and woody species such as elm, ash, cottonwood, boxelder, oak, basswood, willow, aspen, and hackberry in the bottomland swamps. A number of wetland plants were known to be used by Native Americans in this region: cattail, arrowhead, bullrush, yellow pond lily, fragrant water lily, and American water lotus. Other authors note observations of beard grass, Indian grass, muskit grass, porcupine grass, freshwater cordgrass, and rice cut grass in the seasonal prairie wetlands.

Early animal records of the Coteau wet prairies are limited to trapping records and explorer observations. Notes from the 1838 Nicollet expedition describe "innumerable families of muskrat and water birds" in the Great Oasis area of Murray County. The American Fur Company post, located on what was then Bear Lake, reported a harvest of some 30,000 muskrat pelts, along with mink, otter, and raccoon in 1833. Beavers were also prevalent in the area, although they were apparently largely trapped out by the late 19th century. The fur trade was quite lucrative; in the 1880s muskrat furs sold for $.30 each, and a mink pelt was worth $2.00. Waterfowl were also noted as being abundant, particularly during periods of migration. Blue-winged teal, pintails, mallards, gadwall, redhead, ruddy ducks, geese, and coots provided both sustenance and income for the early explorers.

Wetland Drainage

Settlers followed explorers, and settlers brought reason for drainage. In general, prairie wetlands were seen as undesirable, unproductive wastelands that needed to be reclaimed and improved. In the late 1800s it was still believed that wetlands release disease-causing gases, a belief that persisted into the 21st century. Wet prairie regions were desirable for settlement, as they were flat, generally did not need to be cleared and, once drained, could be agriculturally valuable. The federal Swampland Acts of 1849, 1850, and 1860 transferred wetland areas to states, and most states including Minnesota were quick to encourage drainage. Ensuing Minnesota state laws allowed private corporations to be formed for the purpose of draining wetlands and also allowed county governments to authorize drainage efforts. In 1897, the Minnesota State Drainage Commission was created. Renamed the Department of Drainage and Waters in 1919, this commission was given "custody, control, and supervision of all drainage ditches in the state." During this period, approximately 1858-1920, most of the drainage that has been done in Minnesota was accomplished.

Minnesota was not totally devoid of effort to protect surface waters during this period. A State Act of 1867 forbade the drainage of any meandered body of water; however, restructuring the legal definition of "meandered body of water" and leniency in the case of landowner agreement made the attempt at surface water protection all but meaningless in the next few decades. Further laws in the early 20th century allowed for drainage of certain meandered bodies of water only in the case of agreement of a majority of surrounding landowners. In light of the vast number of acres drained during this period, a consenting majority was apparently not difficult to achieve.

The rate of drainage, and perhaps some attitudes concerning wetlands, began to change in the middle decades of the 20th century. The Great Depression, a series of drought years, the war effort, and economics may have all contributed to a reduction in drainage activity, but by this time much of the desirable farmland had already been drained. Incentives to drain still existed, however, particularly through the USDA's Soil Conservation Agency and Agriculture Conservation Program, which offered financial incentives through the late 1940s to farmers who drained wet areas. Amidst these drainage efforts, there is evidence for an increased concern for protection of surface waters in the state. In 1951, a
"Save the Wetlands" program was enacted in Minnesota, which used federal funds to acquire wetlands for state wildlife management areas. In 1955, a new Minnesota state law required that the conservation of soil, water, forests, and wild animals be considered in the determination of the benefits of a proposed drainage system. Also in 1955, the federal Fish and Wildlife Service published an inventory of Minnesota wetlands, perhaps reflecting a changing national opinion of surface waters.

At the time of this survey, approximately one-third of Murray County was still considered a region of high waterfowl value. The southwest corner, which includes Buffalo Ridge uplands, and the eastern portion of the county, which had been extensively drained, were rated as low value areas for waterfowl. The study notes waterfowl nesting, feeding, and migration in the wetlands of southwest Minnesota, particularly in the seasonal wetlands and shallow marsh wetlands. Although it notes considerable muskrat populations in the prairie wetlands, beaver no longer are noted as a major occurrence. By the time of this survey, the eastern portion of the county had "already been drained to the point where its waterfowl production capabilities are practically nil."

Most of the remaining wetlands in Murray County in 1955 were seasonally flooded basins; permanent wet prairie and deeper marshes numbered fewer than five per square mile in the eastern half of the county and fewer than fifteen per square mile in the western half. The emphasis of the wetlands inventory report was on preservation of the remaining wetland resources in the state, particularly for waterfowl habitat.

