CORN ETHANOL AND WILDLIFE: HOW ARE POLICY- AND MARKET-DRIVEN INCREASES IN CORN PLANTINGS AFFECTING HABITAT AND WILDLIFE?

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Abstract

Since 2005, government incentives have driven massive growth in the corn ethanol industry, increasing demand for corn for ethanol by 200%. Corn prices have risen to reflect increased demand, and farmers have responded by planting more acres of corn. The amount of corn planted in the United States grew by 12 million acres from 2005 to 2008. New acres for corn have come from crop switching, loss of conservation program land, and native prairie conversion, all of which affect habitat quantity and quality. This study used GIS software to map "hotspots" of corn plantings and habitat loss in the Prairie Pothole Region of four Midwestern states: Iowa, Minnesota, North Dakota, and South Dakota. These maps informed a statistical analysis that quantifies grassland bird population changes in areas experiencing high increases in corn plantings. A review of current legislation and market data revealed that government incentives are the main driver of corn ethanol expansion. We interviewed over 30 conservation practitioners to assess the potential of federal and state conservation policies and programs to mitigate the adverse effects of increased corn plantings on habitat and wildlife. Our results show that dramatic loss of habitat is occurring in the ecologically unique Prairie Pothole Region, and that populations of sensitive bird species are declining significantly in hotspots in this area. Principal among our recommendations is that government incentives for corn ethanol production be reduced; in particular, we recommend a reduction in blending requirements, which drive demand for corn ethanol. Unless changes are made, corn plantings for ethanol production will continue to expand until at least 2015, resulting in further declines of sensitive wildlife populations in one of the nation's most ecologically important regions.

Acknowledgements

This project's success is due to numerous individuals who generously offered their time, expertise, and support. We would like to thank Julie Sibbing and the National Wildlife Federation for providing much-needed guidance and a venue for our research findings. We also wish to thank our advisors, Professors Michael Moore and Steve Yaffee for their direction and valuable feedback throughout the length of the project. Thanks to Professor Johannes Foufopolous for his support and willingness to meet for hours on end, to Professor Bobbi Low for her enthusiasm and research guidance, and to Bobbi Lab for providing helpful feedback on our methodology.

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List of Acronyms

BBS	Breeding Bird Survey
BWSR	Board of Water and Soil Resources
CCC	Commodity Credit Corporation
CCX	Chicago Climate Exchange
CFI	Carbon Financial Instrument
CPGL	Conservation of Private Grazing Lands
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Security Program
CTA	Conservation Technical Assistance
CWCP	Comprehensive Wildlife Conservation Plan
CWCS	Comprehensive Wildlife Conservation Strategy
DDGS	Dried Distiller's Grains with Solubles
DNR	Department of Natural Resources
EBI	Environmental Benefits Index
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FFV	flex-fuel vehicle
FOIA	Freedom of Information Act
FPP	Farm Protection Program
FSA	Farm Service Agency
FWP	Farmable Wetlands Program
GAO	Government Accountability Office
GFP	Department of Game, Fish and Parks
GHG	greenhouse gas
GM	genetically modified
GRP	Grassland Reserve Program
DNR	Department of Natural Resources

INHF	Iowa Natural Heritage Foundation
MARR	Maximum Allowable Rental Rate
MCBS	Minnesota County Biological Survey
NASS	National Agriculture Statistic Service
NGO	non-governmental organization
NRCS	Natural Resources Conservation Service
PLOTS	Private Lands Open to Sportsmen
PPR	Prairie Pothole Region
REAP	Resource Enhancement and Protection Program
REX	re-enrollment and extension
RFS	Renewable Fuels Standard
RIM	Reinvest in Minnesota
SAFE	State Acres For wildlife Enhancement
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grants
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VEETC	Volumetric Ethanol Excise Tax Credit
VOCs	volatile organic compounds
WHIP	Wildlife Habitat Incentives Program
WRP	Wetland Reserve Program

Executive Summary

Government incentives have led to skyrocketing growth in the U.S. corn ethanol industry over the past five years. This has contributed to major increases in corn prices and corn demand, ultimately resulting in increased corn plantings across the country. Total corn acreage shot up 19% between 2006 and 2007, to a level not seen since the Dust Bowl. Though plantings decreased slightly in 2008, they remain higher than at any point in the last fifty years. Farmers have shifted land into corn production from other crops, idle agricultural land, and native prairie, thereby causing wildlife habitat loss and degradation. Given that current legislative mandates increase blending requirements for corn ethanol through 2015, these patterns are likely to continue.

This study analyzes the current and potential impacts of increased corn ethanol production on wildlife and habitat in four Midwestern states: Iowa, Minnesota, North Dakota, and South Dakota. In addition to experiencing dramatic increases in corn plantings over the last five years, these states all contain significant amounts of a unique wetland ecosystem known as the Prairie Pothole Region (PPR). This region contains important native prairie and wetland habitat, and thus holds special importance for wildlife. The goal of this report is to provide policymakers and practitioners with both an assessment of the wildlife and habitat impacts of corn ethanol expansion and a series of recommendations on ways to mitigate these impacts.

Methodology

We used several methods for our analysis. First, we used GIS to construct a series of maps indicating "hotspots" where increased corn plantings are coinciding with habitat loss. These maps then informed a statistical analysis quantifying changes in grassland bird populations associated with increases in corn plantings. Through a review of current legislation and market data, we identified drivers of growth in the corn ethanol industry. Finally, we interviewed more than 30 conservation practitioners to assess the potential of federal and state conservation policies and programs to mitigate the impacts on wildlife.

Key Findings

Numerous federal and state laws, incentives, and programs drive growth in the corn ethanol industry. Chief among these is the Renewable Fuel Standard (RFS), which sets a floor for corn ethanol demand, and the Volumetric Ethanol Excise Tax Credit (VEETC), which pays blenders to blend ethanol with gasoline. States also support corn ethanol through various channels, ranging from incentives for ethanol refiners to high blending requirements. Furthermore, domestic ethanol is protected from foreign competition by high tariffs. This substantial support for corn ethanol production guarantees demand and easy financing, which are driving growth in the industry.

Dramatic increases in corn plantings and loss of grassland habitat have been concentrated within the Prairie Pothole Region. This region has lost alarming amounts of native prairie and Conservation Reserve Program (CRP) land to crop production since 2006. In addition to this direct habitat loss, increased corn plantings have led to increased erosion, sedimentation, and pesticide and fertilizer pollution—all of which degrade remaining habitat.

Grassland-breeding bird populations have declined in areas experiencing high increases in corn plantings. As demonstrated by our analysis of grassland-breeding birds, areas of high corn increases have shown significant declines in both the number of grassland species and the number of individual grassland birds. Our analysis found that populations of sensitive grassland birds declined by almost 30% between 2005 and 2008 in areas of high corn increase. The loss and degradation of grassland habitat in the region, driven by increased corn plantings, is further imperiling these already threatened species. All but one of the five species we analyzed in our wildlife analysis are listed as species of conservation concern in Iowa, Minnesota, North Dakota, and/or South Dakota. Beyond the effects of increased corn plantings on specific grassland bird populations, loss of habitat in the PPR due to increased corn plantings may threaten North American waterfowl from across the continent, 70% of which breed in this ecologically unique region.

Conservation practitioners in Iowa, Minnesota, North Dakota, and South Dakota presently conserve valuable habitat through a suite of federal and state programs. However, these programs are not equipped to mitigate the additional threats posed by corn ethanol expansion. Practitioners explained that demand for biofuels, high commodity prices, new genetically modified varieties of crops, and insurance payments that make marginal land more suitable for crop production incentivize the conversion of grassland into cropland. Funding and resources for conservation programs have not kept pace with these increasing pressures. If this trend is not reversed, expanding corn ethanol production will have an irreversible impact on habitat and wildlife across the Prairie Pothole Region.

Recommendations

We recommend the following actions be taken to prevent further losses of valuable habitat and declines in wildlife populations:

- Decrease government incentives for corn ethanol
- Prioritize conservation of native prairie
- Invest in CRP to maximize its potential for land conservation
- Increase the capacity of agencies to more effectively implement existing programs
- Collect and make publicly available data measuring conversion of grassland to cropland

Outlook

The Renewable Fuel Standard requires that corn ethanol production increase from 10.57 billion gallons in 2009 to 15 billion gallons in 2015. This 4.47 billion gallon increase in corn ethanol production will create demand for an additional 10.7 million acres of corn plantings a year at present corn yield levels. Such increases in corn production have serious implications for wildlife and habitat.

If corn ethanol demand continues to contribute to high corn prices and CRP rental rates remain too low to incentivize farmers to keep their acres enrolled in the program, CRP land will continue to be converted into cropland to accommodate increased corn plantings. Moreover, there is currently no state or federal legislation that discourages conversion of native prairie into cropland. Without changes to ethanol incentives, CRP, and prairie protection policies, loss of habitat and wildlife in the PPR will continue.

Chapter 1: Introduction

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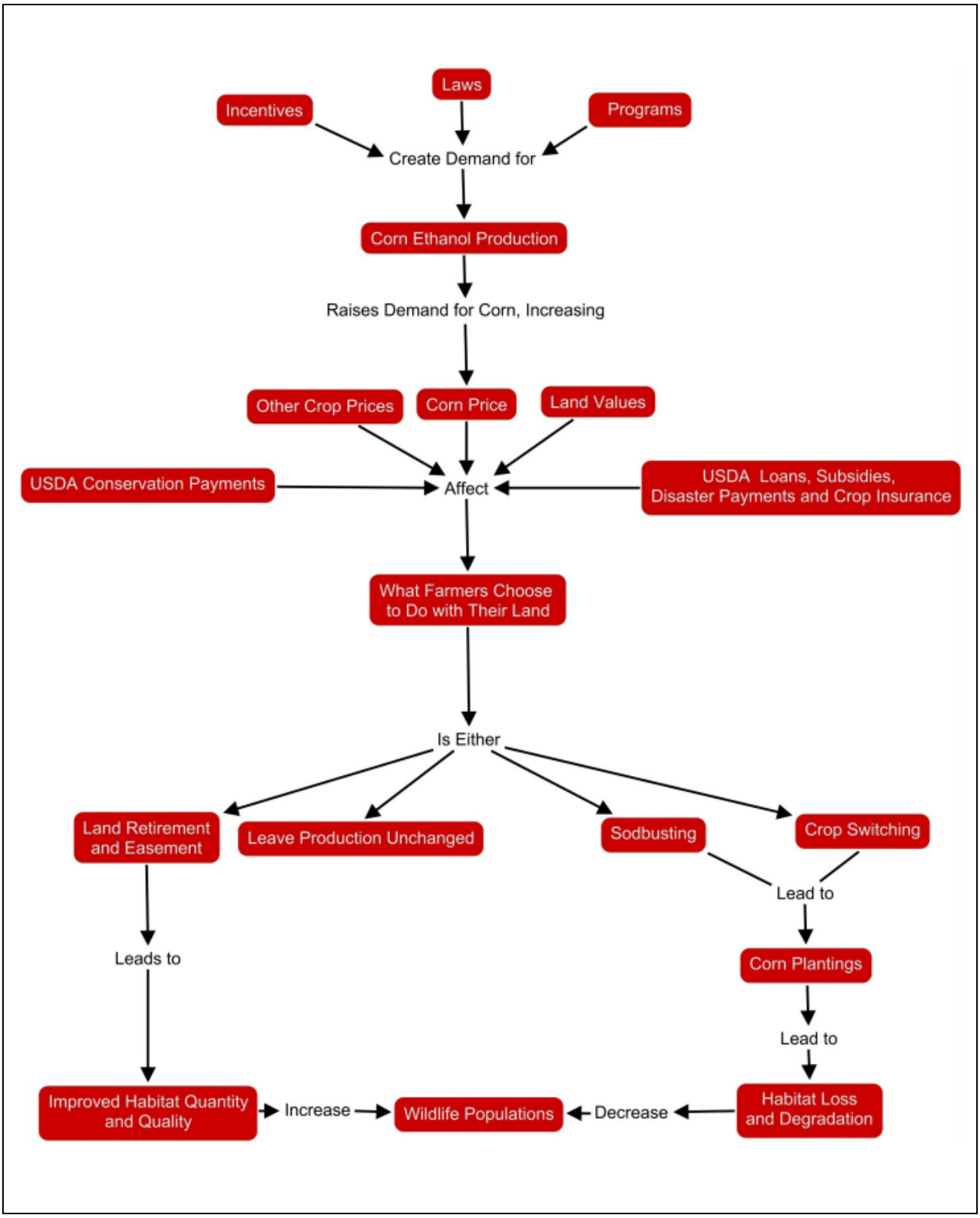
Aerial View of the Prairie Pothole Region
Photo: U.S. Global Change Research Program

Figure 1.1 Diagram of Study System



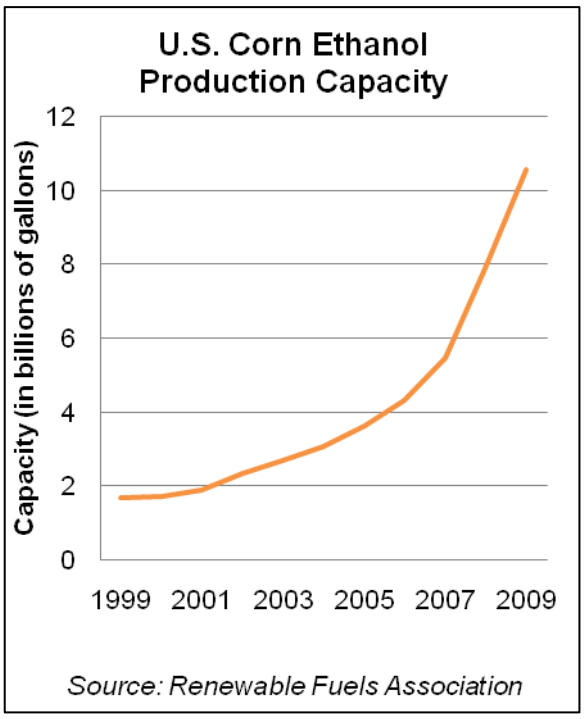
Chapter 1
Introduction

Corn ethanol production has been hailed as a national solution to energy security, rising fuel costs, and climate change. In December 2007, Congress passed the Energy Independence and Security Act, mandating an increase in ethanol production from 4.7 billion gallons in 2007 to 15 billion gallons by 2015. Following this legislation, corn prices increased dramatically, resulting in economic incentives for farmers to shift land to corn production by changing crop rotations to favor corn, removing land from farmland conservation programs, and converting wetland and prairie wildlife habitat to corn production. Such changes raise serious concerns for wildlife populations that rely on wetland and prairie habitat.

This study describes the effects of corn ethanol-driven agricultural expansion on wildlife and habitat in four Midwestern states: Iowa, Minnesota, North Dakota and South Dakota. These states all contain significant amounts of a unique wetland ecosystem known as the Prairie Pothole Region (PPR) and thus hold special importance for wildlife. This report includes a synthesis of information on the corn ethanol industry and government incentives; the creation of a GIS Land-Use Change Index to identify "hotspots" of increases in corn plantings and losses in native prairie and conservation land; a statistical analysis of the effects of this land-use change on grassland bird populations in the four-state area; and recommendations on how conservation policies and programs can respond, drawn from interviews with more than thirty conservation practitioners. The goal of this report is to provide policymakers and practitioners with 1) an assessment of the wildlife and habitat impacts of corn ethanol expansion, and 2) a series of recommendations on ways to mitigate these impacts.

This chapter provides background information that links changes in corn ethanol production to changes in corn price and subsequently to changes in acres of corn plantings. We establish that our four-state focal area stands out as experiencing an especially high level of corn acreage expansion. We also define the research questions which guide our study and discuss the methodology that we employed to answer them. Finally, we outline the remaining chapters of this report. Figure 1.1 illustrates the system we investigate in this study.

Figure 1.2



Background

Corn Ethanol Expansion in the United States

The U.S. Government has implemented many incentives for corn ethanol production over the past two decades, creating a booming ethanol industry (Figure 1.2). Demand for corn ethanol is

largely driven by the Renewable Fuel Standard (RFS), which sets a floor for the amount of ethanol that must be blended with gasoline each year, and the ethanol blender tax credit, which provides a 45 cent tax credit for every gallon of ethanol blended with gasoline. Additionally, tariffs on foreign ethanol protect the domestic industry from lower priced competition. As a result of these and other incentives, national corn ethanol capacity has increased by 600% from 175 million gallons a year in 1980 to 10.57 billion gallons a year at the beginning of 2009.[1] Chapter 2 describes the growth of the corn ethanol industry, government incentives, present market conditions, and future outlook for the industry in greater detail.

Corn Ethanol as a Driver of Corn Price

As corn ethanol production has increased, there has been a growing demand for corn as a feedstock. In 1980, less than 1% of the U.S. corn harvest was used for ethanol production. By 2008, this proportion had increased to almost 25%.[2] Table 1.1 shows the rapid increase in the amount of corn used for ethanol in the United States from 1999 to 2009. These increases were most dramatic in the second half of the decade. Between 2005 and 2009 alone, the number of acres of corn used for ethanol production increased by almost 200%.

Table 1.1

Corn Acres Used for Ethanol Production											
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Corn Acres for Ethanol[3,4] (million acres per year)[a]	4.1	4.2	4.6	5.7	6.5	7.5	8.8	10.5	13.2	19.0	25.5

As demand for corn for ethanol production has risen, so has the price of corn. Figure 1.3 describes the change in yearly corn prices from 2000 to 2009. Although corn prices did rise before 2005, the most dramatic increase occurred between 2005 and 2008. Prices have declined somewhat since, for reasons discussed below.

While it is difficult to quantify the extent to which demand for corn for ethanol is causing the price of corn to increase, there is little doubt that the two are linked. In a 2008 report, outgoing Chief Economist of the U.S. Department of Agriculture (USDA) Keith Collins reviewed a number of studies that quantify the impacts of ethanol production on crop price inflation. According to the report, "increased corn demand for ethanol could account for 25 to 50 percent of the corn price increase expected from 2006/07 to 2008/09."[5] Additional causes of corn price inflation include the weaker dollar, higher prices for other crops, increases in corn feed demand by U.S. livestock, higher energy and production costs, and speculation in commodity markets.[6]

[a] Based on the complete use of available capacity, an average corn yield of 150.68 bushels per acre per year, and an average corn-to-ethanol conversion rate of 2.75 bushels per gallon.

Figure 1.3

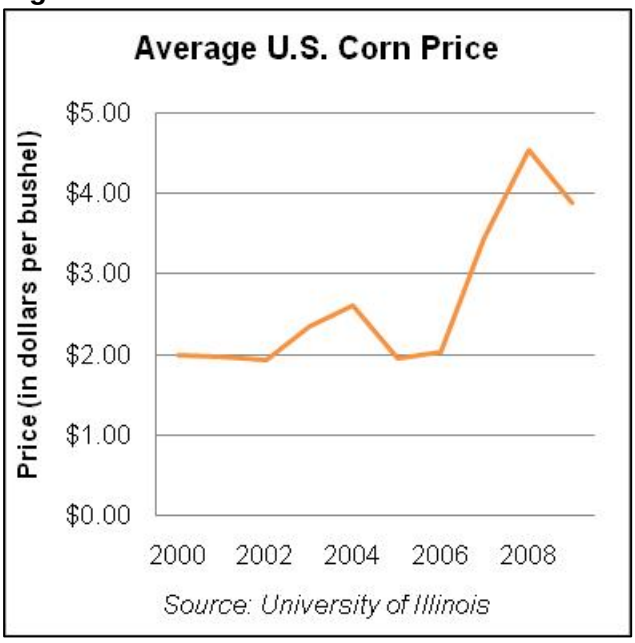


Table 1.2 shows that from 2005 to May 2008, the prices of corn, soybeans, and wheat increased by 156%, 117%, and 157% respectively.[7] Since May 2008, prices have fluctuated more dramatically in both directions.

The peak in corn and soybean prices during the summer of 2008 aligned with record-breaking oil, fertilizer, and pesticide prices, as well as flooding in the Midwest, and prices have fallen since. Furthermore, as gasoline prices have declined, ethanol prices have also fallen to remain competitive. Despite the concurrent reduction in ethanol prices, lower gas prices have resulted in decreased demand for corn for ethanol and, thus, a decrease in corn prices. Nonetheless, the Congressional Budget Office maintains a long-term estimate that crop prices will remain high through 2018 relative to historical prices, due "in part to the strong market demand for ethanol."[8]

Impact of Prices on Land Use

Land-use change can be attributed to both the direct effect of higher corn prices leading to increased plantings and also the indirect effect of higher corn prices on the prices and plantings of other crops.[9] In our analysis, we focus on the impacts of both direct land-use changes (e.g. increased corn plantings) and indirect land-use changes (e.g. changes in crop rotations) on wildlife habitat. A study by researchers from the Center for Agricultural and Rural Development at Iowa State University shows that total cropland expands as ethanol profitability increases, regardless of whether crops are substitutes or complements.[10] While increased corn plantings as a result of ethanol production may be relatively easy to measure, it is more difficult to measure the indirect impacts of corn ethanol production, such as the conversion of native prairie to soybean production and the filling of wetlands for wheat production.

Table 1.2

Major Crop Prices Received by Farmers ($/bushel)			
Crop year	**Corn**	**Soybeans**	**Wheat**
2005/06	$2.00	$5.66	$3.42
2006/07	$3.04	$6.43	$4.26
May 2008	$5.12	$12.30	$8.80
Change 2005/06	+ 156%	+ 117%	+ 157%

Source: Keith Collins, 2008; Data from: USDA, NASS

Numerous studies have described the direct relationship between increasing corn plantings and losses of ecologically important landscapes, such as grasslands, woodlands, and wetlands.[11,12,13] In a 2007 paper, researchers at Iowa State University discuss the impacts of crop plantings on the Conservation Reserve Program (CRP), the largest federal land retirement program (see page 43 for full description). The authors estimate CRP acreage losses as a function of crop price and

CRP acreage savings as a function of CRP rental rate payments in Iowa. As expected, as crop prices increase, CRP losses increase. Likewise, as CRP rental rates increase, fewer CRP acres are put into production.[14] In an article published the following year, the same author argues that as many as 2 million acres of CRP land may be taken out of retirement and put into production annually for the next 10 years "if CRP policy remains unchanged."[15]

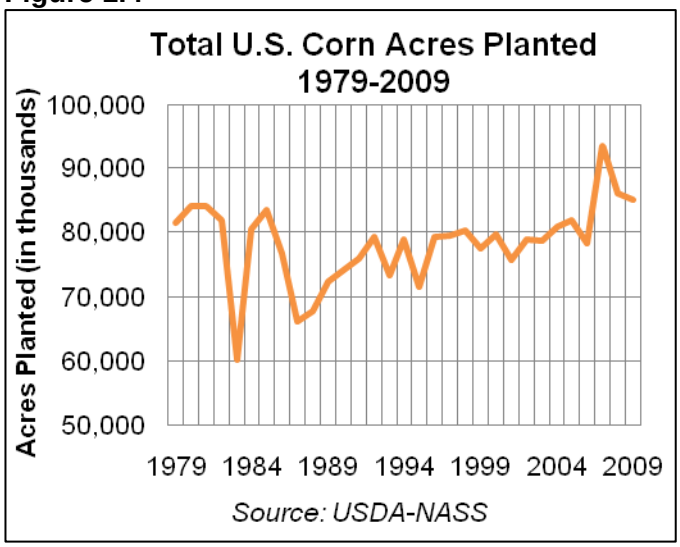
Practitioners have noted that uncompetitive CRP rental rates are a major reason for enrollment declines. In a recent department publication, Randy Kreil, Chief of the Wildlife Division of the North Dakota Game and Fish Department, discussed CRP loss, noting that over 400,000 acres of conservation land in North Dakota were converted to cropland in 2007. Kreil continued, "The meteoric rise in agricultural commodity prices and stagnant CRP rental rates leave the state's farmers and ranchers little choice but to convert erodible grassland habitat into corn, soybeans and wheat."[16]

Conversion of wildlife habitat to cropland can be particularly attractive to landowners when federal programs compound existing price incentives to convert land. According to the Economic Research Service, increases in crop insurance subsidies are responsible for the conversion of millions of acres of hay and pastureland into cropland.[17] The Government Accountability Office has detected the same trend with native grassland and CRP land.[18] When offered insurance, producers have less incentive to conserve marginally productive, ecologically important land.

Increasing Corn Production

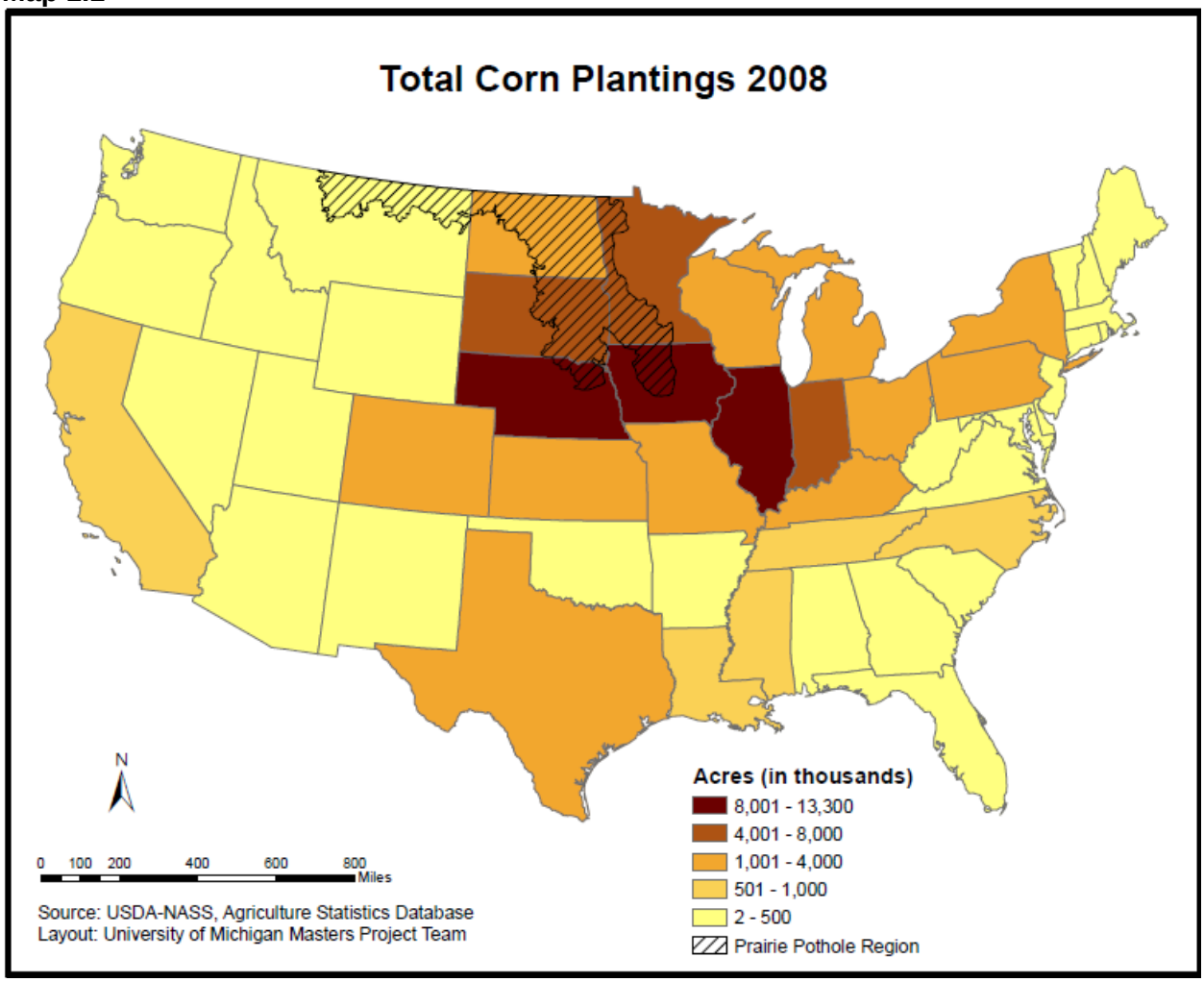
As expected, recent increases in corn ethanol demand have coincided with increases in corn plantings across the United States. Although U.S. corn plantings have fluctuated throughout the past thirty years, the total number of acres planted annually remained between 70 and 80 million for most of the past two decades. Figure 1.4 shows corn acres planted from 1979 to 2009. Between 2006 and 2007, there was a 19.4% increase in U.S. corn plantings, with over 93 million acres of corn planted in 2007. Total corn acreage has since fallen to 85 million acres in 2009. However, corn prices are still at record highs, and the United States still has more total acreage devoted to corn plantings than at any time in the past half-century.[19]

Figure 1.4

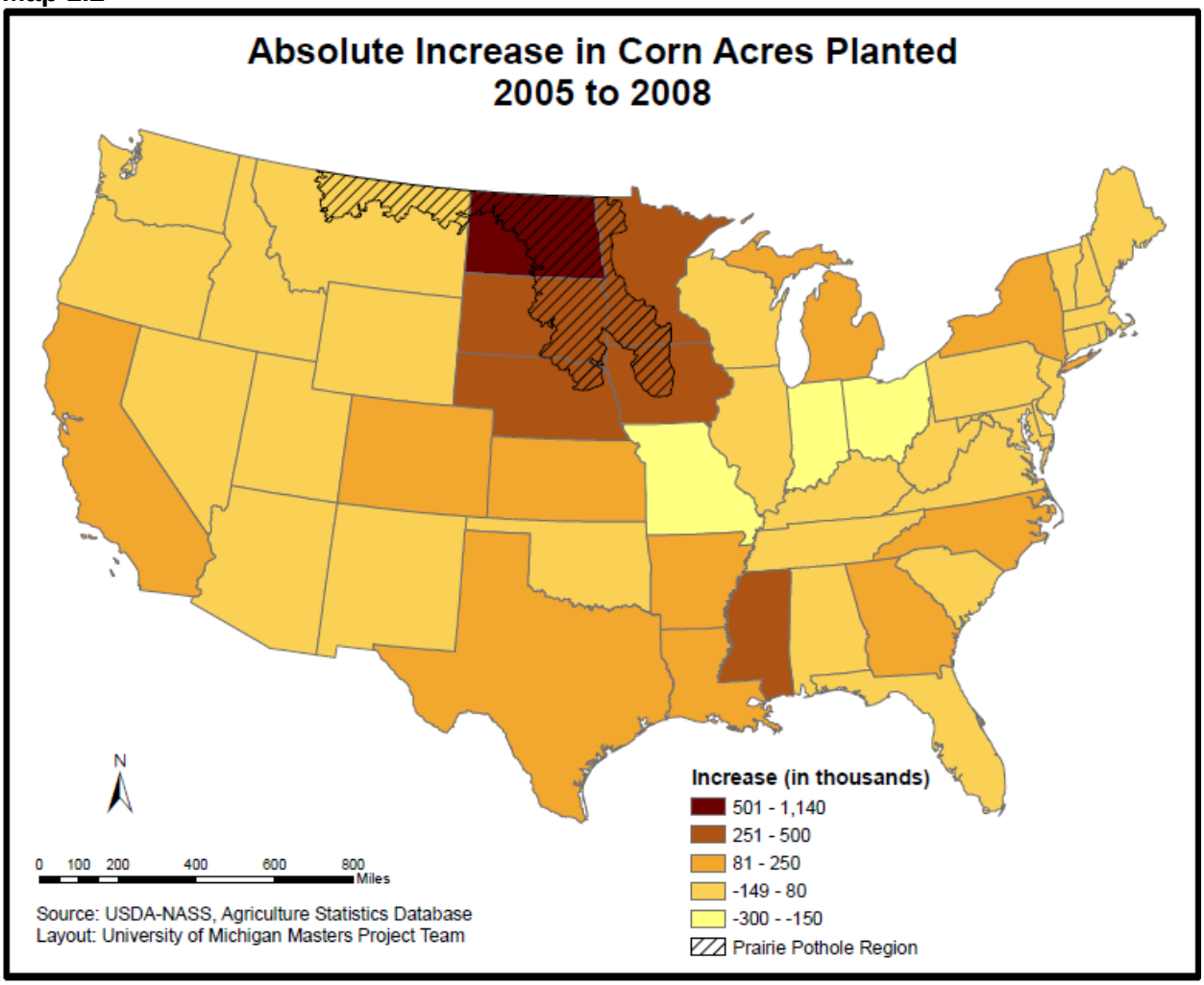


Roughly 65% of the country's corn production occurs in just seven Midwestern states: Iowa, Illinois, Nebraska, Minnesota, Indiana, South Dakota, and Wisconsin. Map 1.1 shows the geographic distribution of acres of corn plantings in 2008. Much of the recent increase in corn plantings also occurred in the Midwest; five of the six states with the greatest increase in total corn acreage between 2005 and 2008 were North Dakota, Iowa, Minnesota, Nebraska, and South Dakota (Map 1.2). However, some states that historically have had a smaller number of acres dedicated to corn also experienced significant increases. Notably, the southern states of Mississippi, Arkansas, and Louisiana experienced increased corn plantings of over 50% between 2005 and 2008.[20]

Map 1.1

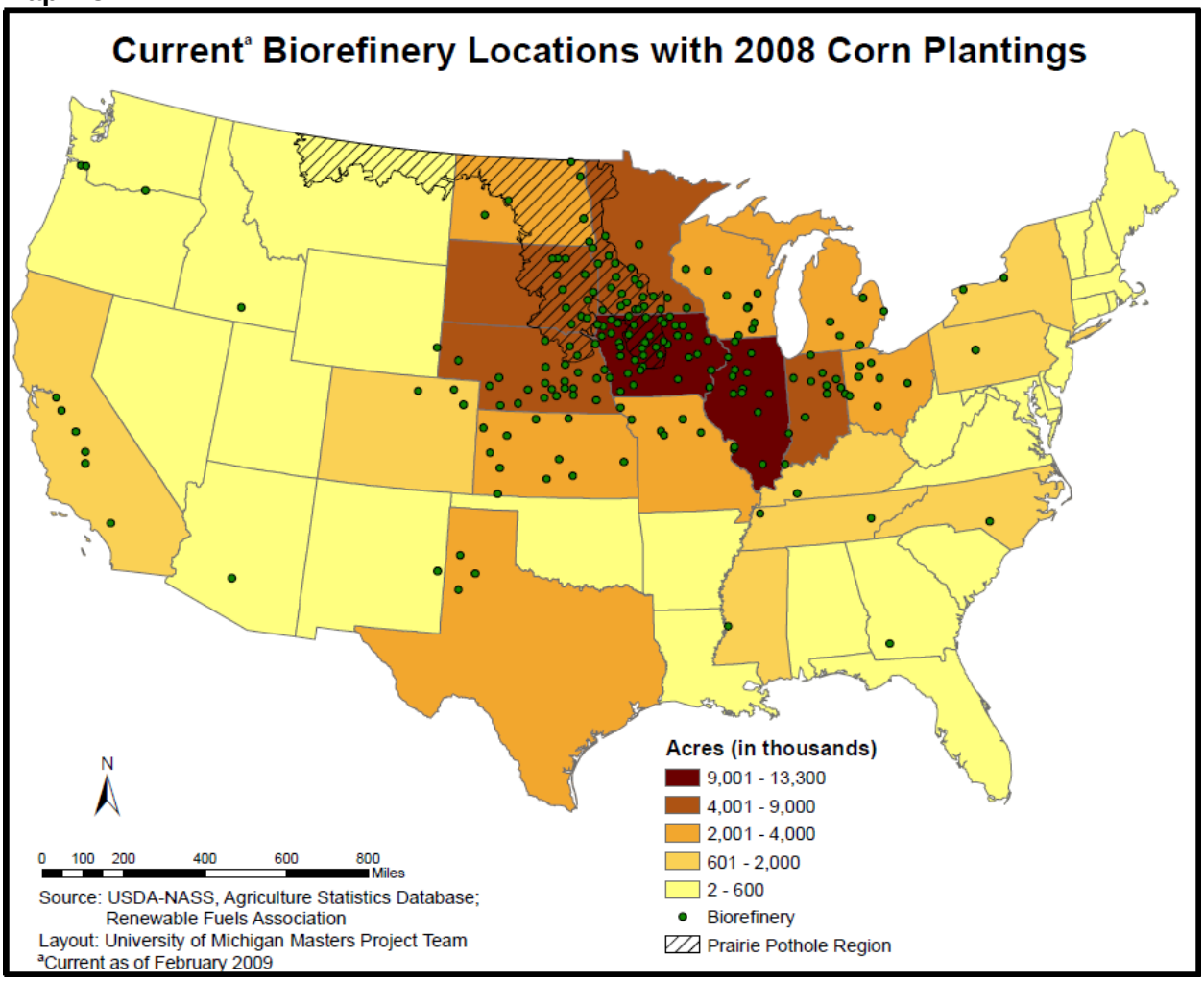


Map 1.2


Absolute Increase in Corn Acres Planted
2005 to 2008
N
0 100 200 400 600 800
Miles
Source: USDA-NASS, Agriculture Statistics Database
Layout: University of Michigan Masters Project Team
Increase (in thousands)
501 - 1,140
251 - 500
81 - 250
-149 - 80
-300 - -150
Prairie Pothole Region

As corn ethanol production has increased, resulting changes in land use and agricultural practices have been concentrated in the Midwestern United States, where most domestic corn is grown. While corn ethanol refineries can be found in 26 states, they are largely located on the central Great Plains, with especially high concentrations in Iowa, Nebraska, Illinois, Minnesota, and South Dakota.[21] Map 1.3 shows the distribution of corn ethanol refineries and acres of corn plantings in 2008. There is a close spatial relationship between corn ethanol refineries and acres of corn planted. A 2008 study found proximity to high corn acreage to be the primary factor in deciding where to site an ethanol refinery.[22]

Map 1.3



The Prairie Pothole Region

As shown by the distribution of corn ethanol biorefineries and increased corn plantings across the country, much of the land-use change associated with increased corn ethanol production is concentrated in the Midwest. We chose to focus our analysis on the Prairie Pothole Region (PPR), a unique ecosystem that lies within this part of the country. The PPR is an ecologically

significant area for wildlife, especially migratory and game birds. Migratory birds from throughout the Western Hemisphere rely on the wetlands and grasslands of the PPR for breeding. According to Ducks Unlimited, the Great Plains and PPR is number one on the list of the 25 most important and threatened waterfowl habitats on the continent.[23]

Within the PPR, we focused our analysis on four states: Iowa, Minnesota, North Dakota and South Dakota. Both Iowa and Minnesota have supported high levels of corn agriculture for decades and have little native habitat remaining. Conversely, the Dakotas have only experienced significant increases in corn agriculture in the past few decades. Historically, these states have had more land open for ranching and grazing. Thus, the Dakotas have significantly larger areas of native habitat that have never been broken for agriculture. All four of our study states also have significant amounts of habitat conserved in agricultural land retirement programs such as CRP.

Research Questions

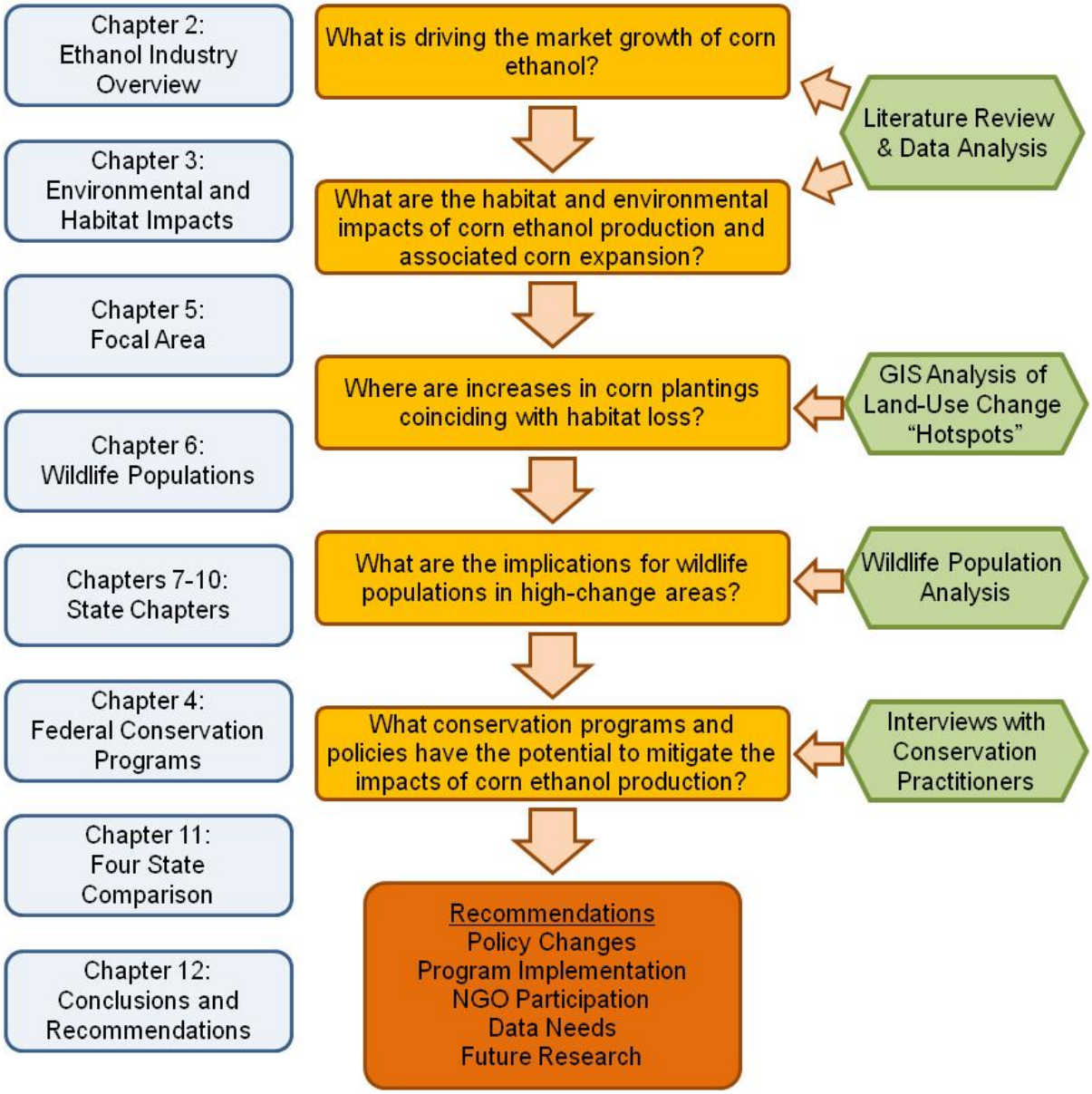
This study addresses six specific research questions:

1. What is driving the market growth of corn ethanol?
2. What are the habitat and environmental impacts of corn ethanol production and associated corn expansion?
3. Where are increases in corn plantings coinciding with habitat loss?
4. What are the implications for wildlife populations in high-change areas?
5. What conservation programs and policies have the potential to mitigate the impacts of corn ethanol production?

The following flow diagram, Figure 1.5, illustrates how our report relates to our research questions and methodology.

Figure 1.5

Research Questions and Methodology



Methodology

Land-Use Change Index

We used ArcGIS, a Geographic Information Systems (GIS) software package, to determine where increased corn acreage coincides with CRP and native prairie losses in our study states. We constructed indexes that incorporate data on corn plantings, CRP enrollment, and first-time crop production on native prairie (available only for North and South Dakota) from 2004 to 2007.

The resultant "Change Index" for each state highlights counties in which the relevant land-use changes have been highest, revealing "hotspots" of change.

To calculate Change Index values for Iowa and Minnesota, we used publicly available corn planting data from the USDA National Agricultural Statistics Service (NASS) and CRP enrollment data from the Farm Service Agency (FSA) Conservation Programs Statistics website. For each county in the state, we normalized the change in corn planting acreage and CRP enrollment acreage from 2004 to 2007 by county area. Each percentage, p, was then converted to a value, v, between 0 and 100 using the equation:

$$v(p) = (p - p_{min})*100/(p_{max} - p_{min}),$$

where p_{min} is the smallest percentage and p_{max} is the largest percentage. The resultant corn plantings value and CRP value for each county were weighted equally to obtain the Change Index score for that county. We tested alternative weightings and the spatial trends were similar.

For North and South Dakota, the corn planting values and CRP values were calculated using the same procedure as for Iowa and Minnesota. However, new breakings data obtained from FSA were also included in the Change Indexes. Broken acres in each county in 2005, 2006, and 2007 were added together to determine grassland loss for the county in the three-year period. Total grassland loss was normalized by county area and converted using the equation above. The corn, CRP, and new breakings value for each county were weighted equally and added together to obtain the Change Index score for that county. As with Iowa and Minnesota, using alternate weightings did not change overall spatial trends. In counties where CRP enrollment increased between 2004 and 2007, the CRP value had the effect of decreasing a county's change index score. Conversely, CRP loss between 2004 and 2007 had the effect of increasing a county's change index score.

Wildlife Analysis

In order to better understand the effects of land-use changes driven by increased corn plantings on wildlife populations within the PPR, we analyzed the relationship between corn plantings and grassland bird populations in our four-state study area. Grassland birds are among the fastest and most consistently declining birds in North America, and increased corn expansion into grasslands may be speeding up their decline. Using publicly available Breeding Bird Survey (BBS) data, NASS corn plantings data, and FSA CRP enrollment data, we analyzed how recent changes in land use are affecting bird populations in our study states.

We focused on a set of sensitive "indicator species" most likely to be affected by decreased grassland habitat and compared them to a set of generalist species, or "insensitive species," to serve as a control. We examined whether birds in areas experiencing the greatest increases in corn plantings and greatest losses in CRP enrollment have suffered population declines. This was done by looking at the affect of land-use changes on number of species and number of individual sightings between 2005 and 2008 for both indicator and insensitive bird populations. In addition to analyzing multiple sensitive indicator species together, we also examined the effects of corn increases and habitat change on our five individual indicator species: Dickcissels, Grasshopper

Sparrows, Sedge Wrens, Upland Sandpipers, and Western Meadowlarks. To understand the effect of land-use change on these species, we examined population changes between 2005 and 2008 for each species along a gradient from low habitat change to high habitat change and from low corn increase to high corn increase.

Policy Analysis

In order to better understand the link between corn ethanol production and land-use change, and also to assess both the regulatory and institutional capacity that exist to deal with associated impacts on the landscape, we conducted phone interviews with state-level conservation practitioners. Our team strove to speak with at least two practitioners in each of the following categories from each of our four focal states:

- State office of a USDA branch (FSA or NRCS)
- State wildlife agency (State Department of Natural Resources or U.S. FWS)
- State Department of Agriculture, Farm Bureau, or Farmers Cooperative
- Conservation NGOs and land trusts

A full list of the organizations interviewed is given in Table 1.3.

Table 1.3

State-Level Interviews
Iowa
Iowa Department of Natural Resources
USDA Natural Resources Conservation Service, Iowa Field Office
USDA Farm Service Agency, Iowa Field Office
Iowa Ducks Unlimited
Iowa Natural Heritage Foundation
Pheasants Forever
Minnesota
Minnesota Department of Agriculture
Minnesota Conservation Federation
Minnesota Department of Natural Resources
Minnesota Ducks Unlimited
US Fish and Wildlife Service, Minnesota Field Office
North Dakota
USDA Farm Service Agency, North Dakota Field Office
Pheasants Forever
USDA Natural Resources Conservation Service, North Dakota Office
National Farmers Union
North Dakota State University Extension
US Fish and Wildlife Services, Regional Office
Ducks Unlimited, Great Plains Office

South Dakota
USDA Farm Service Agency, South Dakota Field Office
South Dakota Department of Agriculture
South Dakota Department of Game, Fish, and Parks
US Fish and Wildlife Service, South Dakota Field Office
USDA Natural Resources Conservation Service, South Dakota Field Office
Ducks Unlimited, Great Plains Office
Northern Prairies Land Trust

Interviews typically lasted 30 to 60 minutes with the goal of understanding the successes and shortcomings of conservation policies and their implementation. From these discussions, we drew conclusions about adjustments that could be made to better cope with corn ethanol-related land-use changes. Questions included:

- Do our hotspot land-use change maps match what you are seeing on the ground? Why are these areas experiencing higher change than other areas in the state?
- What do you see as the greatest threats to habitat in your state? Where does agriculture and corn production fall on that spectrum? Where does cropping on native prairie land fall on that spectrum?
- Was there an increase in corn production in recent years? If so, where did new acres for corn production come from?
- Are there impacts on wildlife habitat associated with increased corn plantings and corn ethanol demand in your state?
- What state and federal policies and programs help conserve wildlife and habitat on agricultural land? How effective are they?
- How are these programs implemented and are there any best practices that you would recommend to other states?
- What, if any, changes should be made to conservation programs at either the state or federal level? What additional resources are needed to make these programs more effective?
- Was there an increase in broken CRP contracts with rising corn prices? Was this information collected in any systematic manner?
- Which organizations are most active in the conservation of wildlife and habitat in your state? Are there any outstanding partnerships between organizations?

Report Outline

In the following chapters, we describe the drivers of corn ethanol expansion, the impact of this expansion through land-use changes, and the implications of these changes for wildlife and habitat in Iowa, Minnesota, North Dakota, and South Dakota.

- Chapter 2 explains the drivers of corn ethanol production and provides an overview of structure, current status, and future outlook of the U.S. corn ethanol industry.

- Chapter 3 describes the national-level habitat and environmental impacts of both corn ethanol feedstock production and the production and consumption of corn ethanol.

- Chapter 4 examines federal conservation programs that have the potential to mitigate the environmental impacts of increased corn plantings.

- Chapter 5 describes our focal region, including the ecological importance of the PPR, the status of corn ethanol production in the region, the changes in corn plantings, and the resultant habitat loss and degradation.

- Chapter 6 analyzes breeding bird population trends in the PPR to quantify the impact of land-use change on wildlife populations.

- Chapters 7, 8, 9, and 10 focus on the individual states in our study area, highlighting the interviews conducted with conservation practitioners. In each of these chapters, we describe state-level corn ethanol laws and incentives, conservation policies, the structure of land ownership, and state-specific ecology and species of conservation concern. We then conduct a "hotspot" analysis of land-use change at the county level.

- Chapter 11 synthesizes the results of our state-level analyses and conversations with conservation practitioners into a four-state comparison. We highlight key themes throughout the focal area, and discuss similarities and differences in landscapes, land ownership and use, state-level policy and politics, and program implementation.

- Chapter 12 highlights our key findings and makes recommendations on ways to mitigate the impacts of corn ethanol production on habitat and wildlife.

Chapter 2: U.S. Corn Ethanol Industry Overview

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Ethanol Billboard along Highway in North Dakota
Photo: Aviva Glaser

Chapter 2
U.S. Corn Ethanol Industry Overview

The United States is the world's largest ethanol producer, responsible for over 50% of global production in 2008.[24] Corn ethanol dominates the U.S. industry and has seen exponential growth over the past 10 years, as shown in Table 2.1. Several factors contribute to industry growth: the desire for energy independence; rising oil prices; and the search for renewable energy. As a result of these factors, the U.S. government has provided an increasing number of incentives for corn ethanol production. This support has provided both the financial stability needed for industry growth and a guaranteed demand for corn ethanol, leading to the construction of new refineries and increased capacity. This chapter provides an overview of the U.S. corn ethanol industry including: the industry structure; present market conditions; government incentives, laws, and programs; and future outlook.

Table 2.1

Historic U.S. Ethanol Refineries and Capacity[25]											
Year	Jan. 1999	Jan. 2000	Jan. 2001	Jan. 2002	Jan. 2003	Jan. 2004	Jan. 2005	Jan. 2006	Jan. 2007	Jan. 2008	Jan. 2009
Total Ethanol Plants	50	54	56	61	68	72	81	95	110	139	170
Ethanol Production Capacity (mgy)[b]	1,701	1,748	1,921	2,347	2,706	3,100	3,643	4,336	5,493	7,888	10,569

Source: Renewable Fuels Association

Corn ethanol refineries can be found in 26 states but are largely located in the Midwest, with especially high concentrations in Iowa, Nebraska, Illinois, Minnesota, and South Dakota.[26] As Map 1.3 shows, high densities of ethanol refineries are located in areas of high corn production. More research is needed to test whether corn plantings increase in the local area after the opening of an ethanol refinery. Other factors involved in siting ethanol refineries include: proximity to high density of livestock feeding facilities (for the sale of the distiller grains by-product), low competition from existing refineries, and state incentives.[27]

Brief History of Corn Ethanol

Corn ethanol was the fuel used to power Henry Ford's first vehicle in 1907, but was replaced by gasoline in the early 1900's. In the 1970's ethanol re-emerged as a gasoline extender during the gasoline shortages caused by the OPEC oil embargo and was used as a substitute for lead (an octane booster) in gasoline. Through the 1980's and 1990's Congress passed a series of tax benefits for ethanol refiners and blenders, helping industry growth.

[b] mgy denotes million gallons per year.