The 1955 wetland survey was part of a national shift in surface water policy, which was particularly evident in Minnesota. State laws promoting the protection of surface waters became more common in the 1960s and 1970s, resulting in the establishment of State Scientific and Natural Areas, a state environmental policy, and the Minnesota Environmental Quality Council. All of these served to either directly protect surface waters or require an environmental impact statement for proposed actions affecting surface waters. By 1976, the Minnesota Waterbank Program had been implemented to grant easements to landowners who agreed to protect their wetlands. Further legislation refining the definition of surface waters and qualifying requirements for drainage or protection have followed to the present day, most notably in the form of the Federal Water Pollution Control Act and the 1985 Food Security Act. In the previous decade, a landowner could pursue compensation for wetland preservation through the 1990 Federal Food, Agriculture, Conservation and Trade Act or the Federal Conservation Reserve Program. Minnesota state programs have followed suit; the 1991 Minnesota Wetland Conservation Act regulates the draining and filling of wetlands. State landowners can apply for easements through the Conservation Reserve Enhancement Program or through the Reinvest in Minnesota Program (RIM). Although new drainage projects are still proposed and approved, the net shift has been from a policy providing financial incentive for drainage to a policy of providing incentives for wetland protection.

The Issues

Wetland Protection

Wetland protection programs, in Minnesota and the rest of the United States, may have come too late. Today, Minnesota has some 25,000 miles of public drainage ditches and 45,000 miles of private ditches, along with vast areas of sub-surface tile drainage. Minnesota has lost an estimated 42 percent of its original 15 million wetland acres to drainage or fill operations. The loss has been particularly high in the prairie pothole region, where 80-99 percent of the original wetlands are now gone. Murray County has some 15,800 wetland acres, with 60-97 percent of original wetlands lost, depending on the estimate. More than two-thirds of the lakes in the county have been affected or completely drained by
artificial drainage systems. Today, approximately 92 percent of the land in the county is devoted to agriculture. Murray County has more land zoned for protection than any other county in the region, but it represents less than 2 percent of the total county area.

The price of this massive conversion to arable land has primarily been paid through the loss of habitat. Wetland habitat loss has almost certainly resulted in a loss of nesting sites for migratory waterfowl. By 1970, nesting of birds such as the American widgeon, the green-winged teal, and the canvas-back and black ducks, had become rare in Murray County. Three other wetland-dependent bird species, the American bittern (Botaurus lentiginosus), Forester’s tern (Sterna forsteri), and the common moorhen (Gallinula chloropus) serve to illustrate the impact of extensive drainage on the prairie pothole ecosystem. All of these birds were once common in southwestern Minnesota, and all are now listed as state species of special concern. The American bittern is an excellent example of a bird that has suffered from wetland habitat loss. This bird is a reclusive marsh dweller with a range that covers most of North America, but its prairie wetland habitat has been greatly reduced and it is now absent in many remaining prairie wetlands that appear to offer excellent habitat. The American bittern prefers large emergent marshes for feeding and breeding, so the fragmentation and small size of remaining potholes likely has contributed to the population decline. It is also likely associated with a concurrent decline in the number of frogs, which are the bittern’s preferred food source. Other factors such as chemical contamination or human disturbance may also have contributed to the bittern’s demise in the prairie wetlands.

A similar decline has been noted in Forester’s tern and the common moorhen. Forester’s tern was commonly observed in prairie wetlands in the early to middle 20th century, but a recent review of colony sites identified only fifteen active colonies in Minnesota. The colonies remaining in the southwestern part of the state are rare and small, generally supporting fewer than fifty nests. Forester’s tern requires large marshes with extensive areas of emergent vegetation for nesting; consistent standing water is apparently another key for successful nesting. Although we still have much to learn about the habitat selectivity of this bird, it seems clear that the fragmentation and restricted flooding of the prairie wetlands have been detrimental to the populations in southwestern Minnesota. The moorhen is nearly worldwide in distribution and was once frequently noted as a breeding resident of many large marshes and shallow lakes. Although it is still sighted in Minnesota, the frequency of observations has declined and nesting sites have become rare, particularly in the prairie wetland region. The moorhen typically chooses secluded marshes with an abundance of emergent vegetation for feeding and nesting, but it generally does not require large, expansive wetlands. While habitat loss is most likely a factor, the exact reasons for the moorhen decline are not well understood.