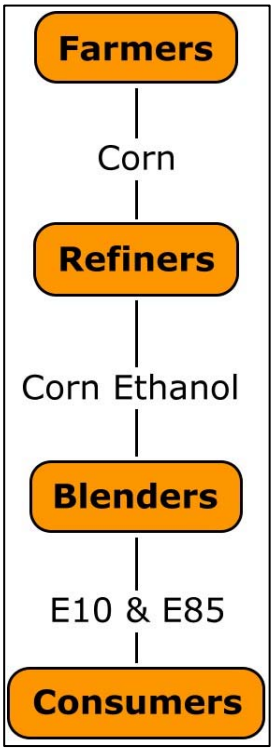
When MTBE (a gasoline additive used to reduce air emissions) was phased out in the early 2000's, corn ethanol became a substitute and demand rose. This coincided with the start of mass production of flex-fuel vehicles capable of running on ethanol blends. The corn ethanol industry grew rapidly in the early part of the decade, as demand outstripped production. The 2005 Energy Bill further spurred rapid industry expansion through the establishment of the first Renewable Fuel Standard (RFS). The RFS sets a floor for ethanol demand by mandating that a certain amount of ethanol be blended with gasoline each year.

In 2007 Congress passed the Energy Independence and Security Act, which increased the RFS. At the same time, cheap construction costs attracted new entrants and industry growth sky-rocketed. This quickly brought the industry capacity above demand, and as a result ethanol prices came down. At the same time, corn feedstock prices rose sharply from 2006 to 2008. Refiners were caught in the middle, paying more for feedstock but commanding a lower price for ethanol. These problems have been further exacerbated by the drop in gasoline prices and the global economic recession in 2008 and 2009.

Corn Ethanol Industry Structure

There are three main players in the corn ethanol value chain as shown in Figure 2.1: farmers, refiners, and blenders.

Figure 2.1



Farmers

Farmers are responsible for corn feedstock production, which includes the harvesting, transportation, storage, and preprocessing of corn for ethanol production. On average, the yield from one acre of corn can produce 414 gallons of ethanol.[28,29] As discussed in Chapter 1, farmers have responded to the growing demand for corn for ethanol with increased acres of corn plantings. In addition to growing corn, some farmers are also members of ethanol refining co-operatives, discussed below.

Refiners

Refiners undertake the physical production of corn ethanol. Corn ethanol for fuel is made through a fermentation process where yeast is used to metabolize the sugar in corn to produce ethanol. Two methods are used to process corn into ethanol—wet milling and dry milling. Today, dry milling is the most common process because of the low capital costs to build and operate these plants.[30]

There are three main inputs for ethanol production: corn, heat for processing (typically from natural gas or coal), and water. Corn, the major feedstock for ethanol production, is 60-70% of the input cost for an ethanol refinery.[31] Heat is the second highest cost of production, used to liquefy corn starch, distill alcohol, and dry leftover distillers grains.[32,33] Water is also a major input in production; at current levels of technology, a biorefinery will use

about 400 million gallons of water per year to produce 100 million gallons of ethanol, the equivalent of 1.1 million gallons of water per day.[34] Chapter 3 addresses the environmental impacts associated with ethanol production. The ethanol production process generates both corn ethanol for transportation fuel and dry distiller grains for livestock feed.

The ownership demographic of corn ethanol refineries has changed in recent years. Farmer-ownership of ethanol refineries was responsible for most of the industry expansion through 2006.[35] In 2006, nearly half of all ethanol refineries were owned or operated by farmer co-operatives or Limited Liability Corporations.[36] However, a significant influx of non-farmer capital has since shifted the majority of refinery ownership to centralized agribusiness corporations.[37] Local ownership dropped to 28% in 2008 and fell further to 23% in early 2009, with only 39 of 170 operating corn ethanol refineries in local ownership.[38,39]

Ethanol distribution is difficult due to the chemical structure of ethanol, which causes it to readily absorb moisture from the air leading to corrosion of transportation containers. This makes it impossible to pipe ethanol through existing oil pipelines. Instead, it is transported to demand centers by train (75%) or truck (25%) in special containers.[40] Most ethanol production facilities are concentrated in the Midwest, while the majority of demand is on the two coasts, making transportation costs an important consideration for refiners.

Blenders

Blenders are oil companies or fuel retailers that blend corn ethanol into gasoline to achieve either a blend of 10% ethanol 90% gasoline (E10) or 85% ethanol 15% gasoline (E85). The most common blend is E10; nearly half of U.S. gasoline contains up to 10% ethanol. The RFS dictates that each blender must blend a set amount of ethanol into the gasoline they sell each year. This essentially dictates demand for ethanol by blenders. Demand above this floor may be motivated by the 45 cents-per-gallon tax incentive for ethanol blending and state-level blending requirements and incentives.

The most common location for ethanol blending is at regional terminals, although new blender pumps allow blending to occur at retail locations. Such pumps prevent the need to transport the fuel to a regional terminal and instead allow local corn ethanol to be distributed directly to retail outlets. In March of 2009, Valero, the largest U.S. petroleum refiner and retailer, purchased seven refineries from the bankrupt VeraSun, making it the first blender to move into corn ethanol refining. Shell has also signaled that it will move in this direction.

Regulatory Incentives for Corn Ethanol Production

Legislative History

The U.S. government provided the first tax incentives for ethanol production in 1978, as a response to the Arab Oil Embargo. Since then, subsidies for blending corn ethanol with gasoline have ranged from 40 to 60 cents per gallon and were most recently lowered from 51 cents per gallon to 45 cents per gallon in the 2008 Farm Bill.

Beginning in 2003, the second Iraq War and growing concern over global climate change created strong public and political support for corn ethanol, which was perceived as a "green" and domestic source of energy. This growing sentiment led to the passage of the 2005 Energy Bill, which included major subsidies for ethanol refineries and infrastructure and also the first RFS. This legislation resulted in a wave of investments in ethanol biorefineries and distribution infrastructure. The RFS was increased in the 2007 Energy Independence and Security Act, and requires increasing levels of conventional biofuel (mostly corn ethanol) to be blended annually with gasoline. Table 2.2 provides the fuel requirements mandated by the 2007 Renewable Fuel Standard.

Table 2.2

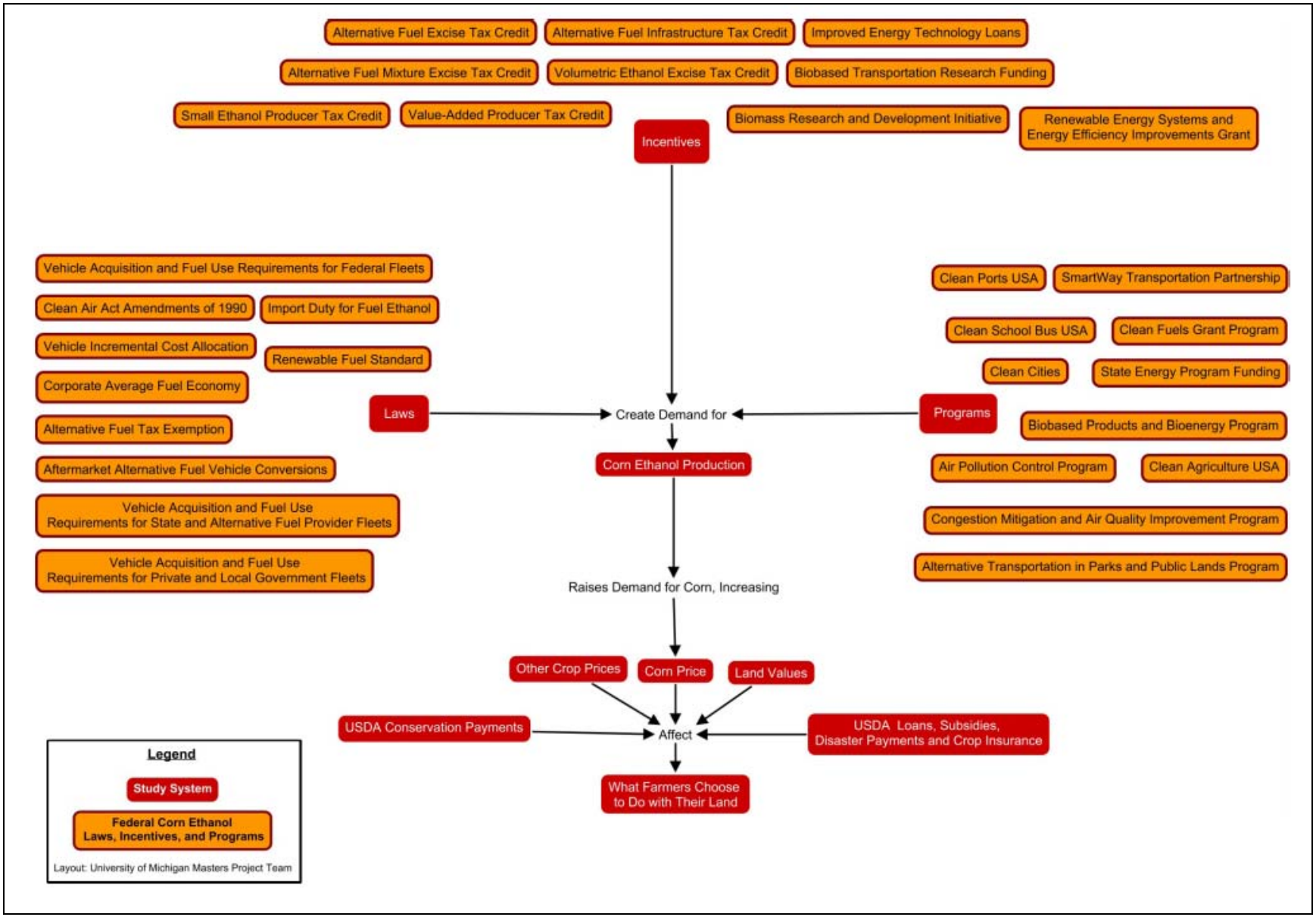
Renewable Fuel Standard (bgy)[c]				
Year	**Total Volume of Renewable Fuels**	**Advanced Biofuel Requirement**	**Cellulosic Requirement**	**Corn Ethanol Requirement**
2008	9.00	0.00	0.00	0.00
2009	11.10	0.60	0.00	10.50
2010	12.95	0.95	0.10	12.00
2011	13.95	1.35	0.25	12.60
2012	15.20	2.00	0.50	13.20
2013	16.55	2.75	1.00	13.80
2014	18.15	3.75	1.75	14.40
2015	20.50	5.50	3.00	15.00
2016	22.25	7.25	4.25	15.00
2017	24.00	9.00	5.50	15.00
2018	26.00	11.00	7.00	15.00
2019	28.00	13.00	8.50	15.00
2020	30.00	15.00	10.50	15.00
2021	33.00	18.00	13.50	15.00
2022	36.00	21.00	16.00	15.00

Federal Incentives

As of the beginning of 2009, a variety of federal incentives for corn ethanol exists, subsidizing not only the production and blending of corn ethanol but also E85 fueling infrastructure and flex-fuel vehicle use. Figure 2.2 shows how federal laws, incentives, and programs drive demand for corn ethanol. In 2007, the ethanol industry received 76%, or $3 billion, of all federal renewable energy tax credits.[41] By 2010, ethanol is projected to cost the federal government more than $5 billion a year—more than is spent on all U.S. Department of Agriculture conservation programs to protect soil, water, and wildlife habitat.[42]

[c] bgy denotes billion gallons per year of ethanol produced.

Figure 2.2 System Diagram of Federal Corn Ethanol Laws, Incentives, and Programs



The RFS drives corn ethanol demand by specifying how much biofuel must be used by each fuel refiner, importer, and blender. If these entities use less than their required amount, then they must buy credits from those who use more than their required amount. The price of these credits in 2009 is 7 cents-per-gallon.[43]

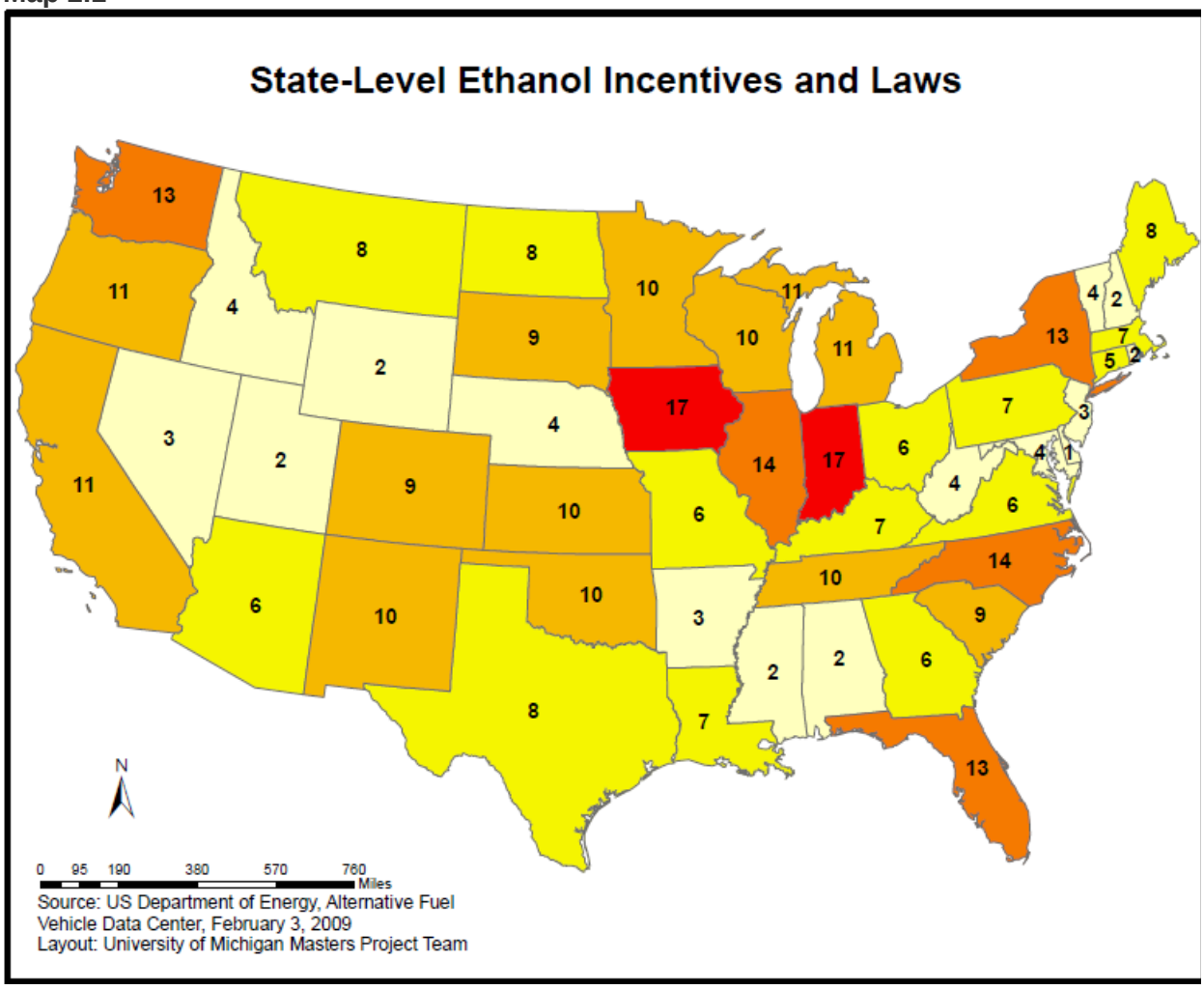
A second federal incentive is the Volumetric Ethanol Excise Tax Credit (VEETC). Through this credit, blenders registered with the Internal Revenue Service are eligible for a tax credit of 45 cents-per-gallon of pure ethanol blended with gasoline. This credit is presently set to expire at the end of 2010. A recent report by the Center for Agricultural and Rural Development at Iowa State University points out that the VEETC is redundant of the RFS in that they both are able to set the demand for ethanol.[44] If the RFS is binding, then eliminating the VEETC will not change ethanol demand, it will simply raise the cost of the credits used to meet the RFS by entities not blending their required amounts. Eliminating the VEETC would ease the burden on taxpayers and make the cost of meeting the RFS more transparent.

Currently, the U.S. government imposes several tariffs on imported ethanol, protecting the domestic industry from lower-priced foreign imports. A basic 2.5% ad valorem tariff taxes imported ethanol on a percent of value basis. In addition, the 54 cents-per-gallon import duty on fuel ethanol is meant to offset the VEETC, insuring that foreign ethanol does not benefit from domestic incentives. However, at 54 cents-per-gallon, this import duty is higher than the 45 cents-per-gallon VEETC, creating what is essentially a trade barrier. Brazilian sugar cane ethanol is the primary fuel affected by such tariffs. The cost of sugar cane ethanol's production is about half that of American corn ethanol, due to 85% higher energy efficiency in production. Should tariffs be removed, sugarcane ethanol will compete with corn ethanol. The "Imported Ethanol Parity Act," introduced to the Senate in March 2009, would reduce the tariffs to an amount equal to the VEETC.[45]

State Incentives

In addition to federal support, many states have enacted legislation that include incentives for ethanol production, incentives for infrastructure, and requirements for ethanol-blended fuel use. Nine states have enacted their own RFS requiring higher blending levels, fourteen states have some sort of incentive for the retail sale of E10 and/or E85, and twenty-three states have incentives for ethanol refiners.[46] Incentives specific to our four-state focal area are discussed in Chapters 7 through 10. Map 2.1 illustrates the number of state ethanol incentives and laws across the country.

Map 2.1



Present Market Conditions

Changing Profitability

The global economic recession in 2009 has presented corn ethanol refiners with multiple challenges. Volatility in corn prices has led to some profit losses. The decline of corn price from its high in 2007/2008 penalized refiners locked into long-term contracts for feedstock. At the same time, ethanol prices have plummeted with declining gasoline prices. The link between gasoline price and ethanol price is largely due to substitutability of the fuels and the lower energy content of ethanol, which is about 68% of the energy of gasoline per unit of volume.[47] If wholesale gas is $3 per gallon, the equivalent energy value of ethanol is $2.04 per gallon.[48] The result of corn price fluctuations and a lower ethanol price is lower profit margins for refiners.

Additionally, the lack of financial liquidity in the market has led to cash-flow problems for many refiners. Companies carrying large amounts of debt have gone bankrupt, while construction on

15 to 18 new refineries has been halted. An additional 20 to 25 previously operating refineries (15% to 20% of U.S. ethanol production capacity) were shut down as of February 2009. [49, 50]

Even with these shutdowns, the currently operating production capacity of 10.57 billion gallons slightly exceeds the 10.5 billion gallons required to meet the RFS blending levels in 2009. While the RFS will increase annually through 2015, the production capacity of existing plants that are not operating or that are presently under construction appear large enough to more than meet federal mandates until at least 2012.[51] As the nation's average ethanol blending percentage approaches 10%, demand will slow and ethanol prices are likely to weaken relative to gasoline prices.[52] One way in which the industry hopes to deal with this is by increasing the cap on the amount of ethanol presently allowed to be blended with gasoline from 10% to 15%.

Consolidation within the Industry

While the corn ethanol industry has historically been highly fragmented, with many smaller players, consolidation is now occurring. Multiple ethanol refiners have gone through bankruptcy and buyouts in recent months. VeraSun, formerly the second largest ethanol producer in the United States, underwent a bankruptcy in February 2009 in which twelve of its sixteen refineries were sold. Seven of these plants, representing 780 million gallons of ethanol capacity, went to Valero, the largest U.S. petroleum refiner and retailer, which beat out ADM for purchase of the plants.[53] This is the first case of an ethanol blender moving into refining. Other bankruptcies in 2009 include Panda Ethanol Inc., Northeast Biofuels, Cascade Grain Products, Greater Ohio Ethanol, Gateway Ethanol, and Renew Energy LLC.[54,55]

Future Outlook for American Corn Ethanol

Potential for Market Growth

While the present market environment is not conducive to growth, the corn ethanol industry is fighting to change this by increasing the federal cap on the amount of ethanol that is allowed to be blended with fossil fuel. In November of 2008 the Environmental Protection Agency raised blending caps from 7.76% to 10.21%. The industry has been pushing for an increase to 15–20%, which has the support of Secretary of Agriculture Tom Vilsack. There is some question as to whether higher blends would require modification to engines. Automakers will have some influence over this decision because they will have to extend warranty coverage to these modified vehicles and alert consumers that higher ethanol blend levels are safe. Critics have argued that such a change would reduce the efficiency range of cars and cause people to fill their tanks more often because of the lower energy content of corn ethanol.

Competition from Other Alternative Transportation Fuel Sources

Multiple substitutes for ethanol exist. The RFS mandates a separate blending level for biodiesel and cellulosic ethanol, thus ensuring that demand for all three fuels exists. Biodiesel, which is derived from soy, can only be used in diesel engines and is blended with mineral diesel rather than gasoline. Cellulosic ethanol is derived from wood, grasses, or the non-edible parts of plants

(such as corn husks). Large investments by both the government and private investors are being made into cellulosic ethanol development, but as of early 2009 this biofuel has not yet entered the market because of cost-inefficiencies. The Chief of the Energy Information Administration said in early April 2009 that it seems unlikely that the cellulosic industry will be able to meet the targets set in the RFS.[56]

Corn ethanol also faces competition from other alternative car technologies, including the electric car industry, hybrid car industry, and fuel cell technology. Commercial development of such alternatives could lead to a significant decrease in demand for ethanol, and perhaps even to the elimination of the industry itself. However, if cellulosic biofuel can be produced more efficiently, the industry may be able to leverage the infrastructure it has already developed for corn ethanol to create a competitive advantage over other alternative transportation energy sources.

Conclusion

Government incentives led to a 200% increase in corn ethanol production between 2005 and 2009. While government support for corn ethanol has existed for over three decades, it has increased dramatically in recent years. The RFS is particularly important in setting demand for corn ethanol through blending requirements. The VEETC further drives demand through payments to blenders. Furthermore, domestic ethanol production is protected from foreign competition by the Import Duty for Fuel Ethanol. Though there are potential substitutes for corn ethanol in the form of other alternative fuel sources, these technologies are not widely available in the short term. While the recent recession has resulted in bankruptcies and consolidation in the industry, federal support for corn ethanol ensures that the industry will continue to grow in the future.

Chapter 3: Habitat and Environmental Impacts of Corn Ethanol Production

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Dyed Atrazine Runoff From Fields in Iowa
Photo: USGS, Toxic Substances Hydrology Program

Chapter 3
Habitat and Environmental Impacts of Corn Ethanol Production

Corn ethanol has myriad environmental impacts, both in its production and use. The recent explosion of the domestic corn ethanol industry has led to more acres being planted in corn. The result has been new breakings, greenhouse gas emissions, and increased erosion, and a greater use of water, pesticides, and fertilizer to grow this input-intensive crop. Such land-use practices lead to habitat loss and degradation as well as public health concerns. The corn ethanol refining process also has environmental consequences, again requiring high water inputs and resulting in additional carbon pollution. When consumed, corn ethanol releases greater amounts of particulate pollution than gasoline. This chapter explores the negative habitat and environmental consequences associated with corn ethanol. Table 3.1 summarizes some of the estimated environmental impacts of corn ethanol production between 1999 and 2009.

Table 3.1

Historic Environmental Impacts of Corn Ethanol Production											
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ethanol Production Capacity[57] (bgy)[d]	1.7	1.8	1.9	2.4	2.7	3.1	3.6	4.3	5.5	7.9	10.6
Corn Acres for Ethanol[58, 59] (million acres per year)[e]	4.1	4.2	4.6	5.7	6.5	7.5	8.8	10.5	13.2	19.0	25.5
Nitrogen for Corn Acres[60] (billion lbs per year)[f]	0.6	0.6	0.6	0.8	0.9	1.0	1.2	1.4	1.8	2.6	3.5
Soil Erosion from Corn Acres[61] (billion lbs per year)[g]	51.0	52.5	57.0	70.5	81.3	93.0	109.2	130.2	164.7	236.7	317.1
Water Use by Ethanol Refining Process[62] (bgy)[h]	6.8	7.0	7.6	9.4	10.8	12.4	14.6	17.4	22.0	31.6	42.3
% Growth Over Previous Year		2.9%	7.9%	19.1%	13.3%	12.6%	14.8%	16.1%	20.9%	30.4%	25.8%

[d] bgy denotes billion gallons per year
[e] Based on the complete use of available capacity, an average corn yield of 150.68 bushels per acre per year, and an average corn-to-ethanol conversion rate of 2.75 bushels per gallon
[f] Based on a multiplier of 138 pounds of nitrogen per acre of corn per year
[g] Based on an erosion rate of 30 pounds of soil per acre per year
[h] Based on a conversion of 4 gallons per water per 1 gallon of ethanol produced

Habitat Impacts of Feedstock Production

Habitat Loss

Between 2005 and 2009, the demand for corn for ethanol production has tripled. In response to increased demand for ethanol, there have been significant increases in the number of corn acres planted in the United States. The demand for corn acres for ethanol has increased from 10.4 million acres in 2005 to 30.2 million acres in 2009. Much of this increase has occurred on land formerly used to grow soybeans and wheat.[63] However, increased corn acreage has also come from land that previously was wildlife habitat, including native prairie, pastureland, and Conservation Reserve Program (CRP) land.[64] Few wildlife species can breed, feed, or live in corn fields; thus, as land is converted to corn production the habitat available for wildlife decreases. Chapter 1 provides more information on increases in corn plantings.

The expansion of corn plantings has also resulted in indirect land-use changes. As corn ethanol profitability increases, total cropland, including land used for soy, wheat, and other crops, has been shown to increase as well, leading to further reductions in potential habitat.[65] Quantifying these indirect effects is difficult, but it is estimated that a significant portion of increased row-crop acreage since 2005 has come from conversions of perennial hay, pasture, or idle lands.[66] While hay and pasture provide lower quality habitat than native prairies, they can support significantly more species than corn and other row crops. See page 31 for a discussion of indirect land-use change.

Habitat Degradation

In addition to the habitat lost due to increased corn and agricultural expansion, increased corn plantings also degrade wildlife habitat. This degradation occurs in two primary ways. First, the conversion of pasture, CRP, fallow land, and native prairie into crop production results in increased soil erosion, as well as additional application of pesticides and fertilizers. Second, switching from other crops to corn can increase erosion, pesticide use, and fertilizer use, as corn production is more input-intensive than the production of other crops. Several reports suggest that many farmers who once implemented corn-soy rotations have switched to corn-corn-soy, or entirely corn.[67] Interviewees in our study states confirmed that farmers have in fact been changing rotations from corn-soy to more intensive corn production. Studies reveal that such monoculture production depletes soil quality, requires higher fertilizer inputs, increases soil erosion, and diminishes the return of organic matter to the soil.[68,69,70,71]

As described in detail below, bringing more land into cultivation and intensifying corn production on current cropland both pose numerous threats to habitat quality. These threats primarily arise due to increases in pesticides and fertilizers that contaminate waterways, intensified tillage leading to soil erosion and sedimentation, and, in some cases, increased agricultural water use leading to less water available for native plants and wildlife.

<u>Pesticide Inputs</u>
Corn requires more pesticide inputs per acre than soy and most other food crops. Additionally, the pesticides applied to corn are, on average, more environmentally harmful and more persistent

than those used on soybeans and other crops.[72] Almost all corn acres are treated with at least one pesticide. In 2005, herbicides were applied to 97% and insecticides were applied to 23% of all field corn acreage in the country.[73]

The top five herbicides used on field corn in the United States are atrazine, glyphosate isopropylamine salt, s-metolachlor, acetochlor, and mesotrione (Table 3.2).[74] With the exception of glyphosate, these herbicides are used at higher rates and on more planted acreage of corn than on soybeans.[75] The difference is particularly large for atrazine, with a much higher amount of atrazine used on corn than on soybeans.

Table 3.2

Herbicide Use on Corn (2005)		
	% of Acres Applied	**Application Rate (lbs per acre)**
Atrazine	66%	1.133
Glyphosate isopropylamine salt	31%	.963
S-metolachlor	23%	n/a
Acetochlor	23%	n/a
Mesotrione	20%	n/a

Source: U.S. Department of Agriculture, National Agricultural Statistics Service, 2006; Agricultural Chemical Usage 2005 Field Crops Summary.

The two most commonly used pesticides on corn, atrazine and glyphosate, have potentially serious effects on wildlife. Atrazine is the most commonly used herbicide in the United States and is also one of the most common pesticide contaminants of ground and surface waters. Atrazine has a high leaching potential, is persistent in soils, and is moderately soluble in water, making it a serious threat to both surface water and groundwater.[76] Runoff from agricultural fields, especially corn fields, often contains atrazine. A 2002 study of herbicides in Midwestern streams detected atrazine in 94% of pre-emergence runoff samples, 96% of post-emergence samples, and 57% of harvest season samples.[77] Transformation products of atrazine were also frequently detected in the runoff samples.[78]

Widespread atrazine contamination is particularly concerning because of atrazine's impact on amphibian health and development. In male frogs, exposure to atrazine at levels as low as 0.1 parts per billion (ppb) causes hermaphroditism, retarded gonadal development, and female sexual development. These effects have been observed in laboratory studies as well as observational studies of wild leopard frogs in agricultural sites contaminated with atrazine throughout the United States.[79] In addition to the endocrine-disrupting effects of atrazine on amphibians, the chemical has indirect effects. Studies have found that wood frog tadpoles exposed to atrazine are more vulnerable to trematode parasitism and have higher intensities of dangerous infections than those not exposed to atrazine.[80]

The combination of phosphorous and atrazine can further increase the susceptibility of frogs to trematode infection.[81] Atrazine's affect on the relationship between the parasite and the frogs is two-fold. First, atrazine suppresses the immune system of amphibians, making them more

susceptible to the parasite. Additionally, both atrazine and phosphorous create conditions ideal for algae growth. Since algae are the food of choice for snails, and snails are intermediate hosts of the parasite, atrazine and phosphorous together indirectly increase frogs' exposure to potentially infectious trematode parasites.[82] This is especially concerning given the prevalence of both atrazine and phosphorous in corn-field runoff.

The second most commonly used pesticide in the region, glyphosate, is the second most commonly used herbicide on corn nationally.[83] Glyphosate herbicides are often used with genetically modified crops, as many corn crops are modified to be tolerant to glyphosate (i.e. Roundup-Ready). Glyphosate is expected to be immobile in soil and thus is not often thought to contaminate groundwater. However, glyphosate readily contaminates surface water and, once in the water, is not easily broken down by water or sunlight.[84] One study measuring the amount of herbicides in runoff detected glyphosate in 55 of 154 water samples (36%). The breakdown product of glyphosate, aminomethylphosphonic acid, was detected in 107 samples (69%).

The use of these pesticides on corn—combined with the use of additional pesticides on other crops—leads to mixtures of pesticides, nitrogen, and other contaminants in runoff and waterways. Pesticide mixtures have greater effects on larval growth and development of amphibians than individual pesticides. In laboratory experiments at the University of California, Berkeley, researchers found that pesticide mixtures cause larvae to take longer to metamorphose, damaging the thymus, and resulting in immunosuppression in amphibians. The researchers concluded that, "Given these adverse effects and the continued increase and use of pesticides in agriculture over the last 50 years, it is likely that pesticides have played and will continue to play a role in amphibian declines."[85]

A January 2008 study found that single, low-dose applications of five insecticides and five herbicides—including four of the top five herbicides used on corn in the United States—caused a wide range of both direct and indirect effects on aquatic communities. While some of the effects were expected due to the individual pesticides, other emergent effects were surprising. When all ten pesticides were mixed together, almost all leopard frogs died. The pesticide mixture also had cascading impacts throughout the community. Gray tree frogs subsequently increased in numbers because they no longer competed with leopard frogs over resources. The study found that "mixtures of globally common pesticides (driven by the mixture of the insecticides) can cause up to 99% mortality in larval amphibians, and this effect was completely explained by the individual pesticide effects." [86]

Fertilizer Inputs

In addition to increased pesticide inputs, expansion of corn acreage results in increased fertilizer application and, thus, an increased volume of nutrients in the environment.[87] Additionally, if corn intensity remains high in response to ethanol demand, fertilizer use may further increase in response to diminishing soil quality associated with continuous corn planting.[88]

Nitrogen is the most commonly used fertilizer on corn in the United States, and more nitrogen is applied per acre of corn than any other fertilizer. In a 2005 U.S. Department of Agriculture study of 19 states, nitrogen was applied to 96% of field corn planted, with an average of 138 pounds of nitrogen applied per acre. The second most commonly used fertilizer on field corn is phosphate,

which was applied to 81% of corn acreage, followed by potash, applied to 65%, and sulfur, applied to 13%.[89] It has been estimated that 40 to 60% of nitrogen applied to corn is not absorbed and is therefore likely to be transported to surface water, groundwater, and aquatic ecosystems.[90]

In landscapes dominated by corn, estimates suggest that around 17.8 to 35.7 lbs of the nitrogen applied per acre is transported to downstream aquatic ecosystems each year.[91] Transport of phosphorous from corn fields into waterways is also a concern. The amount of phosphorous lost from corn fields can range from 1.8 to 13.4 lbs of phosphorous per acre in a year. This tends to be higher than the amount lost from soybean fields (0.9–7.1 lb phosphorous per acre per year).[92]

Increased deposition of nitrogen and phosphorous has been shown to damage aquatic ecosystems. High nutrient levels can cause overproduction of organic matter. This, in turn, creates high biological oxygen demand from the breakdown of the organic matter by microorganisms, which can lead to oxygen depletion, or hypoxia

Nitrogen leached from corn fields in the Midwest is a major contributor to the hypoxic zone in the Gulf of Mexico.[93] One study found that the increase in corn production required to meet the Renewable Fuels Standard (RFS) (15–36 billion gallons by 2022) set by the most recent Energy Bill would increase the amount of dissolved inorganic nitrogen carried by the Mississippi and Atchafalaya Rivers by 10–34%. This increase would make reducing the nitrogen load to address the hypoxia problem virtually impossible without drastic changes in land management and reduction in corn for human and animal consumption.[94]

Tillage

Tillage refers to the series of operations required to prepare and cultivate a field for crop production. Conventional tillage involves disrupting and exposing the soil, and therefore leads to soil erosion, increased sedimentation of waterways, reduced soil quality, and disruption of wildlife habitat. Conservation tillage—a less disruptive alternative to conventional tillage—is a tillage system that leaves at least 30% of residue cover on the ground after planting.[95] Conservation tillage mitigates the environmental impacts associated with conventional tillage, but it is generally less common on corn acres than conventional tillage. A 2007 survey conducted by the Conservation Technology Information Center revealed that as corn acreage in Iowa increased from 2006 to 2007, no-till practices (a form of conservation tillage) decreased from 16% to 13% on corn acres planted. The same survey also revealed a slight decrease in no-till practices in Minnesota over the same time period.[96] These results suggest that conservation tillage practices may not keep pace with expanding corn acreage.

Based on Midwest erosion rates, studies suggest that for each gallon of grain ethanol produced, approximately 20–44 pounds of soil are eroded.[97] Much of this eroded soil is deposited in aquatic ecosystems in the form of sediment. Excessive sediment can have severe impacts on aquatic ecosystems, especially wetlands.[98] Increased sediment in the water column reduces the amount of light available for primary production by algae and macrophytes. Suppression of primary production has the capacity to drastically alter food chain interactions and negatively impact wetland invertebrates.[99]

Research shows that conventional tillage practices may in fact be detrimental to terrestrial wildlife populations as well. Researchers in Australia found that fields that were not tilled

contain the highest population densities of soil-dwelling invertebrates; conventional tillage resulted in the lowest abundance.[100] Similarly, a study in southern Illinois found a greater abundance of invertebrates, birds, and mammals in no-till than in conventionally tilled cornfield.[101] Another U.S. study compared Iowa no-till fields to conventionally tilled fields and found significantly greater diversity and density of birds nesting when no-till was used.[102]

Water Use

Increased corn agriculture may result in greater or less agricultural water use, depending on the region and type of land that is being converted to corn agriculture. On average, an acre of corn transpires between 3,000 and 4,000 gallons of water per day during the growing season.[103] Whether or not the corn is irrigated also affects its water usage. Over 90 percent of corn grown in the United States is not irrigated. However, irrigated corn requires a significant amount of water. The National Renewable Energy Laboratory estimates that, for irrigated corn, 785 gallons of water are needed to grow the corn for a single gallon of ethanol.[104] These water volumes may be greater or less than the water consumed by what was previously grown on the land.

Environmental Impacts of Ethanol Production and Consumption

Greenhouse Gas Balance

The exact life-cycle greenhouse gas (GHG) emissions of corn ethanol depend on a variety of different factors, such as the technology used to convert corn into ethanol and the type of land converted into feedstock production to meet ethanol demand. A 2006 study at the University of Minnesota concluded that corn ethanol production and consumption releases 88% of the total GHGs released by an "energetically equivalent amount of gasoline."[105] While this calculation includes the emissions associated with the full lifecycle of corn ethanol production, it relies on the assumption that the ethanol feedstock is being grown on land that was already in agricultural production.[106] Thus, releases of GHGs due to land-use changes are not included in this 88%.

The type of land being converted to ethanol feedstock production can determine whether or not ethanol results in a net gain or a net release of GHGs, most specifically carbon. The soil of native grasslands contains a great deal of sequestered carbon. Similarly, land begins to accumulate carbon in its soil when taken out of production and enrolled in CRP. When previously undisturbed soil is put into cultivation, it releases between 20% and 50% of all the carbon in the soil over 50 years of cultivation.[107] A 2009 Duke University study determined that converting native grassland into agricultural land for corn for ethanol production results in a net release of carbon for the first 49 years.[108] One 2008 study estimated that this conversion releases approximately 59.8 tons of CO_2 per acre over this time span.[109] For CRP land, there is a net release of carbon for 48 years, with an estimated release of 30.8 tons of CO_2 per acre into the atmosphere.[110,111]

The potential GHG emissions from land-use changes associated with the conversion of land to corn production for ethanol was modeled at Princeton University. When land-use changes were incorporated into the total GHG emissions of ethanol, ethanol's life-cycle GHG emissions resulted in a worldwide increase in GHG emissions of almost 100% over 30 years.[112] Looking at

only the GHG emissions related to land-use change, the conversion of land for corn ethanol increases GHG emissions for 30 years.[113]

Air Pollution

Recent analyses have demonstrated that both the production and the combustion of corn ethanol contribute to air pollution. Corn ethanol has been shown to have higher health costs from levels of particulate matter[i] than gasoline.[114] In addition to emission of particulate matter, other pollutants, such as black carbon, nitrogen oxides, ozone, and volatile organic compounds (VOCs) are created during ethanol production and combustion.[115] A study by researchers at the University of Minnesota found that the total life-cycle emissions of five major air pollutants are higher with E85 corn ethanol-gasoline blends than with conventional gasoline. The five major air pollutants examined were carbon monoxide, VOCs, PM10,[j] sulfur oxides, and nitrogen oxides.[116]

Water Use

In addition to requiring intensive amounts of water for feedstock growth, corn ethanol production also requires water for the refining process. Current estimates of water use by corn ethanol biorefinery facilities are approximately four gallons of water per gallon of ethanol produced. This is significantly more than the 1.5 gallons of water per gallon of petroleum produced. Thus, at current levels of technology, a biorefinery will use about 400 million gallons of water per year—roughly 1.1 million gallons per day—to produce 100 million gallons of ethanol.[117] Currently, the total corn ethanol industry operating capacity is 10.57 billion gallons. At four gallons of water per gallon of ethanol, an estimated 42.28 billion gallons of water will be required to produce this fuel.

A related concern is that many ethanol plants are being built or have been built at sites where water resources are already scarce due to intensive agricultural use. While the withdrawal of water for biorefinery use is only a fraction of the amount of water withdrawn for agriculture, this additional "mining" of groundwater may contribute to the irreversible losses of vital water resources, which is a particular concern in areas where current withdrawal rates are already greater than recharge rates.[118]

Byproducts of Ethanol Production

Byproducts of ethanol production are known as Dried Distiller's Grains with Solubles (DDGS) and are sold to beef and dairy farmers as cattle feed.[119] High levels of nitrogen and phosphorous in DDGS can increase the levels of these compounds in manure, indirectly contributing to increased nitrogen and phosphorous contamination of waterways.[120] Additionally, DDGS can contain the antibiotics that are routinely added to ethanol during production to prevent the growth of fermentation-disrupting bacteria. Concerns have arisen about potential "superbugs" developing from the high usage of antibiotics, as well as about antibiotics in DDGS entering the food system once they are fed to livestock.[121] Thus, in addition to concerns over runoff and waste,

[i] The particulate matter studied was PM2.5, or particulate matter with a diameter of less than 2.5 microns.
[j] PM10 is particulate matter with a diameter of less than10 microns.

there are also potential public health concerns associated with corn ethanol production byproducts.

Projected Environmental Impacts under the RFS

The increase in corn ethanol production required by the RFS through 2015 will result in additional environmental impacts due to the expansion of corn acreage. Using estimates taken from the literature, we approximate how these potential impacts will continue to grow over the next six years (Table 3.3).

Table 3.3

Projected Environmental Impacts of Corn Ethanol Production							
	2009	2010	2011	2012	2013	2014	2015
Ethanol Production Capacity[122] (bgy)[k]	10.57	12.0	12.6	13.2	13.8	14.4	15.0
Corn Acres for Ethanol[123,124] (million acres per year)[l]	25.5	29.0	30.4	31.9	33.3	34.8	36.2
Nitrogen for corn acres[125] (billion lbs per year)[m]	3.5	4.0	4.2	4.4	4.6	4.8	5.0
Soil erosion from corn acres[126] (billion lbs per year)[n]	317.1	360.0	378.0	396.0	414.0	432.0	450.0
Water use by ethanol refining process[127] (bgy)[o]	42.3	48.0	50.4	52.8	55.2	57.6	60.0
% Growth over previous year	25.4%	11.9%	4.8%	4.6%	4.4%	4.2%	4.0%

Conclusion

Corn ethanol production has serious environmental consequences. Increased corn plantings lead to habitat loss and degradation through increased corn-corn rotations and the conversion of both conservation program land and native prairie to production. A highly input-intensive crop, corn plantings degrade habitat more than most other crops. Pesticide and fertilizer applications lead to environmental contamination, increased tillage results in erosion and sedimentation, and water use for irrigation reduces stream levels and depletes aquifers. In addition, processing corn ethanol and burning it for energy result in particulate air pollution. All of these impacts will continue to grow as corn ethanol production increases, presenting considerable threats to habitat and wildlife populations.

[k] Requirements of the Renewable Fuel Standards. bgy denotes billion gallons per year
[l] Based on the complete use of available capacity, an average corn yield of 150.68 bushels per acre per year, and an average corn-to-ethanol conversion rate of 2.75 bushels per gallon
[m] Based on a multiplier of 138 pounds of nitrogen per acre of corn per year
[n] Based on an erosion rate of 30 pounds of soil per acre per year
[o] Based on a conversion of 4 gallons per water per 1 gallon of ethanol produced

Chapter 4: Federal Conservation Policies and Programs

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Scientist Identifying Grass Species in Conservation Reserve Program Field
Photo: USGS

Chapter 4
Federal Conservation Policies and Programs

While the federal government is largely responsible for driving the corn ethanol boom, it has also created a number of policies and programs that have the potential to mitigate the associated habitat and environmental impacts. The Farm Bill conservation programs in particular are helpful in lessening the adverse effects of corn expansion on wildlife habitat. There are also programs run through the U.S. Fish and Wildlife Service (USFWS) and federal funding allocated to state agencies for wildlife and habitat conservation. In the future, federal carbon policy may become an important tool for protecting habitat threatened by expanded agricultural production. This chapter explores the federal conservation policies and programs that have the potential to mitigate environmental impacts of corn ethanol production.

U.S. Farm Bill Conservation Programs

The Farm Bill is the primary vehicle by which the federal government sets food and agricultural policy and deals with issues under the jurisdiction of the U.S. Department of Agriculture (USDA). Revisited every five years, this bill was most recently passed in May of 2008 and contains 15 titles dealing with a variety of agriculture-related topics. Title II, the Conservation Title, authorizes a suite of programs aimed at farmland conservation. These programs either retire farmland from agricultural use for a set amount of time ("land retirement programs"), improve environmental practices on farms ("working lands programs"), or protect farmland from development ("farmland protection programs"). Three conservation-related compliance mechanisms, Swampbuster, Sodbuster, and Sodsaver are also contained in the title. These mechanisms deny farm program benefits to producers who fail to meet applicable conservation requirements, but conservation practitioners consider the latter two policies to be ineffective. Table 4.1 summarizes federal Farm Bill conservation programs that are most commonly used in the Midwestern United States, and Figure 4.1 illustrates how these programs enable conservation in our study system.

Land retirement programs have historically made up the largest part of the Conservation Title of the Farm Bill and have provided significant benefits to wildlife. Under these programs, landowners voluntarily sign a contract with a government agency, typically the USDA Farm Service Agency (FSA), to remove land from production for a specified number of years in order to protect specific natural resources. In return, landowners receive a payment from the government. In the case of the Wetland Reserve Program (WRP), land protection may also be accomplished through a conservation easement, which is the legal sale of a specified land-use right to an organization or government agency for the purpose of environmental conservation.

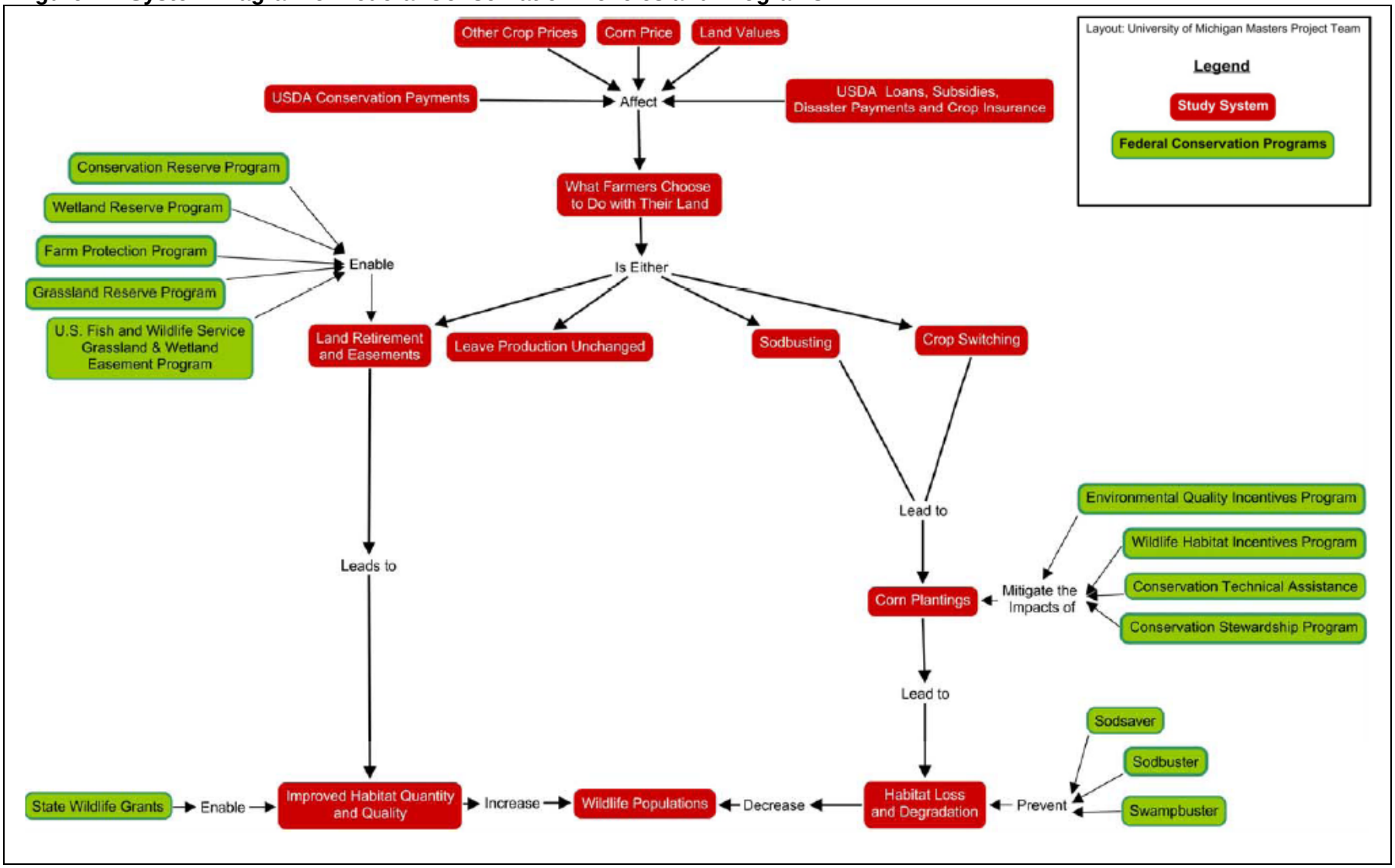
In the 2008 Farm Bill, Congress decreased the emphasis on land retirement programs in favor of working land programs through new acreage caps and funding levels. Though the Conservation Reserve Program (CRP) remains the largest of the Federal Farm Bill programs, the de-emphasis of land retirement has worrisome implications for the conservation of wildlife habitat.

Table 4.1

Farm Bill Conservation Programs[p]	
Type of Program	**Program Name**
Compliance Mechanisms	Highly Erodible Land Conservation (a.k.a. Sodbuster)
	Wetland Conservation (a.k.a. Swampbuster)
	Sodsaver
Land Retirement	Conservation Reserve Program (CRP)
	Wetland Reserve Program (WRP)
Working Land Programs	Environmental Quality Incentive Program (EQIP)
	Conservation Stewardship Program (CSP)
	Wildlife Habitat Incentives Program (WHIP)
	Conservation of Private Grazing Lands (CPGL)
	Technical Assistance
Agricultural Land Preservation Programs	Farm Protection Program (FPP)
	Grassland Reserve Program (GRP)

[p] This table does not include Farm Bill conservation programs designed for forest land or watershed protection.

Figure 4.1 System Diagram of Federal Conservation Policies and Programs



Compliance Mechanisms

Sodbuster

Sodbuster was established in the 1985 Farm Bill and requires producers growing crops on highly erodible land to implement a soil conservation plan in order to be eligible for certain government payments. This program is considered a failure by most conservation organizations because it has not prevented the loss of native prairie. The mechanism only applies to highly erodible land, and even then allows native prairie to be plowed if a soil conservation plan is followed.

Swampbuster

Swampbuster was also established in the 1985 Farm Bill and denies certain government payments to producers who convert natural wetlands for agricultural production. To maintain eligibility, producers must certify that they have not produced crops on converted wetlands after December 23, 1985 and did not convert any wetlands after November 28, 1990 to make agricultural production possible. A 2007 report by the U.S. Geological Survey found that, without Swampbuster, thousands of small, shallow wetlands would be at risk of drainage and could potentially reduce the breeding duck population in the Prairie Pothole Region (PPR) by 37%.[128]

Sodsaver

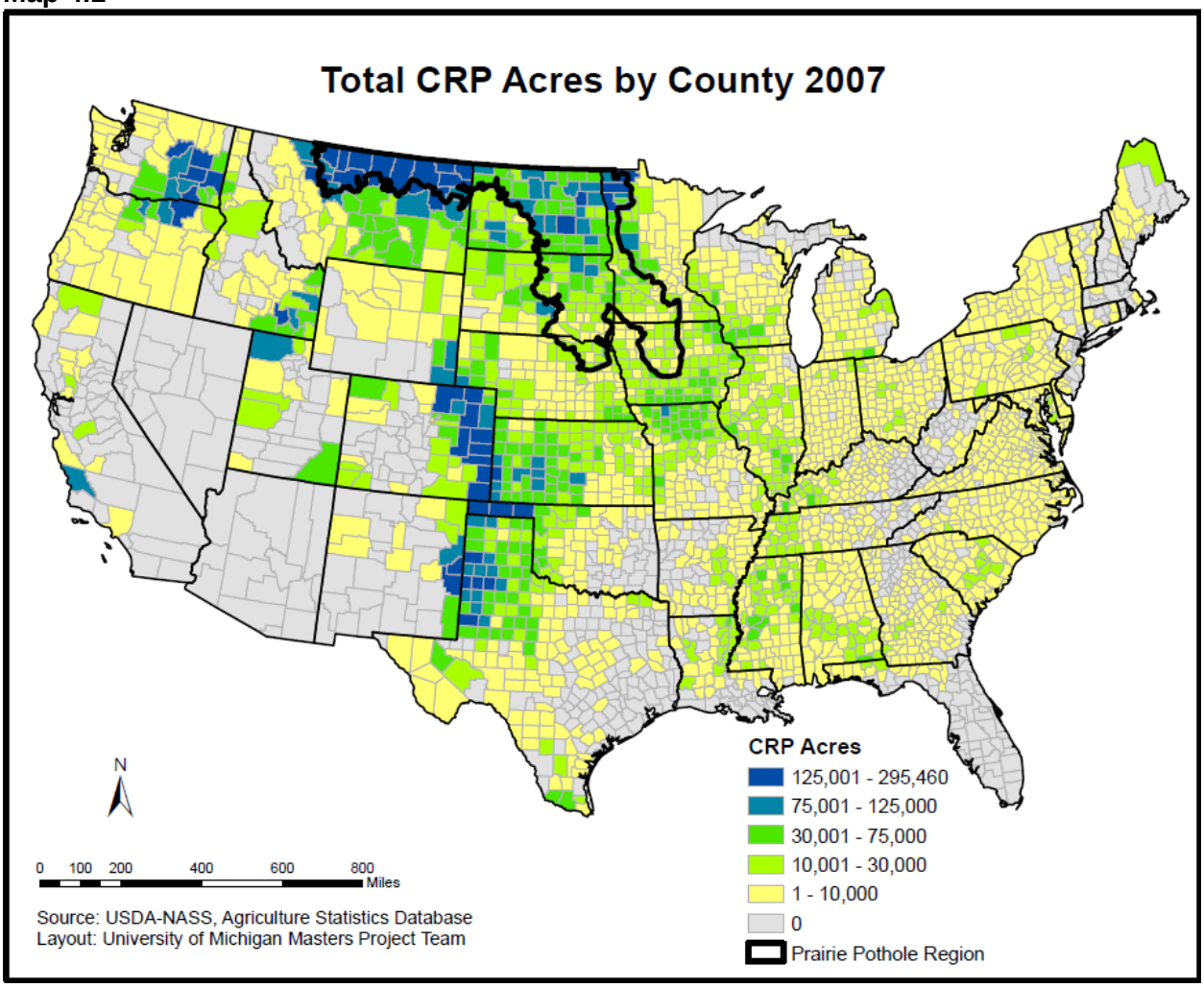
A new item in the 2008 Farm Bill, Sodsaver is designed to prevent the conversion of native prairie into crop production. Under this policy, crops planted on converted native prairie would not be eligible for crop subsidies for five years. This mechanism applies only to land in the Prairie Pothole National Priority Area, with the final decision for participation being left to each state's governor. Originally intended as a national program, the provision was scaled down to only the PPR in the final bill to the discouragement of the conservation organizations who had originally championed it. Agricultural groups have argued that the policy will place a competitive disadvantage on farmers in that region if other farmers can convert native prairie with no consequences. As of the spring of 2009, all PPR state governors had declined to participate in Sodsaver, effectively making it defunct.