Other wetland organisms have shown similar decline in southwestern Minnesota. While the beaver, muskrat, and mink that the early trappers so highly prized are still present, none are present in large numbers. Beaver (Castor canadensis) were reduced or extirpated from much of southwestern Minnesota during the period of uncontrolled trapping, and were reintroduced by the DNR in the 1930s. Although suitable beaver habitat has been greatly reduced in Minnesota's prairie region, a small population remains near suitable streams, lakes, or even marshes. Populations of muskrat (Ondatra zibethicus) can be drastically affected by modified water levels, particularly through surface or subsurface drainage. In the prairie wetlands that remain, muskrats can be quite prolific, although their numbers do not approach those noted by the early explorers. A major predator of the muskrat, the mink (Mustela vision), also appears to exist in a small, sustained population in southwestern Minnesota. Amphibians such as the northern cricket frog (Acris crepitans) and reptiles like the snapping turtle (Chelydra serpentina), while abundant over much of their range, appear to have declined in the prairie wetlands region. Certain plant populations may have suffered as well, as delicate hydrologic and
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chemical balances have been disturbed over the years. Many of the remaining potholes are dominated by aggressive, dense vegetation consisting of plants like cattail (Typha sp.) and giant reed grass (Phragmites sp.), which are well-suited to flourish in high-nutrient environments. Less competitively dominant plants such as Hall's sedge (Carex hallii), water hyssop (Bacopa rotundifolia), and marsh arrow grass (Triglochin palustris), while perhaps never abundant, appear to have declined throughout the period of drainage and agricultural eutrophication of surface waters.

To the individual landowner, the monetary cost of habitat loss and species decline is zero. The accompanying ecological costs may be significant. In addition to habitat loss, the drainage of the prairie wetlands and conversion to agriculture has altered the hydrology and nutrient cycling of the landscape. Prairie wetlands, even those that are seasonal, are intimately connected to the regional water cycle. Wetlands act as natural flood controls, reducing the peak runoff into lakes and streams during storms or snow melts. Potholes also play a role in groundwater recharge, as they slowly release water into aquifers. In this way, wetlands can contribute to our drinking water supply, soil moisture, and spring-fed streams. Wetlands also influence water quality as they retain nutrients like nitrogen and phosphorus and act as a sink for sediment. These costs of wetlands drainage – increased soil erosion, increased stream pollution, increased flooding, decreased groundwater recharge - are easier to estimate that the costs of habitat loss. Southwestern Minnesota is a critical erosion area, and valuable topsoil is lost each year. The average annual flooding cost in Minnesota was estimated at $125 million in 1993, primarily in the intensely drained and farmed southwest. The state has also spent millions of dollars on non-point source pollutant control. These pollutants include agricultural runoff, which is quickly escorted to streams and rivers by ditches and tile lines. Finally, some 75 percent of Minnesotans get their drinking water from aquifers. The loss of aquifer recharge is a cost that may not be realized until drinking water resources are over-exploited.
The current prairie wetlands in southwestern Minnesota are mostly small, highly isolated, low in diversity, and almost exclusively confined to scattered park and wildlife areas (Figure 2). Murray County was slow to formally protect wetlands; from 1972-1980, only ten wetland acres had been enrolled in the Water Bank Program. About 4 percent of the land was enrolled in Conservation Reserve in 1994, but this dropped to about 1.5 percent in 1997. Today, 14,318 acres are enrolled in the Conservation Reserve Program and another 1,025 acres are preserved as part of the Reinvest in Minnesota Program; together these account for about 3.5 percent of Murray County. A few wetland restoration projects are currently underway or have been recently completed, but these, too, are small and isolated. For the most part, it is safe to say that the prairie wetlands are all but gone in this part of the world. In the place of these marvelous ecosystems is an industry - a necessary industry, and one in which the human inhabitants take a great deal of pride. It is worth remembering, however, that the benefits we reap from the land have not come without a cost.

References

Literature

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**Key Principles**

1. Habitat Loss
2. Wetland Legislation: Drainage and Protection
3. Land Use

**Ethical Considerations**

1. What are the benefits of devoting our land so completely to agriculture?
2. What are the consequences of devoting our land so completely to agriculture?
3. Explain if the costs and benefits of ecosystem destruction have been ignored when land is used for agriculture?
4. What is the value of agricultural alternatives that do no destroy prairies?

**Civic Engagement & Service Opportunities**

1. Volunteer for a local community group involved in environmental stewardship.
2. Write or e-mail your local politicians about developing or preserving green spaces in your area.
3. Form a student group having an environmental preservation mission.
4. Set up a public forum at your school discussing land use in your area.

Learn more about community service as part of your educational enrichment by visiting the following websites: [http://www.learnandserve.org/](http://www.learnandserve.org/), [http://www.servicelearning.org/](http://www.servicelearning.org/).

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