Land Retirement Programs

Conservation Reserve Program (CRP)

CRP pays landowners to convert environmentally sensitive agricultural land to vegetative cover for a specified length of time. The goal of the program is to reduce soil erosion, improve water quality, and establish wildlife habitat. Landowners can participate in CRP either through an annual rental payment for the term of a multi-year contract or through cost-sharing to establish certain conservation practices. Map 4.1 shows enrollment in CRP by county in 2007.

Map 4.1



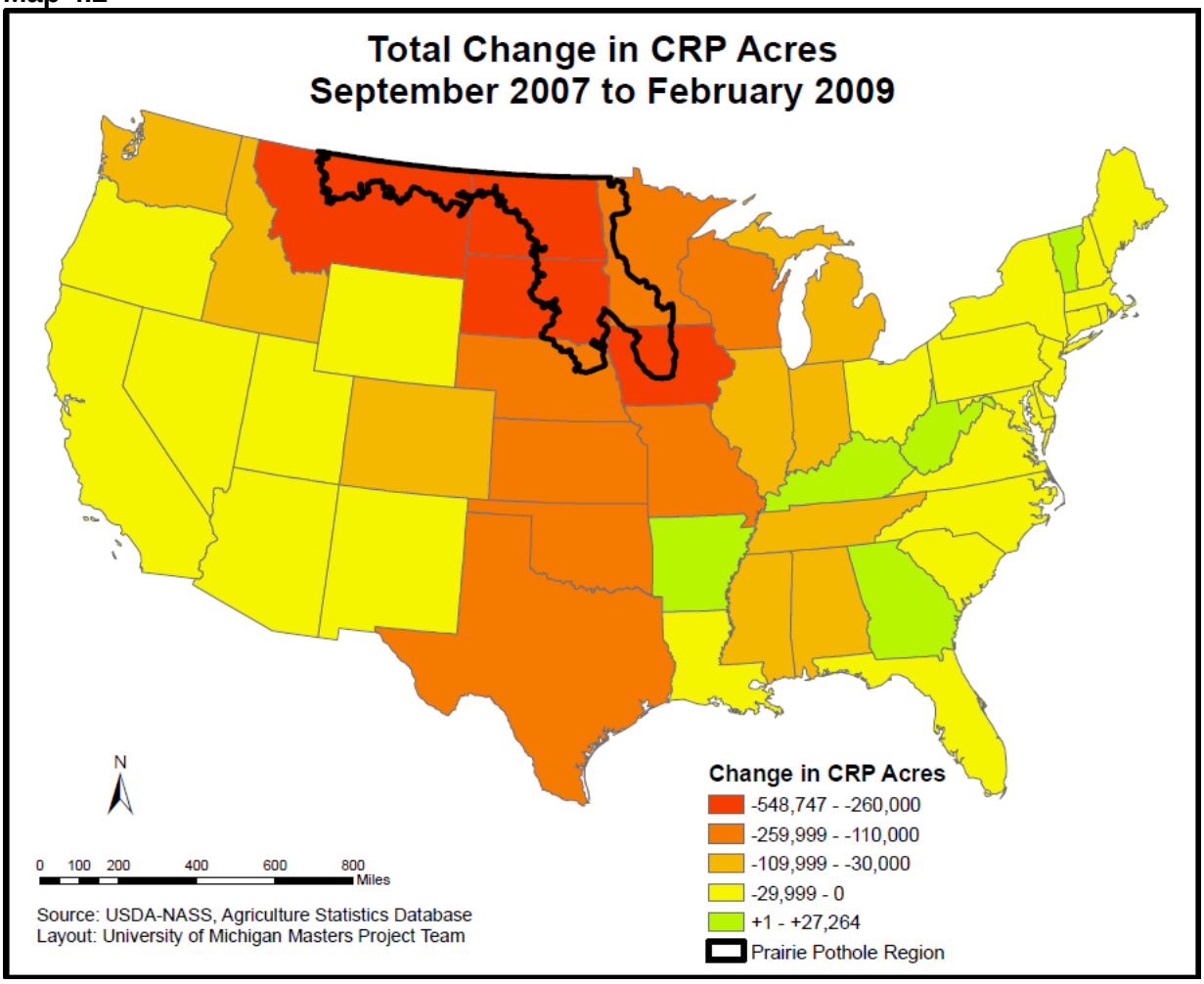
Land is enrolled in CRP either through a "general sign-up" process or through an ongoing "continuous sign-up" process. General sign-ups are held at specific times determined by the Federal FSA office. The most recent general sign-up was in 2006. The lack of a more recent general sign-up is due to the 2008 Farm Bill, which reduced the cap on CRP enrollment, forcing a halt to general enrollment sign-ups in order to release acreage from the program. During a general sign-up, landowners compete nationally for land retirement contracts based on the Environmental Benefits Index (EBI) score of their land. The EBI is based on factors such as wildlife habitat benefits and reduced erosion, runoff, and leaching.

Continuous sign-up is an ongoing process for which landowners may apply at any time. This type of sign-up is aimed at land which qualifies for high-priority conservation practices, such as filter strips and riparian buffers. Unlike general sign-up, land enrolled through continuous sign-up does not compete at a national level and may be eligible for additional incentives. Within the continuous sign-up process, the Conservation Reserve Enhancement Program (CREP) requires landowners to implement particular environmental practices and the Farmable Wetland Program (FWP) targets small non-flood plain wetlands.

Payments for CRP contracts consist of a base rental rate, which is based on the soil within each county, and the average rental value of the land. During a general sign-up, land owners applying to CRP may offer their land at rates lower than the county rental rate to increase the likelihood that their offer will be accepted. In addition to the base rental rate, land owners may receive an additional incentive to perform certain maintenance obligations or participate in a cost-share agreement in which the government will cover up to 50% of expenses associated with planting approved cover vegetation.

Enrollment in CRP is presently declining nationally. This is partly due to the large number of contract expirations between 2007 and 2010. In 2006, the FSA offered a special re-enrollment and extension (REX) opportunity for contracts expiring between 2007 and 2010. REX offered landowners the opportunity to extend their contracts for between 1 and 15 years based on EBI scores. Despite REX, CRP enrollment began to decline in 2007. One possible reason many landowners chose not to re-enroll land through REX were the low rental rates offered (rental rates remained at levels of the original contract), coupled with a high corn price in 2007 and the public perception that corn prices would continue to rise due to ethanol production. Map 4.2 shows the decline in CRP acres at a state level from September 2007 to February 2009.

Map 4.2



The 2008 Farm Bill mandated a reduction in the maximum number of acres that can be enrolled in CRP from 39.6 million to 32 million by October of 2009. In October 2008, there were 33.6 million acres enrolled in the program, and 3.9 million acres are set to expire between October 2008 and October 2009. These expirations will bring total enrollment down to 29.7 million acres by October of 2009, leaving some room for contract renewals or continuous sign-up to occur. The likelihood of these renewals occurring will depend on the competitiveness of CRP rental rates. Table 4.2 shows annual enrollment and funding levels for CRP from FY 2002 to FY 2010.

Table 4.2

Conservation Reserve Program USDA Farm Service Agency												
Year	Funding[129] ($ Millions)							Enrollment Levels[130] (Millions of Acres)				
	Annual Rental Payments	Signing Incentive Payments	Practice Incentive Payments	Haying/ Grazing Adjustment	Wetland Restoration Incentive	Cost-Share Payments	Total Outlay	Acres Enrolled Total	General	Continuous (non-CREP)	CREP	Farmable Wetlands
FY09	TBD	TBD	TBD	TBD	TBD	TBD	TBD	33.6 (As of 2/09)	29.5 (As of 2/09)	2.8 (As of 2/09)	1.1 (As of 2/09)	1.85 (As of 2/09)
FY08	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	$1,711	33.5	29.5	2.7	1.1	.182
FY07	$1,722	$18	$39	($10)	$1	$90	$1,861	36.8	32.9	2.7	.962	.167
FY06	$1,645	$33	$49	($9)	$1	$100	$1,819	36	32.4	2.6	.831	.154
FY05	$1,631	$25	$49	($11)	$1	$93	$1,788	34.9	31.7	2.4	.676	.130
FY04	$1,598	$28	$55	($10)	$1	$116	$1,790	34.7	31.8	2.2	.596	.111
FY03	$1,572	$40	$60	$2	$1	$98	$1,774	34.1	31.6	2.0	.503	Not Available
FY02	$1,530	$45	$68	($11)	$1	$143	$1,777	33.9	31.8	1.7	.363	.059

Wetland Reserve Program (WRP)

WRP is a much smaller program than CRP and focuses specifically on restoring wetland habitat through permanent easements, 30-year easements or cost-sharing agreements, which last for a minimum of 10 years. Applications for WRP are accepted at any time. The 2008 Farm Bill increased the program's enrollment cap from 2.3 million acres to a little over 3 million acres and requires an annual survey of the PPR to determine the level of interest in the program and allocations for each state. The more specialized Wetland Reserve Enhancement Program allows states and NGOs to partner with the federal government in the selection and funding of contracts. Map 4.3 shows enrollment in WRP by practice as of 2007, while Table 4.3 provides enrollment acreage and funding levels.

Map 4.3

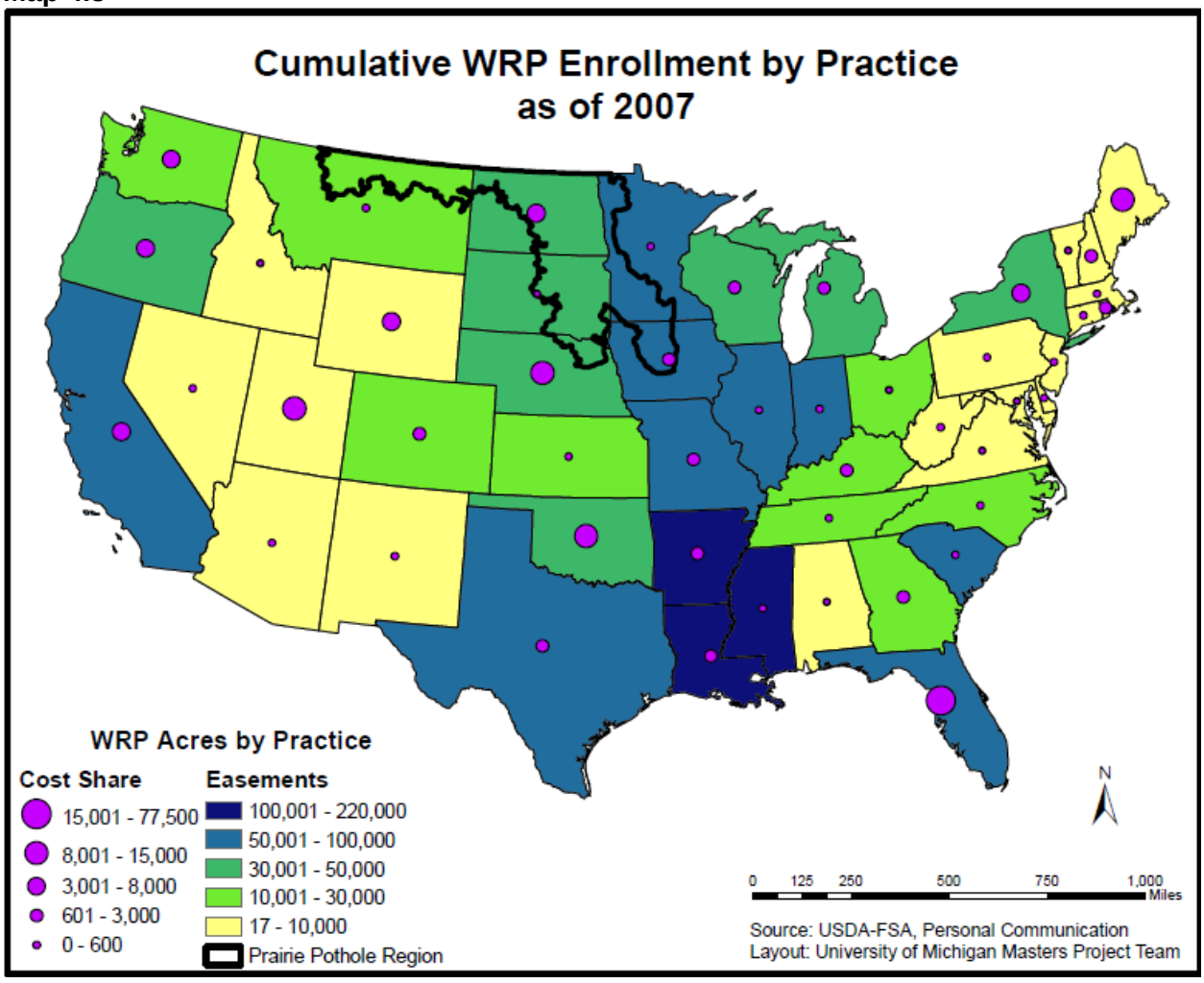


Table 4.3

Table 4.3: Wetland Reserve Program USDA Natural Resources Conservation Service							
Year	Funding[131], [q] ($ Millions)		Enrollment Levels[132] (Millions of Acres)				
	Authorized	Actual	Permanent Easements (new acres this fiscal year)	30 Year Easements (new acres this fiscal year)	Restoration Cost-Share Agreements (new acres this fiscal year)	Enrollment (new acres this fiscal year)	Total Cumulative Acres Enrolled
FY08	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2.0
FY07	$403	$228	.066	.011	.018	.095	1.92
FY06	$392	$250	.082	.011	.012	.105	1.85
FY05	$344	$275	.095	.012	.012	.119	Unknown
FY04	$354	$285	.133	.019	.013	.165	Unknown
FY03	$314	$309	.151	.015	.014	.180	1.47[133]
FY02	Unknown	Unknown	.154	.018	.005	.177	1.27[134]

Working Land Programs

Working land programs have received increasing recognition as being critical to conservation efforts in recent years.[135] The majority of new conservation spending in the 2008 Farm Bill is allocated to working land programs, primarily the Environmental Quality Incentive Program (EQIP) and the Conservation Stewardship Program (CSP).[136] Working land programs are run by the Natural Resources Conservation Service (NRCS) and provide incentives for farmers to improve conservation practices on cropland and grazing land that is in production. Incentives include payment programs, cost-share agreements, and technical assistance.

Environmental Quality Incentives Program (EQIP)

EQIP provides incentive payments and cost-shares to farmers and ranchers to implement conservation practices based on a specified plan of operations. Agreements can be up to 10 years in duration and practices are based on a set of national priorities that are adapted to each state. Priorities include: reduction of point- and non-point source pollution to watersheds and groundwater; water conservation; reduction of air emissions, reduction of soil erosion; and promotion of at-risk-species wildlife habitat. Map 4.4 shows total EQIP acres by state in 2008.

Funding for EQIP was increased in the 2008 Farm Bill from $4.92 billion for FY 2002-FY 2007 to $7.325 billion for FY 2008-FY 2012. Cost-sharing under the program was extended to include

[q] Information in the appropriations process uses acres rather than dollars; costs are estimated based on enrolled acres during fiscal year. FY2006 and FY2007 are CBO estimates, and do not include the Emergency Forestry Conservation Reserve Program, estimated to spend $21 million in FY2006 and $110 million in FY2007.

land and forest management practices and conservation practices related to organic agriculture.[137] Table 4.4 provides cost share dollars and contract acres for FY 2003 to FY 2008.

Map 4.4

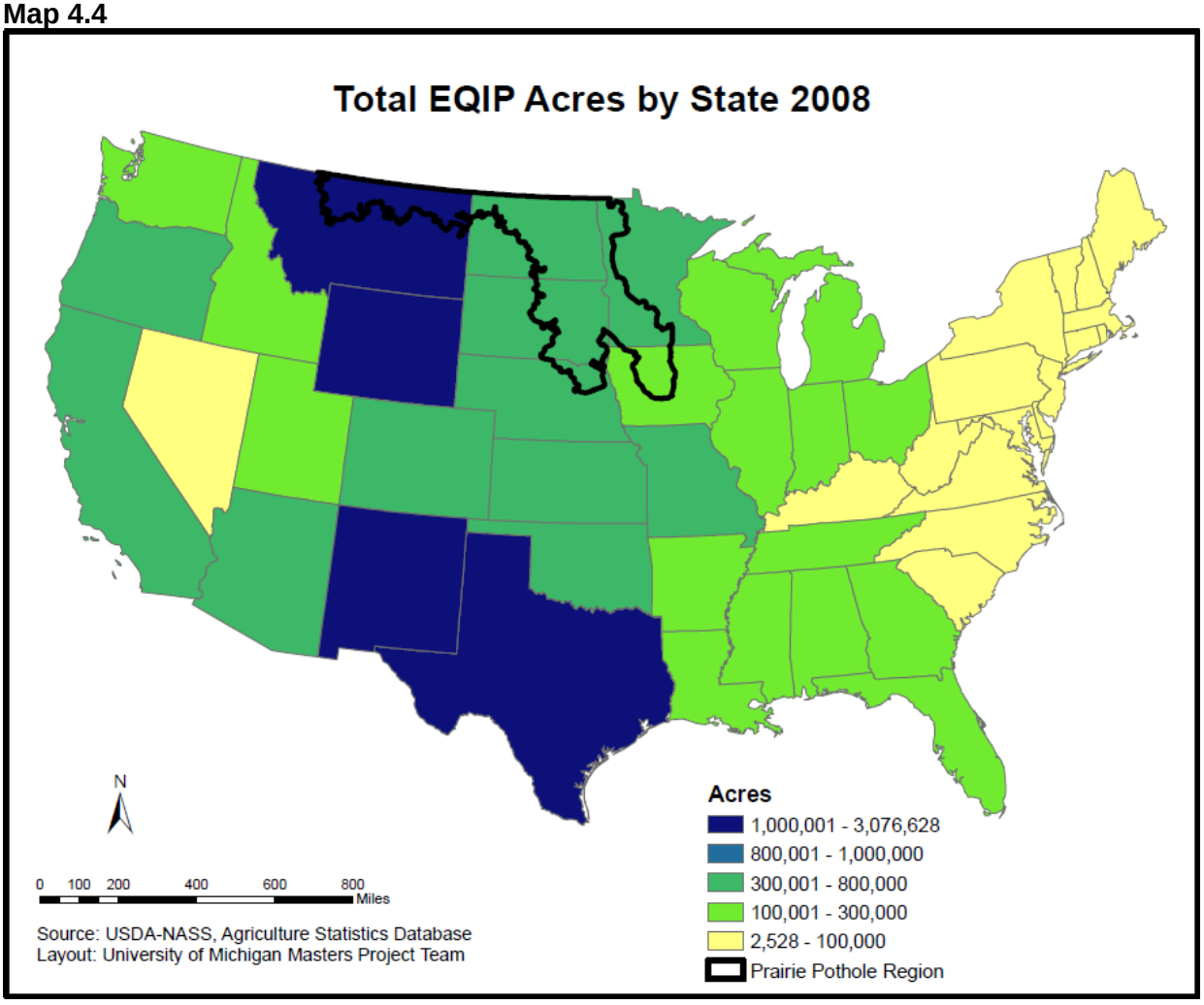


Table 4.4

Environmental Quality Incentives Program USDA Natural Resource Conservation Service						
Year	Cost Share ($ Millions)			Contract Acres (millions of acres)		
	Incentives	All Other	Total $	Incentives	All Others	Total Acres
FY08	Unavailable	Unavailable	$937.0	Unavailable	Unavailable	16.8
FY07	$147.1	$597.9	$745.0	8.2	12.0	16.6
FY06	$145.9	$561.0	$706.9	13.4	13.5	19.7
FY05	$132.3	$573.7	$706.0	6.5	13.7	16.4
FY04	$114.7	$512.2	$626.0	7.0	14.2	16.3
FY03	$74.4	$359.6	$44.0	7.2	16.4	17.8

Wildlife Habitat Incentives Program (WHIP)

WHIP is designed specifically for the establishment and improvement of fish and wildlife habitat on private land. This program is also in high demand. In 2007 there were 1,600 unfunded WHIP applications totaling more than $44.5 million.[138] Table 4.5 shows funding allocations and annual enrollment in the program from FY 2003 to FY 2008. The program provides both technical assistance and up to 75% cost share assistance, which generally lasts between five and ten years. The NRCS places no limits on the number of acres or level of payment a landowner may receive, though some states choose to develop such limits. State and local government land may be enrolled in the program on a limited basis.

WHIP ranking criteria are based on a State WHIP Plan, which is developed by the State Technical Committee with guidance from the NRCS State Conservationist. Landowners may apply at any time and, if selected to participate, work with NRCS staff to develop a WHIP plan of operations and an operations and maintenance agreement for their property. These documents describe the participant's goal for improving wildlife habitat and detail a plan for conservation practices to be put in place through the duration of the agreement.

Table 4.5

Wildlife Habitat Incentive Program USDA Natural Resource Conservation Service				
Year	Funding ($ Millions)			Annual Enrollment[139] (millions of acres)
	Authorized[140]	Appropriated[141]	Obligated[142]	
FY08	$85	$85	$57.22	.646
FY07	$85	$43	$31.5	.358
FY06	$85	$43	$31.5	.325
FY05	$85	$47	$34.4	.450
FY04	$60	$42	$27.1	.432
FY03	$30	$30	$16.6	.300

Conservation Stewardship Program (CSP)

CSP was created by the 2008 Farm Bill, replacing a very similar program called the Conservation Security Program. CSP seeks to support ongoing stewardship efforts on private land and encourage additional conservation practices through a combination of financial and technical assistance. Sign-ups are offered in select watersheds throughout the nation and applications are ranked on the current conservation activities and interviews with applicants.

Table 4.6

Conservation Stewardship Program *(Formerly the Conservation Security Program)* USDA Natural Resource Conservation Service				
Sign-Up Date	**Funding[143]**		**Outcome[144]**	
	Authorized	**Appropriated**	**# of Watersheds**	**Enrollment**
April 2008	Unavailable	Unavailable	51	1,967 contracts on 2.1 million acres[145]
February 2006	$331	$259	60	4,323 contracts on 3.6 million acres
November 2005	$53	$41	220	15,000 contracts on 12.1 million acres
July 2004	$53	$41	18	

There have been four sign-ups through CSP since the program's first enrollment period in 2004. Under the 2008 Farm Bill, the program is authorized to enroll 12.77 million acres a year, at an average of $18/acre, or $229 million a year.[146] Table 4.6 shows funding levels and enrollment for all enrollment periods offered for CSP.

Conservation Technical Assistance (CTA)

The CTA program provides technical assistance including expertise, information, and tools necessary for the conservation of natural resources and land active in agriculture, forestry, or related uses. Assistance is available for farmers, ranchers, local units of government, citizen groups, and others in order to conserve, maintain, and improve natural resources. No financial assistance is offered through this program. All landowners are eligible and state NRCS offices prioritize requests for assistance. The 2008 Farm Bill changed funding for this program from a previous authorization of $4.14 billion for FY 2002-FY 2007 to annual appropriations beginning in FY 2008. The bill also provided mandatory funding through the Commodity Credit Corporation (CCC) for technical assistance associated with all USDA programs. Table 4.7 provides funding to states for technical assistance for FY 2005 to FY 2007.

Table 4.7

Conservation Technical Assistance USDA Natural Resource Conservation Service	
Year	**Funding to States ($ Millions)[147]**
FY07	$512.7
FY06	$574.8
FY05	$597.9

Table 4.8

Farm Protection Program USDA Natural Resources Conservation Service, Farm Service Agency, & Forest Service		
Year	Funding[148] ($ Millions)	
	Financial Assistance	Technical Assistance
FY08	$90.4	$4.7
FY07	$70.2	$2.6
FY06	$70.2	$2.1
FY05	$106.9	$3.6
FY04	$88.1	$2.5
FY03	$75.1	$2.1
FY02	$50.7	$.028
FY01	$16.8	$.7

Agricultural Land Preservation Programs

The Farm Bill contains two farm protection programs, which share the goal of keeping productive farm and ranchland in agricultural use.

Farm Protection Program (FPP)

The FPP (formerly the Farm and Ranchland Protection Program) protects the agricultural use and conservation value of land by providing matching funds to state, Tribal or local governments or non-governmental entities to purchase conservation easements. The program will provide up to 50% of the easement cost and the cooperating entity must provide between 25-50% of the easement cost. Purchase of easements is considered a financial cost, while technical assistance refers to the funding needed to run this program. Funding for the program was increased from $499 million for FY 2002-FY 2008 to $734 million for FY 2008-FY 2012 in the 2008 Farm Bill.[149] Table 4.8 provides funding levels for the FPP from FY 2001 to FY 2008.

Grassland Reserve Program (GRP)

GRP helps landowners restore and protect grassland, rangeland, pastureland, and shrubland and provides assistance for rehabilitating grasslands by helping maintain viable ranching operations. Enrollment options include permanent or 30-year easements, rental agreements of 10, 15, 20, or 30 years (rental rates vary by county), and cost-sharing agreements based on specific grassland management plans. Each state has established ranking criteria to prioritize enrollment; criteria consider threats of conversion, including cropping, invasive species, urban development, and other activities that threaten plant and animal diversity on grazing lands. The 2008 Farm Bill authorized an additional 1.22 million acres for enrollment in the program between FY 2008 and FY 2012, with priority given to land already enrolled in CRP.[152] Table 4.9 provides funding levels for GRP from FY 2003 to FY 2006.

Table 4.9

Grassland Reserve Program USDA Natural Resources Conservation Service			
Year	Authorized Funding[150] ($ Millions)	Enrollment Levels[151] (Million of Acres)	
		Acres Authorized	Acres Added Annually
FY06	$54	2	.093
FY05	$128	2	.384
FY04	$57	2	.283
FY03	$38	2	.241

U.S. Fish and Wildlife Service Programs

The USFWS works to improve fish and wildlife habitat on private land through both cost-share programs and conservation easements.

The Partners for Fish and Wildlife Program is a cost-share program with the goal of restoring habitat for wildlife species that are federal trust responsibilities. The species list includes migratory birds, as well as some mammals, fish, reptiles, and amphibians whose numbers are declining. On-the-ground habitat restoration projects include: stream renovation for native fish; prairie wetland restoration for waterfowl and wading birds; and native prairie renovation for grassland songbirds and upland nesting ducks.[153]

The USFWS also offers private landowners the opportunity for permanent protection through grassland and wetland conservation easements. These agreements transfer certain property rights to the USFWS to protect the conservation value of the land. To be eligible for the USFWS Easement Program, land must be in an approved county and have high potential value to wildlife. Priority is given to land with significant amounts of wetlands and native prairie. Payments are determined by a fair market appraisal of the land.[154]

Federal Funding for State-led Conservation

State Wildlife Grants Program (SWG)

SWG is the nation's core program for preventing wildlife from becoming endangered. Funds are appropriated by Congress on an annual basis and apportioned to state fish and wildlife agencies through a formula based on population and acreage. Federal SWG funds require matching levels of funding on the state level. Projects funded through SWG address needs or risks identified through each state's wildlife action plan, which are coordinated by the state fish and wildlife agencies. Table 4.10 shows annual appropriations for SWG.

Table 4.10

State Wildlife Grants US Fish and Wildlife Service and state fish and wildlife agencies	
Year	**Funding to States ($ Millions)[155]**
FY08	$74
FY07	$67
FY06	$67
FY05	$69
FY04	$70
FY03	$65
FY02	$85

Environmental Markets and Carbon

The 2008 Farm Bill lays the groundwork for incentivizing conservation on private land through landowner involvement in new environmental markets, such as the carbon market. The legislation requires that the Secretary of Agriculture develop a procedure for measuring the benefits of environmental services from conservation and other land management activities; a protocol for reporting these benefits; and a registry to document the benefits measured.[156] Priority is given to establishing guidelines for participation in carbon markets. In December of

2008, the USDA established a new Office of Ecosystem Services and Markets to carry out this directive.

Developing these guidelines will facilitate agricultural landowners' involvement in carbon trading systems, such as the Chicago Climate Exchange (CCX). Through CCX, interested landowners are issued tradable Carbon Financial Instrument (CFI) contracts if they cut their emissions or implement "offset" projects that sequester or displace greenhouse gases. CFIs for carbon sequestration on millions of acres of farmland and ranchland are already traded on the CCX. However, participation is low due to the low price that voluntary offsets command. National cap-and-trade legislation would change this by increasing demand for sequestration services and increasing the amount paid for offset projects.

If Congress requires the reduction of carbon emissions through this type of market mechanism, carbon markets have the potential to incentivize farmers to conserve native prairie, ranchland, and pastureland. Offset projects relevant to agricultural landscapes include implementing no-till, planting grass, and improving grazing practices that increase soil carbon sequestration on the land. Providing these offset payments to landowners incentivizes conservation practices that not only mitigate carbon emissions but may also provide important benefits to habitat and wildlife.[157]

Conclusion

There are a wide variety of federal policies and programs that could be strengthened to address the habitat impacts associated with corn ethanol production. Currently, the ability of such programs to permanently protect wildlife habitat is limited. Only three small programs offer permanent easement options: WRP, GRP, and the USFWS Grassland Easement Program. Furthermore, Congress and the USDA have reduced their support for land retirement programs, which conserve land for 10-15 years. In the 2008 Farm Bill, Congress reduced the CRP enrollment cap from 39.6 million acres to 32 million acres. Waning support is also apparent in the lack of a general sign-up for the program, which has not occurred since 2006. At the same time, resources for working land programs, in particular EQIP and CSP, have increased. Working land programs are critical for mitigating the environmental impacts of agricultural production but focus less on conserving larger areas of untouched, high-quality habitat. This has implications for wildlife populations, particularly in light of recent land-use changes and new pressures on habitat from increased corn production.

Chapter 5: Four-State Focal Area

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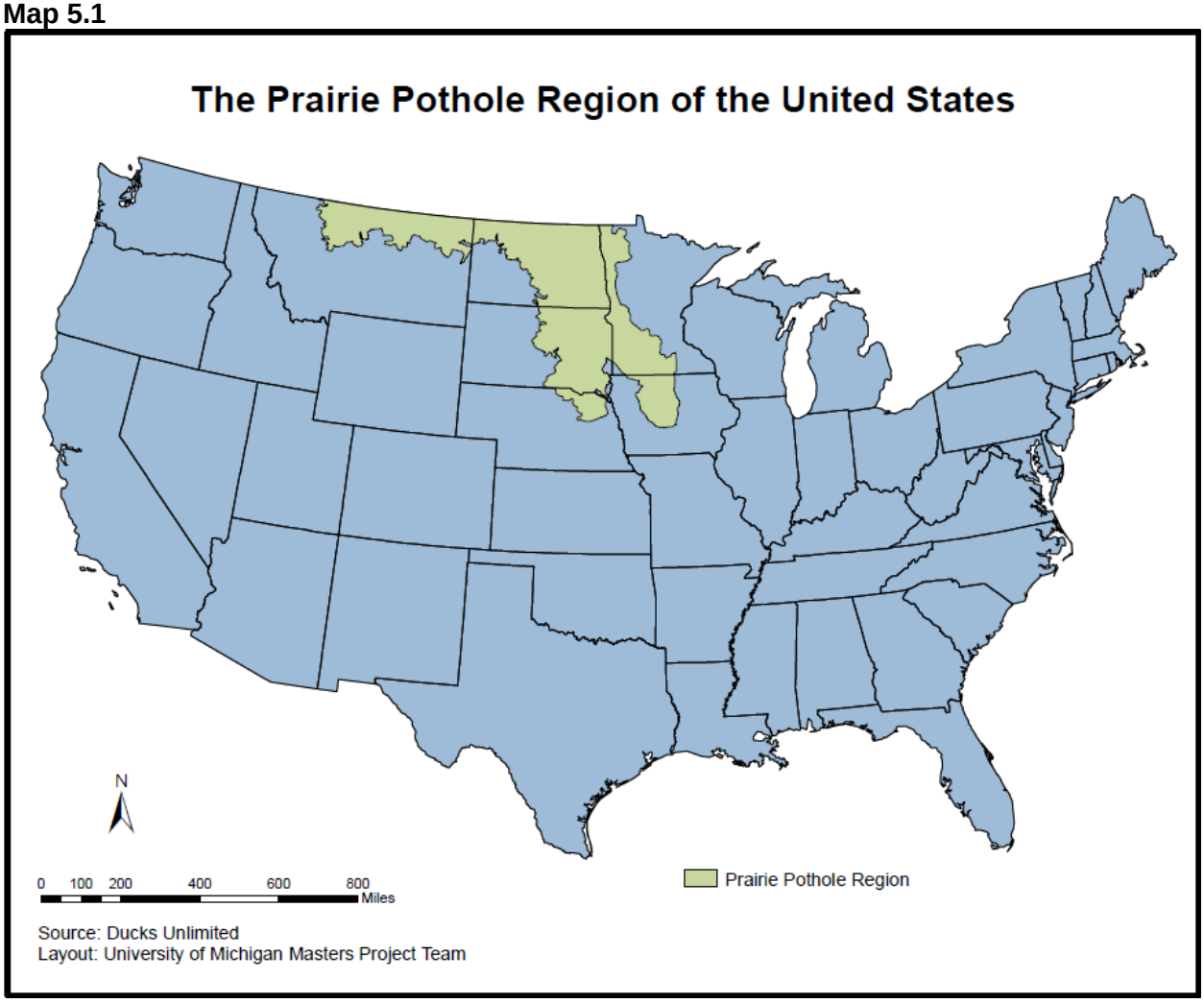
Sodbusting of Native Prairie in North Dakota
Graphic Courtesy of Ducks Unlimited

Map 5.1


The Prairie Pothole Region of the United States
N
0 100 200 400 600 800
Miles
Prairie Pothole Region
Source: Ducks Unlimited
Layout: University of Michigan Masters Project Team

Chapter 5
Four-State Focal Area

The choice of Iowa, Minnesota, North Dakota, and South Dakota as a focus of our research was based on the area's ecological significance, enrollment in federal agricultural conservation programs, and the high agricultural land-use change due to changing crop prices and increased corn plantings. Additionally, these four states contain a significant portion of the Prairie Pothole Region (PPR), a unique and imperiled ecosystem that supports nationally and internationally important wildlife (Map 5.1). Although the PPR also stretches into Montana, we chose not to include this state in our analysis, as it has relatively few acres in corn production, has not seen increases in corn plantings, and has no corn ethanol production. The choice of Iowa, Minnesota, North Dakota, and South Dakota also allowed us to study a cross section of states that differ in levels of ethanol production, agricultural production, and habitat availability.

Prairie Pothole Region Overview

The PPR lies in the Northern Great Plains of the United States and extends north into Canada. It is characterized by native grasslands and unique depressional wetlands. During the Pleistocene epoch, retreating glacial ice blocks created depressions in the ground.[158] Today, these depressions are the shallow lakes and marshes that comprise the prairie potholes. As semi-permanent wetlands, prairie potholes require a dry period every five to ten years in order to maintain emergent wetland vegetation.[159]

The PPR is an ecologically unique habitat important for many species, particularly birds. Up to 75% of all North American waterfowl are estimated to breed in the PPR.[160] The grasslands and wetlands found in the prairie pothole ecosystem are vital nesting, breeding, and migration habitats for many endangered and threatened species of birds. Of the 800 migratory bird species in North America, more than 300 rely on this region for breeding and nesting habitat, as well as for feeding and resting during spring and fall migrations.[161]

The PPR encompasses critical wetland habitat for waterfowl. For many duck species, the PPR is the primary breeding area in the country.[162] Wetland and grassland habitat in the PPR are vital for the survival of many waterfowl populations, as they breed in the prairies adjacent to wetlands. Agricultural development has led to severe losses in this important upland nesting cover. Loss of native prairie grasslands has been especially detrimental to upland nesting species such as mallards, gadwalls, and northern pintails.[163] Waterfowl are the most economically important group of migratory birds in North America, generating expenditures of billions of dollars annually in hunting and related tourism revenues.[164] As a result, the PPR has become a major area of focus for waterfowl conservation. According to Ducks Unlimited, the Great Plains and Prairie Pothole Region is number one on the list of the 25 most important and threatened waterfowl habitats on the continent.[165]

Land-use changes stemming from development and increased agricultural pressure have led to high levels of habitat loss in the focal area over the past 250 years. Between the 1780s and the 1980s, estimated wetland losses were 89% in Iowa; 42% in Minnesota; 49% in North Dakota;

and 35% in South Dakota, with most losses due to draining for agricultural purposes.[166] Over 50% of the entire wetland area in the U.S. PPR has been drained for agricultural development.[167] Grasslands losses across the Great Plains have also been large, with estimated losses of tallgrass prairie between 83% and 99% compared to pre-settlement levels.[168]

Rates of land-use change have increased over the last 25 years, further threatening the important wildlife habitat found in this region. Habitat in the PPR includes tallgrass prairie, shortgrass prairie, mixed prairie, and wetlands. Pastures, hay fields, and idle cropland also provide suitable habitat for many grassland bird species.[169] Intense agricultural development in the PPR has led to declines in grassland bird populations over the past 25 years that are steeper and more consistent than the declines seen in any other North American bird group.[170]

Conversion of prairies to more intensive agricultural production causes not only loss of habitat, but often also leads to fragmentation of remaining native vegetation. Grassland birds are extremely vulnerable to habitat fragmentation.[171] In addition to reducing the size of habitat and isolating habitat patches from one another, fragmentation increases the ratio of habitat edge to total habitat area.[172] Habitat edges can lead to "edge effects," such as decreased nesting success in grassland bird species.[173] To protect remaining populations of grassland birds, wildlife agencies and practitioners agree that native prairie must be protected.[174]

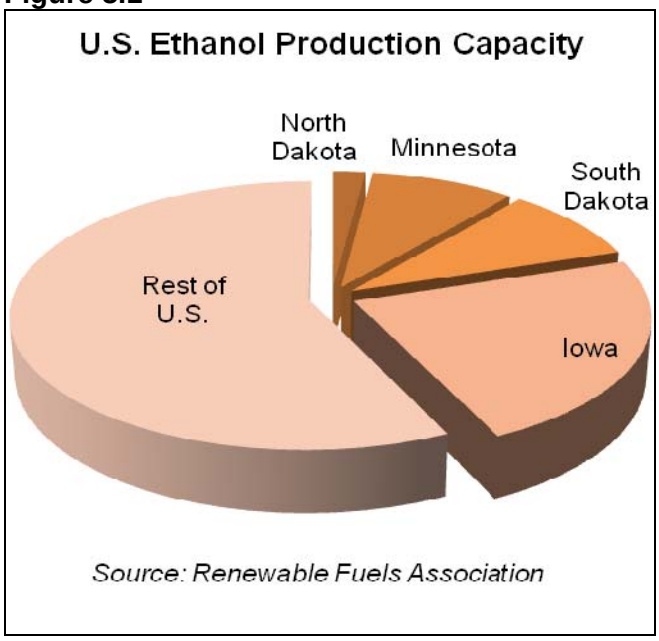
Land-use changes in the PPR are affecting plant, fish, mammal, and amphibian populations as well as bird populations. Draining and filling of wetlands, sedimentation, soil compaction, pesticide use, and increased cropland are all changes associated with amphibian population declines in the Northern Great Plains.[175] Loss of native prairie has resulted in steep declines in the Western Prairie Fringed Orchid, a federally threatened species native to North Dakota, Iowa, and Minnesota.[176]

Regional Corn Ethanol Production

Our four-state focal area is home to 85 of the nation's 204 corn ethanol refineries and is responsible for 43% of U.S. corn ethanol production (Figure 5.1). The high level of corn ethanol production in this region is undoubtedly linked to high levels of corn plantings in the area. Map 5.2 illustrates the geographic relationship between ethanol refinery location and corn plantings.

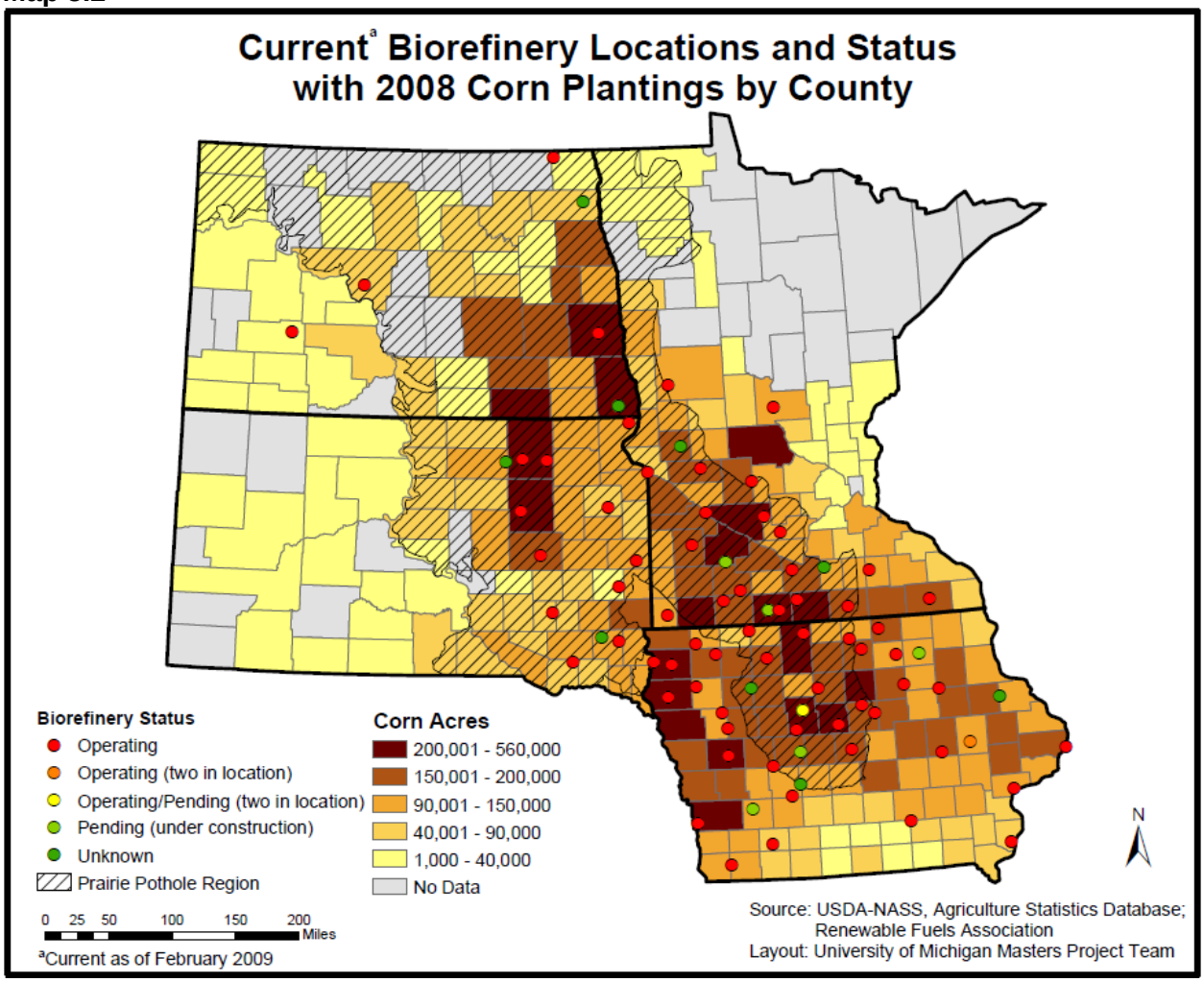
Notably, almost all refineries in the four-state area are located within the PPR portion of these states. Only Iowa has a significant number of refineries that are not within 20 miles of the PPR. In contrast, Minnesota, North Dakota, and South

Figure 5.1



Dakota have two, one, and none, respectively, outside the PPR. Of the 85 corn ethanol refineries in the four-state area, 48 (24% of all refineries nationwide) are located within the PPR and another 13 (for a total of 61, or 30% of all national refineries) are within 20 miles of the PPR.[177] As discussed in Chapter 3, there are many environmental impacts associated with corn ethanol production. The concentration of ethanol refining may have large effects in this ecologically rich and already threatened area is concerning.

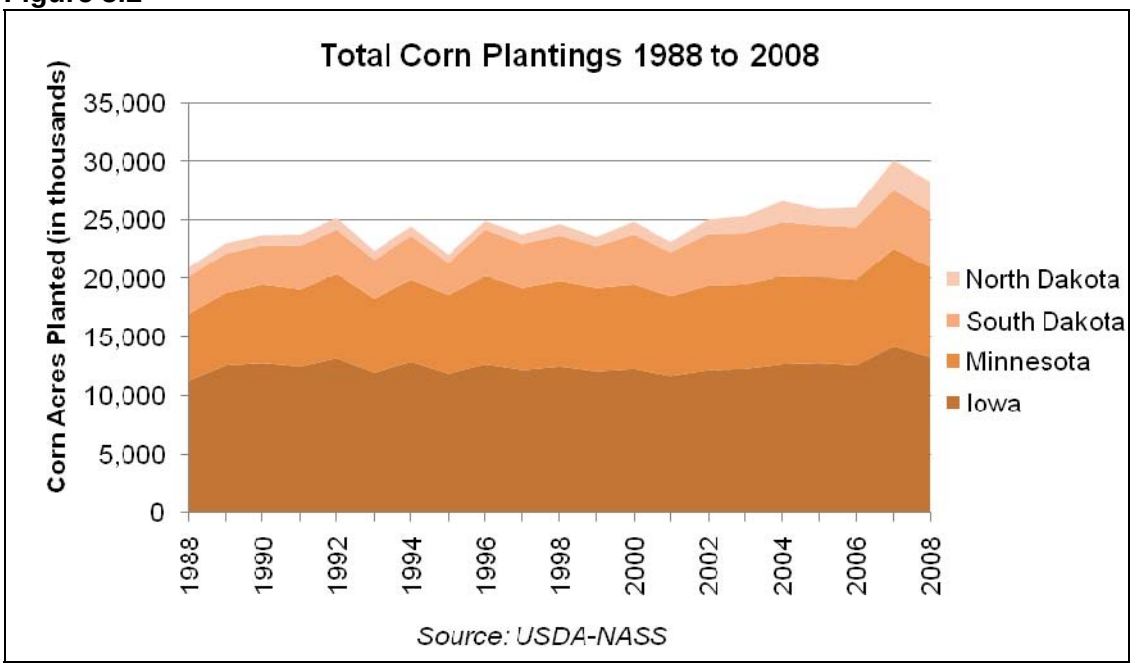
Map 5.2



Corn Plantings across the Region

While the total acreage of corn planted in our focal area fluctuates from year to year, there has been a steady increase in the total acres of corn planted over the past three decades (Figure 5.2). Iowa has consistently had the most corn plantings of our four states, followed by Minnesota, South Dakota, and North Dakota.

Figure 5.2



While both South Dakota and North Dakota have significantly fewer acres devoted to corn than Iowa and Minnesota, they have had much greater increases in their annual average corn acres planted over the past two decades (Table 5.1). North Dakota has experienced a 92.0% increase in the annual average number of corn acres planted over the past two decades, while the annual average of planted acres in South Dakota has increased by 37.4%. A more moderate increase of 13% occurred in Minnesota, and Iowa remained relatively stable with an increase of 1.6%. For all four states, the rate of increase was greater between the 1990s and the 2000s than between the 1980s and 1990s. This difference is most extreme in North Dakota, which experienced a slight decrease in average annual corn acres planted from the 1980s to 1990s, followed by an over 95% increase in the annual corn acres planted from the 1990s to the 2000s.

Table 5.1

Average Changes in U. S. Corn Plantings, 1980s to 2000s[178]						
	Average 1980s	**Average 1990s**	**Average 2000s**	**Percent Change 1980s to 1990s**	**Percent Change 1990s to 2000s**	**Percent Change 1980s to 2000s**
Iowa	12,515	12,480	12,678	-0.3%	1.6%	1.3%
Minnesota	6,550	6,940	7,400	6.0%	6.6%	13.0%
North Dakota	848	833	1,628	-1.8%	95.4%	92.0%
South Dakota	3,254	3,620	4,472	11.2%	23.5%	37.4%
Total	**23,167**	**23,873**	**26,178**	**3.0%**	**9.7%**	**13.0%**

Source: USDA NASS

Less data is available on historical and current corn plantings in the Canadian region of the PPR, making it difficult to compare the long-term trends of the two countries. However, reliable country-level data is available for much of the last decade. These numbers reveal that Canada experienced a decrease in corn plantings from 2001 (3.21 million acres)[179] to 2006 (2.70 million acres).[180] Whereas corn plantings in the U.S. PPR increased sharply in 2006, Canada's plantings did not spike until 2007,

when they reached 3.44 million acres. However, this increase lasted only a year, as plantings fell back to pre-2001 levels of 3.0 million acres in 2008.[181]

Habitat Loss Associated with Increased Corn Plantings

Between 2005 and 2007, at the height of the corn ethanol boom, an additional 4.15 million acres were put into corn production in North Dakota, South Dakota, Iowa, and Minnesota.[182] This land has mostly come from three major sources: crop switching, conversion of native grassland to cropland, and removal of land from CRP. Crop switching refers to land that was previously planted with other crops being planted with corn. Nationally, the most common crops that corn displaces are soybeans, cotton, and wheat.[183]

Conversion of Native Grassland to Cropland

Habitat loss occurs when grassland is "broken," or plowed for crop production. Most often, the grassland being converted was formerly used to graze livestock or had been deemed unsuitable for growing crops. Often referred to as *new breakings* or *sodbusting*, the conversion of grassland to cropland has occurred steadily in our Northern Great Plains for decades, and many believe the conversion rate will increase in response to rising commodity prices and ethanol demand.[184] Given that privately held grassland and wetlands compose most of the remaining habitat in the PPR, their protection is considered critical for sustaining wildlife populations.

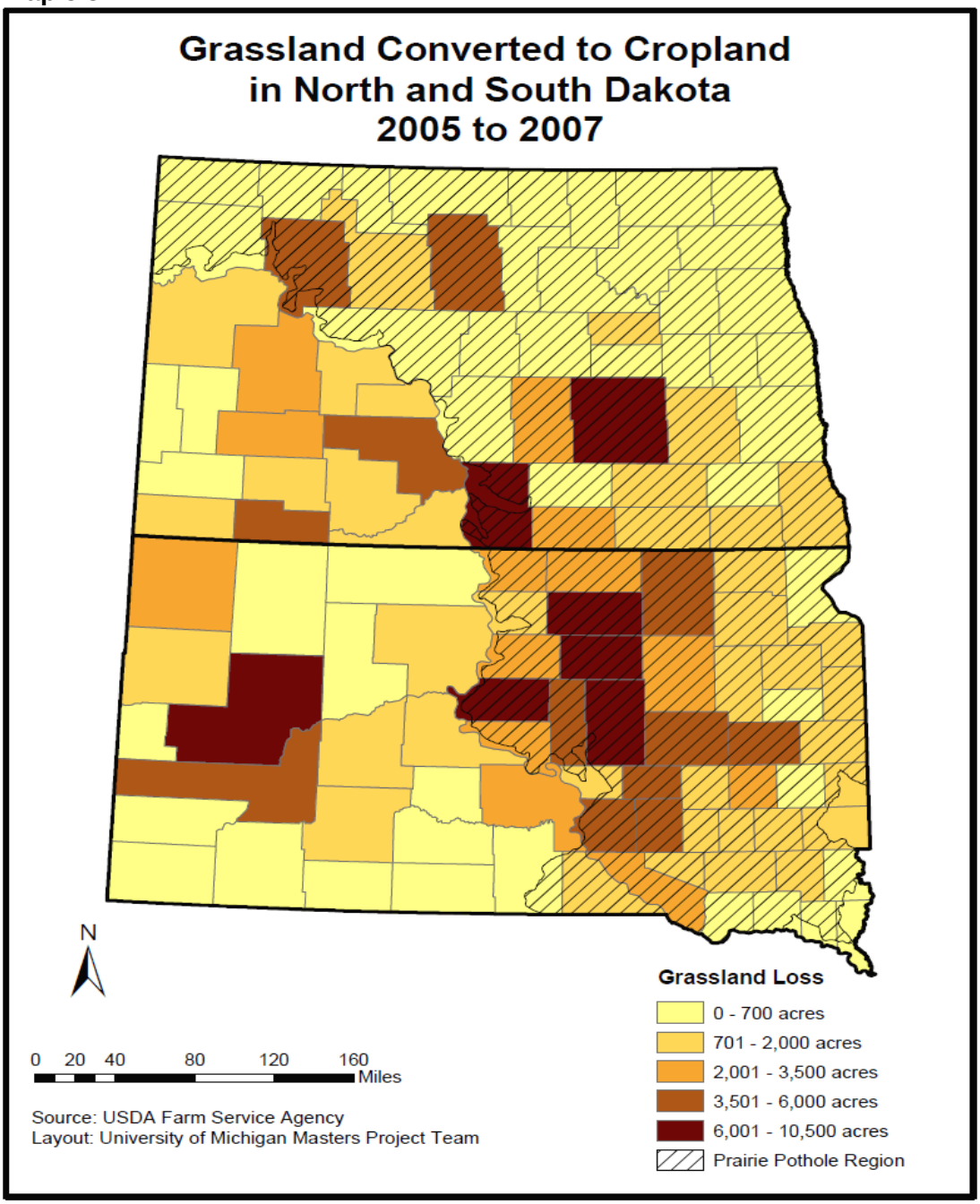
Preventing the conversion of private grassland has been a priority for many conservation agencies and nonprofits; however, policy and economic factors continue to encourage new breakings. A 2007 U.S. Government Accountability Office study found that farm program payments have incentivized the conversion of unproductive, drought-prone land that otherwise would not provide substantial profits. For instance, the report found that landowners in South Dakota counties with high levels of conversions received more crop insurance and crop disaster assistance payments than landowners in other areas.[185] The study also found that rising crop prices, particularly as a result of corn ethanol demand, have contributed to landowners' decisions to bring more land into cultivation. The study explains that improved farming technologies, such as genetically modified crops, have enabled farmers to plow formerly unsuitable land.

The compounding factors explained above were mentioned by multiple conservation practitioners we interviewed in the focal area, particularly in North and South Dakota. One practitioner referred to a "perfect storm" of factors driving grassland conversion: high commodity prices, the limited profitability of ranching, new farming technologies, crop hybrids that make new land suitable for production, and the economic incentives to plow even the most risk-prone land. Similarly, another practitioner referred to an "uneven playing field" between crop interests and ranching interests as a major driver of new breakings. Several practitioners offered examples like the following: when a parcel of pasture or rangeland is put up for sale, ranchers looking to expand their operations simply cannot compete with buyers interested in crop production. Similarly, an increasing number of ranchers have been forced to sell or lease their land for additional income and the land is subsequently broken.

Data are not systematically collected on the extent and location of new breakings. The available data are either several years old or cover small geographic areas.[186] However, several studies reveal that habitat loss in the form of sodbusting is significant in our study region, particularly in North and South Dakota. Data collected by the U.S. Farm Service Agency (FSA) suggest that over 475,000 acres in North and South Dakota were broken between 2002 and 2007.[187] Of these acres, over 350,000 acres were in counties within the PPR. Sodbusting is even more difficult to quantify in Iowa and Minnesota, as FSA has not collected new breakings data for these states. There is very little prairie left to plow. Nonetheless, practitioners we spoke with expressed that breaking native prairie is still a concern in these states. Losing pastureland is an even greater concern. Even though pasture is non-native habitat and has lower ecological value, it provides important water quality and habitat benefits in a landscape otherwise dominated by row crops.

Map 5.3 illustrates the most recent county-level sodbusting data for North and South Dakota from 2005 to 2007, with the PPR region highlighted. While the accuracy of these measurements has been debated, conversations with practitioners in these states confirmed the same general trends. They expressed particular concerns about grassland loss in Stutsman and Emmons counties in North Dakota (Map 9.1), as well as Hyde, Hand, Faulk, and Edmunds counties in South Dakota (Map 10.1).

Map 5.3



In addition to reducing habitat, converting grassland to cropland increases soil erosion and surface runoff, degrading and filling-in nearby wetlands with sediment.[188] Furthermore, once prairie is plowed, restoration efforts can only regain a fraction of the land's original ecological function. Restoring native prairie is difficult and expensive, and few believe the habitat quality can be fully restored.[189]

Removal of Land from the Conservation Reserve Program

In addition to conversion of native prairie, habitat loss also occurs when land is removed from the Conservation Reserve Program (CRP). For a full description of CRP, see page 43. CRP has had a significant impact on the landscape of the PPR. Only three years after the establishment of the program, over 2.7 million acres across the region were enrolled in CRP, with one county in North Dakota having over 25% of its agricultural enrolled in the program.[190] At the peak of enrollment in 2007, CRP enrollment in our four focal states was almost 9 million acres (Table 5.2). Subsequently, enrollment in the four states dropped, with the greatest declines seen in North and South Dakota (Figure 5.3).

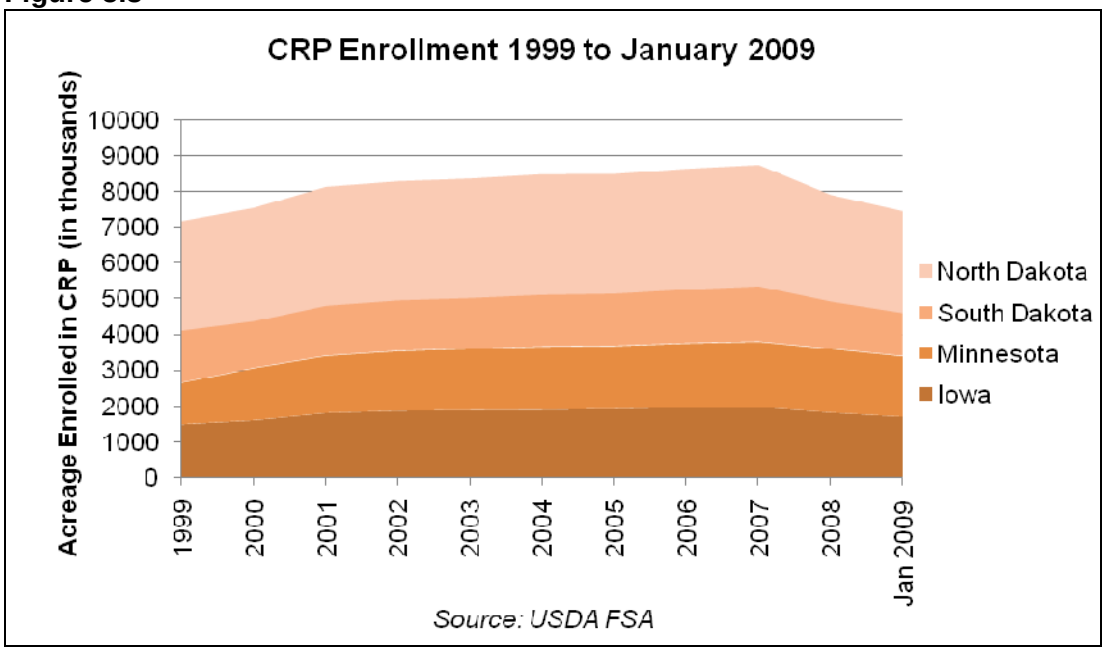
Table 5.2

CRP Acreage Enrolled in Region, 2007-2009					
State	**2007 CRP Acreage[191]**	**2008 CRP Acreage[192]**	**January 2009 CRP Acreage[193]**	**Absolute Change 2007 to January 2009**	**Percent Change 2007 to January 2009**
Iowa	1,971,000	1,814,000	1,694,000	-277,000	-14.1%
Minnesota	1,828,000	1,783,000	1,692,000	-136,000	-7.4%
North Dakota	3,387,000	2,928,000	2,839,000	-548,000	-16.2%
South Dakota	1,559,000	1,336,000	1,229,000	-330,000	-21.2%
Total	**8,745,000**	**7,911,000**	**7,454,000**	**-1,291,000**	**-14.8%**

Source: USDA, National Agricultural Statistics Service

CRP was established with the aims of improving soil quality, water quality, and wildlife habitat.[194] Wildlife biologists agree that CRP has been successful in increasing habitat for grassland and wetland birds and in improving declining populations of many species. Researchers have found that grassland bird abundance is 1-10 times higher and nest abundance is 13.5 times higher in CRP land than in cropland.[195] Grassland bird species in decline benefited the most from CRP land. Because the loss of perennial grassland to annually tilled cropland has been cited as a major cause of grassland bird decline,[196] it is not surprising that a number of grassland bird species which have seriously declined in population abundance are common in CRP fields.[197]

Figure 5.3

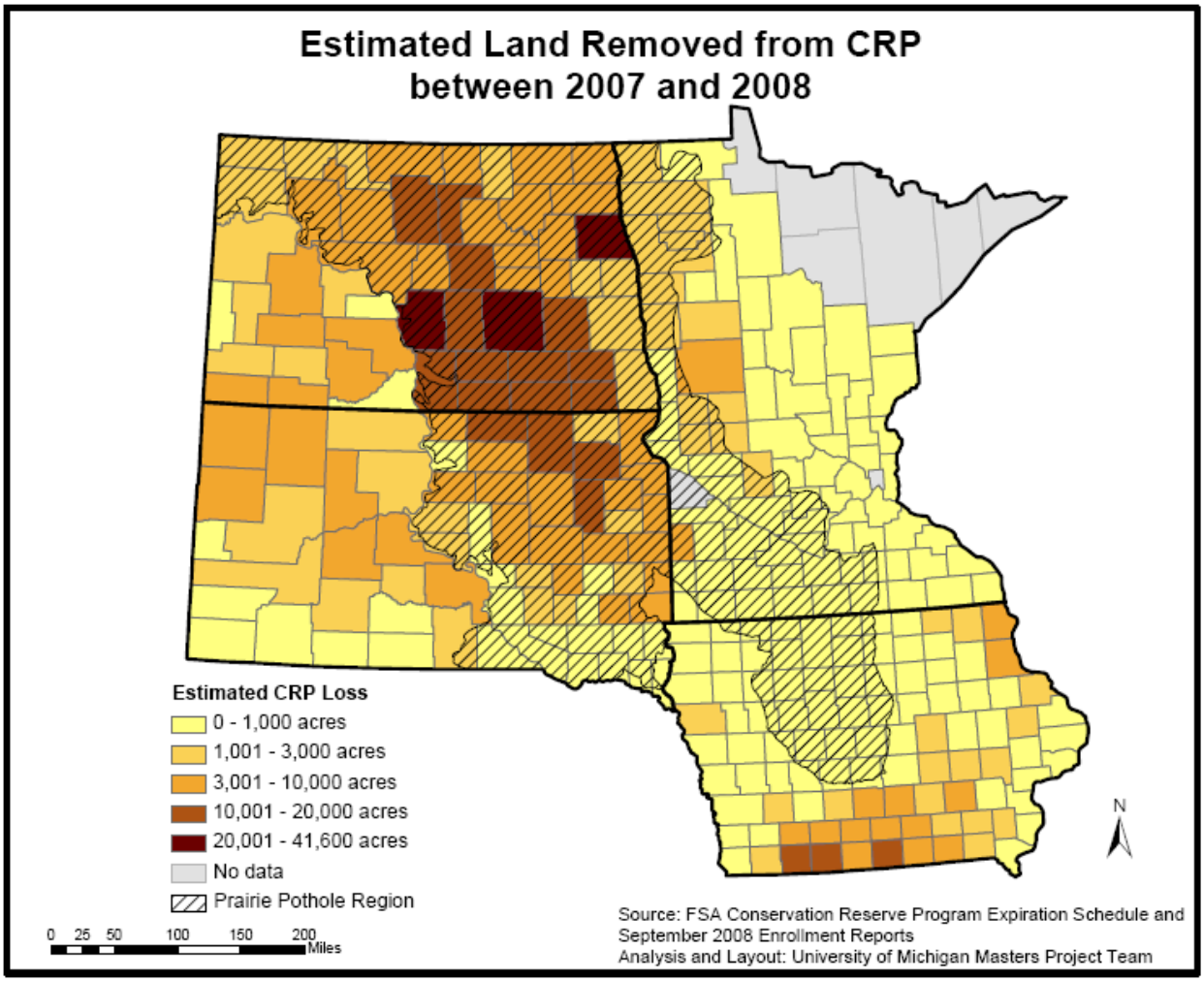


There is also evidence that CRP has helped to increase duck populations in the PPR. This is especially promising, as the PPR has seen large-scale declines in populations of ducks and other waterfowl over the last few decades. Declines in nest success of ducks are thought to be due to increases in predation, coinciding with conversion of perennial grassland to cropland. The loss of grassland nesting habitat for ducks causes more ducks to crowd into the remaining fragments, making them more vulnerable to predation.[198]

In studies similar to those of grassland birds, researchers have found that duck nest success is significantly higher on CRP fields than non-CRP fields in the PPR.[199] Another study estimated that combined nest success rates for five species of ducks were 46% higher on CRP cover than on cropland.[200] CRP land has also significantly affected duck recruitment in the PPR. Researchers estimate that 12.4 million ducks were recruited to the region as a consequence of CRP between 1992 and 1997.[201]

As Map 5.4 reveals, CRP loss between 2007 and 2008 occurred throughout the four-state region but was predominantly concentrated in the PPR region of North and South Dakota. The spatial distribution of these losses is similar to the pattern of total enrollment in 2007, meaning that areas with the most CRP enrolled in 2007 were generally the areas with the greatest CRP losses. However, the intensity of CRP losses in North and South Dakota is most likely explained by the comparative amount of acreage that expired in 2007. North and South Dakota had the highest number of acres expire in the four-state region; in 2007, approximately 400,000 acres expired in North Dakota and approximately 300,000 acres in South Dakota. This was significantly more than expiration levels in Iowa and Minnesota: 149,000 acres and 79,000 acres, respectively. Therefore, more landowners in North and South Dakota were presented with the option of either re-enrolling in or withdrawing from the program.

Map 5.4



Given the high value of CRP for habitat and wildlife, theses losses have important implications in the states. The fact that South Dakota had the fewest CRP acres of the four states (Table 5.2) means that these large losses have an even greater impact on the landscape. Additionally, the limited and fragmented amount of grassland in Iowa and Minnesota makes the CRP losses in these states even more serious for wildlife populations.

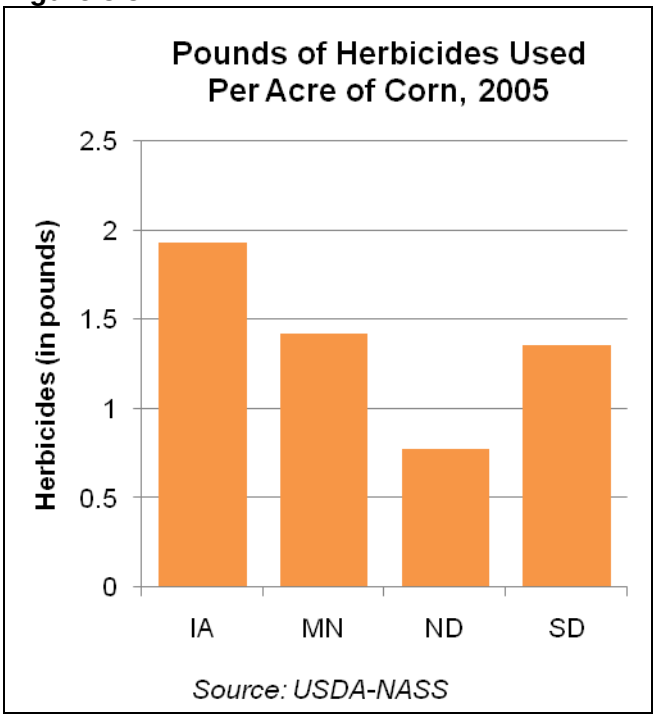
CRP lands shifting in and out of cultivation are generally located in areas with more imperiled plants and animals.[202] Loss of CRP land has the potential to reverse some of these gains. Researchers estimate that in some parts of the PPR, returning CRP habitat to cropland would reduce numbers of certain at-risk species by as much as 25%.[203]

Soil and water quality remain two of the top priorities for the CRP. CRP land reduces nitrogen, phosphorous, and sediment runoff from fields. Conserving land, rather than cultivating it, results in the use of less fertilizer, reducing nutrient runoff. Grass fields, uplands, and riparian buffers enrolled in CRP also intercept nutrients and sediment, preventing them from entering waterways.

By one estimate, nitrate loadings have been reduced by 90 percent and herbicide loadings by 50 percent in some regions because of CRP.[204] CRP retires marginal, highly erodible cropland, and thus reduces soil erosion and improves water quality. It is estimated that 45 million acres in CRP will reduce soil erosion by 750 million tons per year.[205] According to a 2007 U.S. Department of Agriculture (USDA) study, "enrollment of marginal cropland in CRP virtually eliminates soil and nutrient loss and increases the amount of organic matter on enrolled fields."[206]

In a 2004 USDA study, researchers estimated that the conversion of cropland to perennial cover in the upland zones of the PPR reduced total soil loss by 1.94 million tons annually, reduced nitrogen loss by 5,622 tons annually, and reduced phosphorous loss by 75 tons annually. Using these data to estimate the benefits of CRP land over the life of the program, the authors concluded that CRP enrollment has reduced soil loss by 23.3 million tons, nitrogen loss by 66,971 tons, and phosphorous loss by 879 tons in the PPR.[207] Conversion of CRP land to cropland would result in significant increases in soil erosion, nutrient loading, sedimentation, and water pollution.

Figure 5.5



Habitat Degradation Associated with Increased Corn Plantings

In addition to losses of habitat through new breakings and land released from CRP, the intensive production techniques associated with corn expansion may also result in degradation of important habitats. In particular, corn expansion may be leading to increases in pesticide and fertilizer use, erosion and sedimentation, and water use.

Pesticide Inputs

Of our four study states, Iowa had the highest levels of herbicides applied per acre of corn, while North Dakota had the

lowest (Figure 5.5). Atrazine, which is the top herbicide used on corn nationally, was applied in highest quantities and on the highest percent of acres in Iowa and Minnesota (Table 5.3). Glyphosate, which is the second most commonly used herbicide on corn nationally, is applied on the highest percent of corn acres in North Dakota and South Dakota, with over 70% of corn in South Dakota treated with glyphosate. Both atrazine and glyphosate have been found in runoff from treated fields and are common contaminants of surface water. The ecological effects of atrazine and glyphosate are discussed in detail in Chapter 3.

Table 5.3

Top 5 Herbicides and Top 4 Insecticides Used on Corn in Study States, 2005								
Active Ingredient	Percent Corn Acres Treated				Total Applied (1,000 pounds)			
	ND	SD	IA	MN	ND	SD	IA	MN
Herbicides								
Atrazine	20	33	61	41	95	893	8,276	1,660
Glyphosate iso. Salt	56	71	21	44	771	3,030	2,230	2,853
S-Metalochlor	N/A	6	22	N/A	N/A	329	4,335	N/A
Acetochlor	N/A	19	32	33	N/A	1,109	6,706	3,095
Mesotrione	N/A	11	32	17	N/A	50	443	125
Insecticides								
Cyfluthrin	N/A	N/A	6	5	N/A	N/A	4	7
Tebupirimphos	N/A	N/A	6	5	N/A	N/A	89	43
Tefluthrin	N/A	3	2	N/A	N/A	13	30	N/A
Chlorpyrifos	N/A	4	N/A	2	N/A	163	N/A	107

Source: U.S. Department of Agriculture, National Agricultural Statistics Service. 2006; Agricultural Chemical Usage 2005 Field Crops Summary

Many of the species listed as species of conservation concern in the State Wildlife Action Plans (SWAPs) of Iowa, Minnesota, North Dakota, and South Dakota are threatened by pesticides. Beyond amphibians, many species of birds are sensitive to wetland degradation due to pesticide and herbicide runoff. Some of these species, as identified in the SWAPs, include the American White Pelican, the Long-Billed Curlew, the Black Tern, and the Chestnut Collared Longspur. The federally threatened Piping Plover, which relies on aquatic habitats, is also sensitive to pesticide contamination.

Fertilizer Inputs

As discussed in Chapter 3, increased corn acreage results in increased fertilizer use. In our study states, nitrogen is the most common fertilizer used, followed by phosphate, potash, and sulfur (Table 5.4). All four study states treat over 90% of corn acres with nitrogen. Phosphate is used most widely in North Dakota, followed by Minnesota.

Increased fertilizer inputs will also lead to increased nutrient loading in wetland habitat. One mitigation strategy currently in use is to buffer wetlands with vegetation, a practice that shows effective removal of nutrients. This benefit was found to be greatest on wetlands enrolled in CRP and the Wetland Reserve Program. However, this benefit will be compromised if land is taken out of these programs and converted to crop production.[208]

Table 5.4

Fertilizer Use on Corn (2005)[209]									
	Planted Acreage (1,000 acres)	Percent of Corn Acres Treated				Total Fertilizer Applied (in million lbs)			
		Nitrogen	Phosphate	Potash	Sulfur	Nitrogen	Phosphate	Potash	Sulfur
Iowa	12,800	92%	70%	71%	5%	1653.2	1653.2	1653.2	1653.2
Minnesota	7,300	94%	86%	77%	9%	953.9	953.9	953.9	953.9
North Dakota	1,410	99%	94%	38%	8%	169.3	169.3	169.3	169.3
South Dakota	4,450	95%	79%	37%	13%	477.7	477.7	477.7	477.7

Source: U.S. Department of Agriculture, National Agricultural Statistics Service. 2006; Agricultural Chemical Usage 2005 Field Crops Summary

Water Use

In 2008, 1.1% (324,000 acres) of all corn grown in our study states was irrigated.[210] Although the vast majority of corn in the PPR is not irrigated, corn expansion in the region is still linked to increased water usage. Water use varies based on a number of factors, including crop type, soil conditions, and climatic conditions. For example, in North Dakota, the amount of water needed for each crop decreases from north to south, with all crops exhibiting highest water usage in the south of the state. Despite this variability, there are clear trends across crops. Table 5.5 gives the maximum and minimum crop water usage for seven crops during North Dakota's 2004 growing season.[211] Corn has both the highest minimum and maximum water usage of the crops for which data is available. Most notably, corn used more water than soybeans at all locations across the state. This general pattern holds true throughout the Northern and Southern Plains, though the reverse is true in the Western and Mountain Regions of the country.[212] Thus, in our study area, agricultural water usage will increase when corn plantings replace soybean plantings.

Table 5.5

Water Usage by Crop (inches/week)		
	High	Low
Wheat	14.76	11.39
Potato	17.67	13.27
Dry Beans	15.92	12.23
Barley	13.09	10.03
Corn	19.57	14.54
Soybeans	17.64	13.07
Sunflower	17.07	12.93

Source: North Dakota State University

Biorefineries also use water to convert corn into ethanol. While the water used in this process is less than that used in corn agriculture, it can have significant local impacts. Using current technology, a biorefinery will use about 400 million gallons of water per year to produce 100 million gallons of ethanol.[213] The high number of biorefineries in the PPR, along with the high levels of corn plantings in the region, may be having significant impacts on water usage in the region, and conservation practitioners are concerned about the decreasing water table and draining of wetlands.

Conclusion

Much of the national increase in corn plantings since 2005 has been concentrated in our four-state focal region, with increases of over a quarter million acres in each of our four study states. The majority of the U.S. PPR lies within these states. This ecologically unique region is particularly important as habitat for migratory birds, waterfowl, and grassland and game bird species. Increased corn plantings in the region have led to both habitat loss and habitat degradation. Within the four states, increased corn prices have led to conversion of native prairie to cropland, along with removal of land from CRP. These changes have been particularly acute within the PPR. In addition to this loss of habitat, increased corn plantings have led to habitat degradation from increased pesticide inputs, fertilizer inputs, and water use.

Chapter 6: Wildlife Populations

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Dickcissel
Photo: Fish and Wildlife Service

Chapter 6
Wildlife Populations

Recent increases in corn plantings, driven in part by increased corn ethanol demand, threaten both the quantity and quality of remaining grassland and wetland habitats in Iowa, Minnesota, North Dakota, and South Dakota. As described in Chapters 3 and 5, conversion of native prairie and Conservation Reserve Program (CRP) land to cropland has decreased total amounts of available grasslands, while the application of pesticide, fertilizer, and water inputs and the erosion and sedimentation associated with increased corn plantings have degraded the habitat that remains. These impacts have been especially significant in the Prairie Pothole Region (PPR), an ecologically important wetland landscape that is now increasingly dominated by intensive row-crop farming. Numerous species of birds, mammals, reptiles, and amphibians are threatened by agricultural expansion in this region (see Tables 9.3 and 10.3). Conservation practitioners we interviewed expressed concerns about waterfowl, grassland, and game bird species. In particular, representatives of Ducks Unlimited, the U.S. Fish and Wildlife Service, and North Dakota's Department of Game and Fish explained that the Northern Pintail, Baird's Sparrow, and Sprague's Pipit are currently suffering from habitat loss, fragmentation, and degradation associated with intensive row cropping.

To focus our analysis on the potential impact of increased corn ethanol production on wildlife populations, we chose to analyze the relationship between corn plantings and grassland bird populations in our four-state study region. Many grassland bird species are currently facing significant declines. According to a 2009 report by the North American Bird Conservation Initiative, grassland birds as a group face the most pressing conservation challenges and are in need of comprehensive, large-scale management. Forty-eight percent of grassland birds are considered species of conservation concern and 55 percent are showing significant population declines.[214] Not only are grassland bird species facing increased habitat threats, they are also ideal subjects for population trend analyses. Because birds have short generation times, population sizes are sensitively dependent on changes in habitat. Additionally, unlike many other species, there is high-quality, consistent, regional-level data available for birds.

Using publicly available Breeding Bird Survey (BBS) data, National Agricultural Statistics Service (NASS) corn plantings data, and Farm Service Agency (FSA) CRP enrollment data, we analyzed how recent changes in land use are affecting bird populations in our study states. We hypothesized that if increased corn plantings have the effect of decreasing habitat amount and quality, we will see the greatest declines of obligate grassland-breeding birds in areas experiencing the largest increases in corn production. Conversely, we expect that generalist bird species—those less reliant on grasslands for breeding—will not be affected by increased corn plantings. Our results support these hypotheses. Our sensitive indicator species showed significant declines in both the number of species and the number of individuals in high-change areas and high corn-increase areas compared to low-change areas and low corn-increase areas. In contrast, our control species showed no declines in either high-change or low-change areas.

Materials and Methods

Breeding Bird Survey Data

The BBS is a long-term, large-scale, international bird-monitoring program jointly coordinated by the U.S. Geological Service, the Canadian Wildlife Service, and the National Wildlife Research Center.[215] The program was initiated in 1966 to track the status and trends of North American bird populations. Every June, trained bird observers collect bird population data along greater than 4,100 roadside survey routes throughout most of the United States and Canada. Each survey route is 24.5 miles long, with stops at 0.5-mile intervals. At each stop, a 3-minute point count is conducted. During the point count, every bird heard or seen within a 0.25-mile radius is recorded. Surveys start one-half hour before local sunrise and take about 5 hours to complete. All the raw data from BBS surveys, as well as GIS shapefiles of routes, are publicly available. More than 270 scientific publications have relied heavily, if not entirely, on BBS data.[216] For our analysis, we used BBS data from routes in our four study states: Iowa, Minnesota, North Dakota, and South Dakota.

Corn Plantings Data

We obtained the 2004 and 2007 corn plantings acreage from the United Stated Department of Agriculture (USDA) NASS Quick Stats website. Corn acreage reflects the number of acres of corn planted for grain (as opposed to silage and forage) under all cultivation practices. Corn acreage was available for almost all counties in the four-state study region for the two years under question (approximately 93% of the data points were available). When corn acreage was not available at the county level, the remaining 7% of the data were interpolated from the district-level (combined county) corn acreage. The Quick Stats website provides district-level acreage when two or more counties in that district lack county-level data for a given year. To determine how to divide up the district-level data and assign acreage to individual counties, we found years in which county-level data for the counties in question were available. We then calculated the average ratio of corn plantings between those counties for the available years. We applied this ratio to the combined county acreage for the year under question and assigned the resultant corn acreage values to the respective counties. For the purpose of our analysis, corn acreage for each county was normalized by county area and expressed as a fraction of county surface area.

Habitat Change Index

To determine the combined impact of changes in corn plantings and CRP enrollment on bird populations, we calculated a Habitat Change Index for all counties in Iowa, Minnesota, North Dakota, and South Dakota. CRP enrollment data for 2004 and 2007 were obtained from the FSA's Conservation Programs Statistics website. For each county in this four-state region, we divided the change in corn planting acreage and CRP enrollment acreage from 2004 to 2007 by county area to determine the change in corn plantings and change in CRP as a percent of county area. Each percentage, p, was then converted to a value, v, between 0 and 100 using the equation

$$v(p) = (p - p_{min})*100/(p_{max} - p_{min}),$$

where p_{min} is the smallest percentage and p_{max} is the largest percentage. The resultant corn plantings value and CRP value for each county were weighted equally and added together to obtain the Habitat Change Index score for that county. The corn plantings and CRP values were weighted equally given their respective impacts on habitat: increased corn plantings occurred over a larger area but represent a less direct impact on habitat, whereas changes in CRP occurred at a smaller scale but represent a direct change in habitat abundance. This equal weighting was also used in our hotspot analysis, during which we experimented with slight variations of weightings, none of which resulted in visibly different spatial patterns. In counties where CRP enrollment increased between 2004 and 2007, the CRP value had the effect of decreasing a county's index score. Conversely, CRP loss between 2004 and 2007 had the effect of increasing a county's index score.

Assigning County Land-Use Data to BBS Routes

To assign county land-use data to BBS routes, we used the publicly available GIS shapefile of BBS routes and ArcMap to determine the county or counties in which each route is located. While the majority of the routes in our four-state study region do not cross county lines, some run through two or more counties. If the route passes through more than one county, we also determined what percentage of the route was in each county. For those routes that traveled along county lines, we determined how much of the route traveled along the county line and allocated half of it to each county. Out of the 100 routes that we could spatially locate that had data from both 2005 and 2008, 41 of the routes were in 2 counties, and 4 of the routes were in 3 counties.

While the vast majority of the BBS routes in our four-state study region had GIS shapefile data, some routes were missing data. For those routes that were not, we downloaded the turn-by-turn route directions available through the Patuxent Wildlife Research Center. For each of those routes with turn-by-turn directions available, we used Google Earth to determine the route's path, which counties it passes through, as well as an approximate percentage of how much of the route is in each of those counties. Some routes were neither in the shapefile nor had turn-by-turn data available; we did not include these routes in our analysis. This resulted in the exclusion of 17 routes from our analysis.

After determining which counties each route passes through, and how much of the route is in each of those counties, we calculated the corn plantings and Habitat Change Index score for each route. For corn plantings, we calculated the weighted average of total corn plantings (normalized by county area) for each county through which the route passes. Thus, a route with X% in county A and Y% in county B would have a corn increase value of

$$(0.X * \text{corn increase in county A}) + (0.Y * \text{corn increase in county B})$$

The same calculation was used to assign a Habitat Change Index score to each route or partial route.

Time Period

We used 2004 as our baseline year for corn plantings and CRP enrollment because corn acreage across the region increased significantly beginning in 2005 with the establishment of the Renewable Fuel Standard. For most of the species studied, habitat loss and degradation are not likely to result in immediate death but rather in failed reproduction. Thus, effects of land-use changes on bird populations are reflected in the subsequent year's population. We therefore compared land-use data from a given year to bird data from the subsequent year; we related 2004 land-use data to 2005 BBS data, and 2007 land-use data to 2008 BBS data. Routes were characterized by the amount of change and corn increase between 2004 and 2007, and bird data were analyzed as changes in populations between 2005 and 2008. According to the U.S. Drought Monitor, our four-state study region experienced drier conditions during the breeding season of 2004 than during the breeding season of 2007.[217] This could have the effect of potentially depressing 2005 bird counts, which we considered when analyzing our results.

Macro-Analysis

Bird Species Used

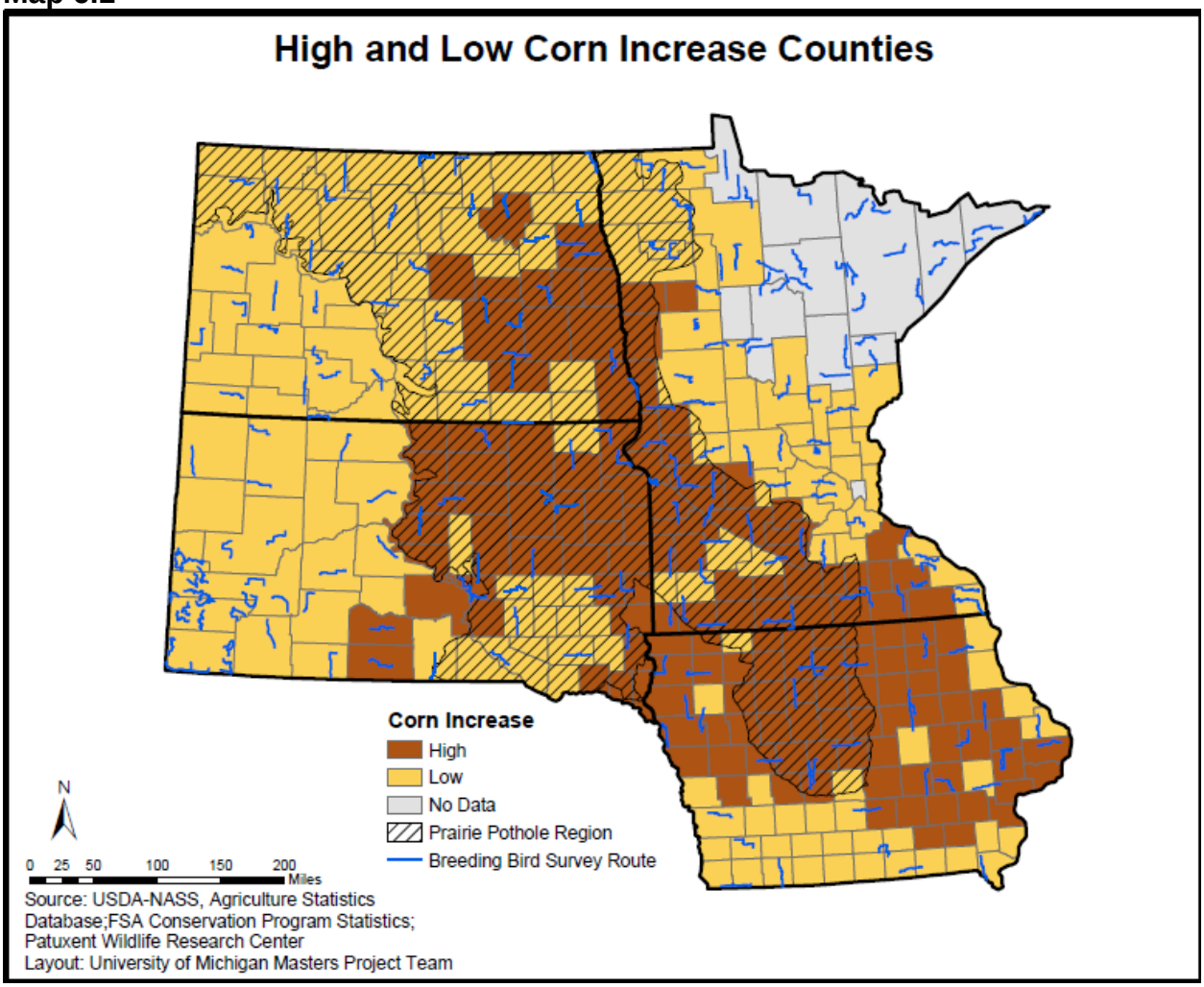
To analyze how land-use changes driven by increased corn plantings have affected populations of birds that breed in grasslands in the four-state region, we focused on a number of grassland species that have been shown to be sensitive indicators of environmental change and for which sufficient BBS data were available. To be considered for analysis, species had to have had over 500 total sightings at a minimum of 40 routes within the four state study region for either 2005 or 2008. This narrowed the list of possible species down to 41. We used the Cornell Lab of Ornithology database and the USGS Patuxent Bird Identification InfoCenter to assess the habitat requirements and nesting preferences of these species, [218,219] We then determined whether each species is an obligate grassland breeder or a generalist species that uses a variety of natural and human habitats.

Based on these data and habitat criteria, we chose five grassland-breeding species to be our "indicator species." The five indicator species used are: Dickcissels, Grasshopper Sparrows, Sedge Wrens, Upland Sandpipers, and Western Meadowlarks (*Spiza Americana, Ammodramus savannarum, Cistothorus platensis, Bartramia longicauda,* and *Sturnella neglecta*). We also chose as a control five "insensitive species," American Crows, American Robins, Bank Swallows, Brown-headed Cowbirds, and Mourning Doves (*Corvus brachyrhynchos, Turdus migratorius, Riparia riparia, Molothrus ater,* and *Zenaida macroura*). These were taxa that occurred in the same area and were subject to the same general environmental conditions that might shape population trends (such as susceptibility to West Nile Virus, drought, and global warming) but did not share the same dependence on grassland habitats.

Quantification of habitat and population changes

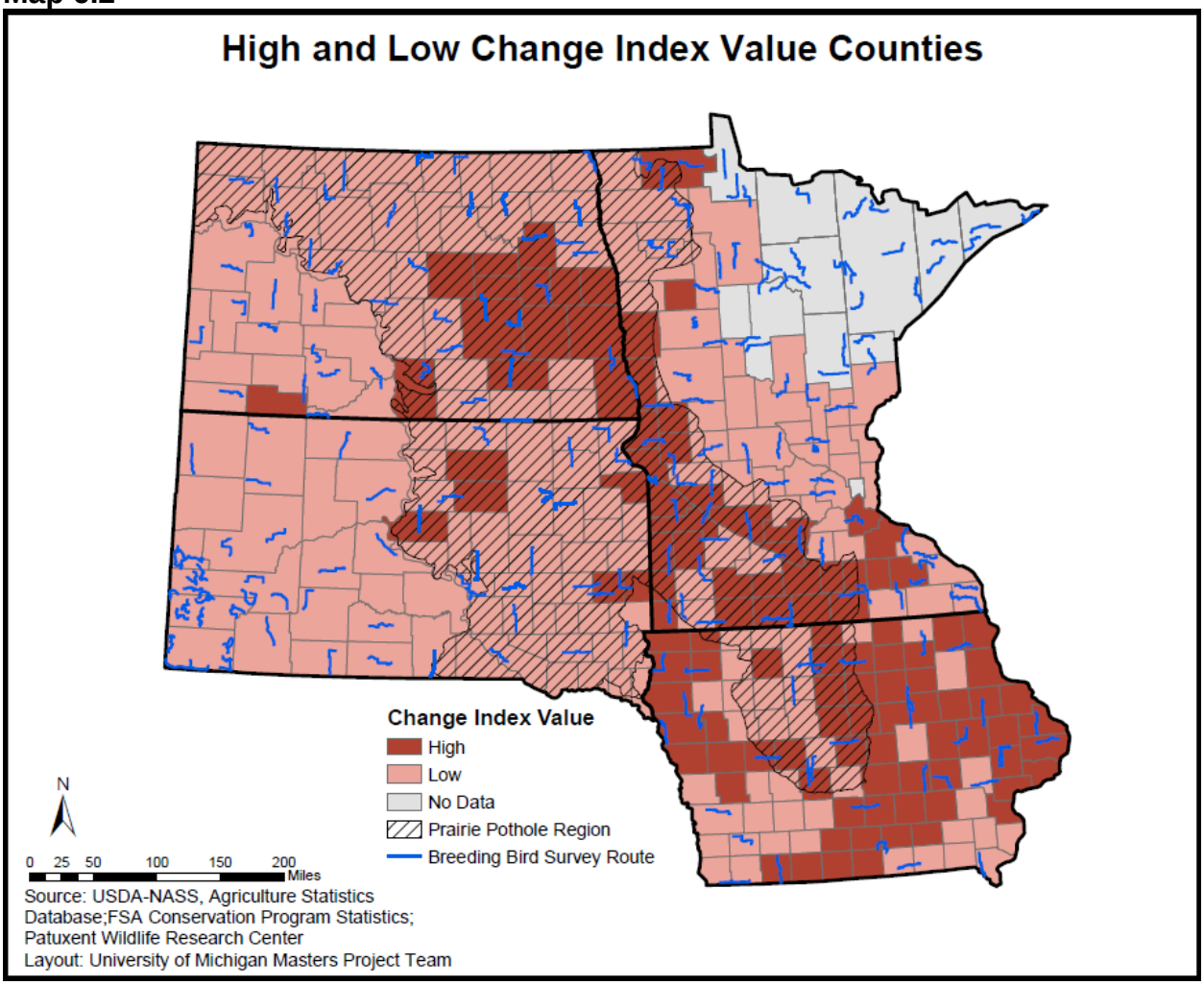
After we assigned a corn increase percentage and a Habitat Change Index score to every route, we grouped the routes into “high corn increase” and “low corn increase” categories based on a cutoff of 3% of county area. We determined this cutoff by considering the distribution of corn increase data. Because choosing the midpoint would arbitrarily divide counties with very similar measurements into two categories, we increased the threshold until we reached a natural break in the data. While the precise cutoff of 3% was arbitrary, we consider this to be a substantial impact on the county’s landscape. Map 6.1 shows which counties in the four-state area are high corn increase versus low corn increase. The lines indicate BBS routes.

Map 6.1



Alternately, to look at the effects of both changes in corn plantings and CRP enrollment, we grouped the routes into “high change” and “low change” routes using a Habitat Change Index value cutoff of 45. The resultant ratio of “high” to “low” counties was similar to the ratio used in the corn analysis, although the number in each group was adjusted slightly to find an appropriate break in the data. Map 6.2 shows which counties in the four study states have high Habitat Change Index values and which counties have low Habitat Change Index values. The lines indicate BBS routes.

Map 6.2



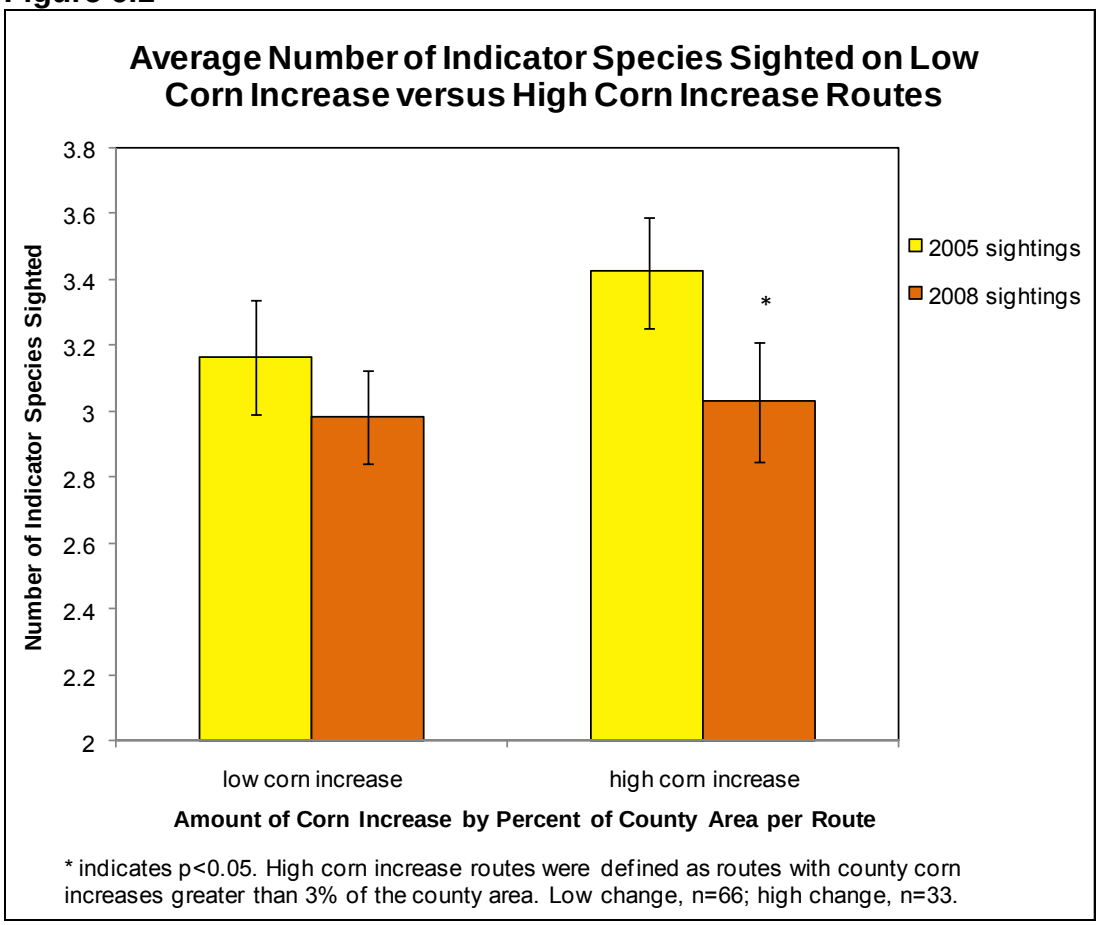
We tested the hypothesis that indicator species would show greater declines between 2005 and 2008 on routes with high Habitat Change Index scores and high corn increase by comparing both the average number of indicator species and the average number of indicator individuals on high- and low-change routes. Conversely, we tested the hypothesis that control bird species population levels would remain unchanged or even increase on routes with high index scores and high corn increases. Changes in number of species and number of individuals were assessed using two-sided paired t-tests.

Results

Indicator Species Results

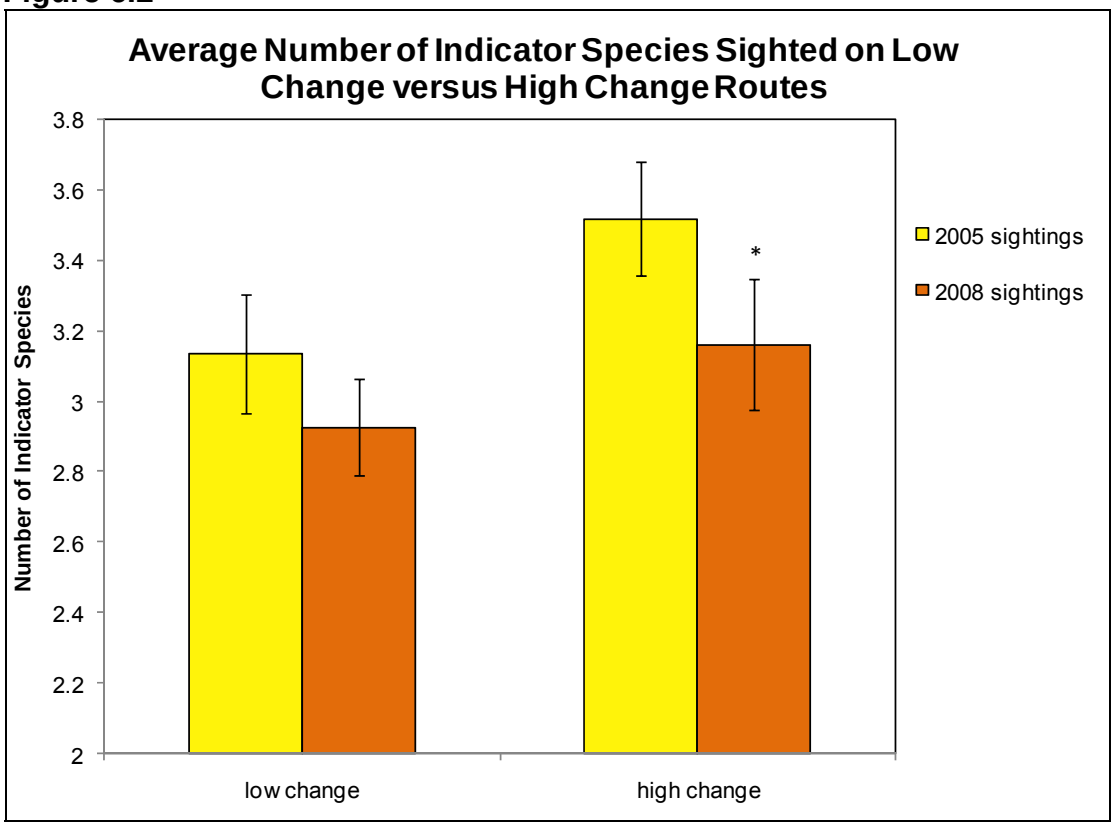
The average number of indicator species on routes in areas with low corn increases was not significantly different between 2005 and 2008 (p=0.11). The average number of indicator species on routes in counties of high corn increase was found to decline significantly from 3.4 species per route to 3 species per route between 2005 and 2008 (p=0.046, Figure 6.1).

Figure 6.1



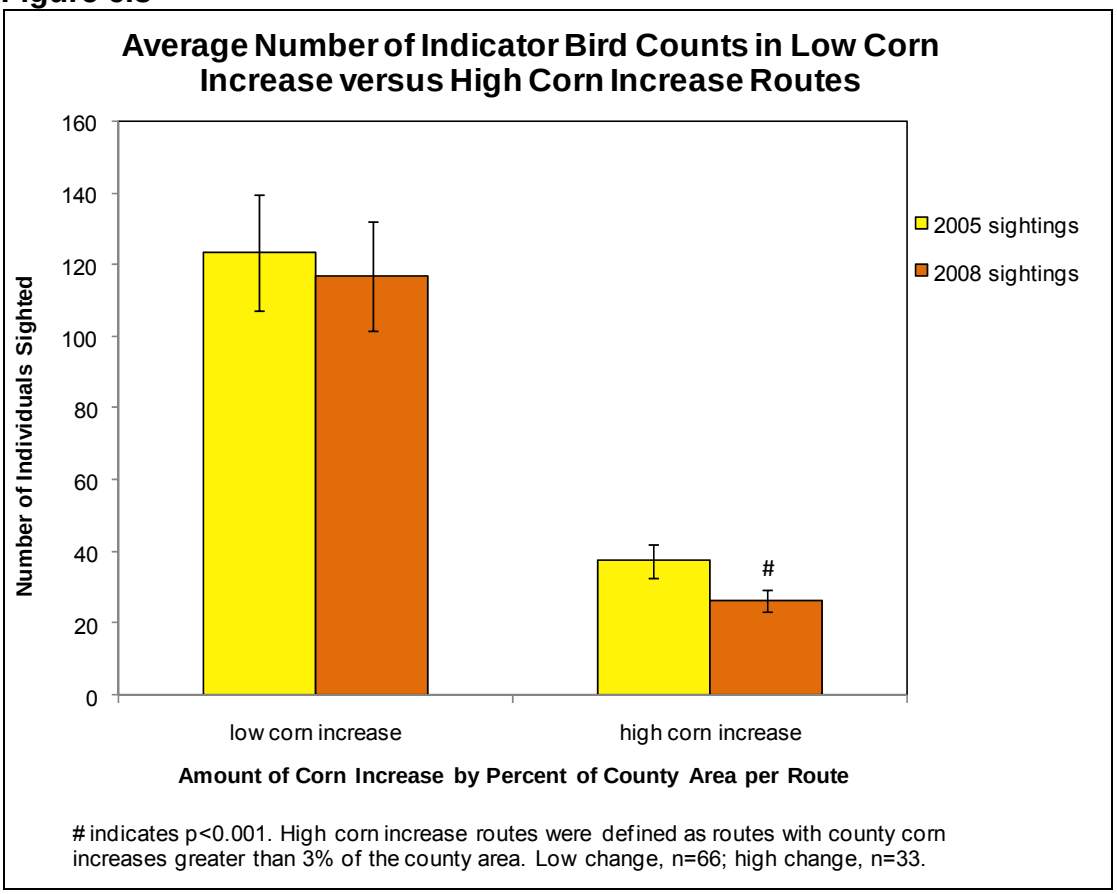
Similarly, the average number of indicator species on routes with low Habitat Change Index scores was not significantly different between 2005 and 2008 (p=0.07). The average number of indicator species on routes with high Habitat Change Index scores was found to decline significantly from 3.5 species per route to 3.2 species per route between 2005 and 2008 (p=0.039, Figure 6.2).

Figure 6.2



In addition to looking at whether the indicator species were present or absent on each route, we compared the number of individuals on each route. We found similarly significant trends. The average number of individual birds counted on high corn increase routes significantly decreased between 2005 and 2008, while there was no significant difference in bird counts on the low corn increase routes (p=0.31). The average number of indicator individuals on routes in counties with high corn increase was found to decline significantly from 37.4 indicator birds per route to 26.4 indicator birds per route between 2005 and 2008 (p=0.0005, Figure 6.3). This was a decrease of 29.4% on high corn increase routes, compared to a non-significant decrease of 5.3% on low corn increase routes.

Figure 6.3

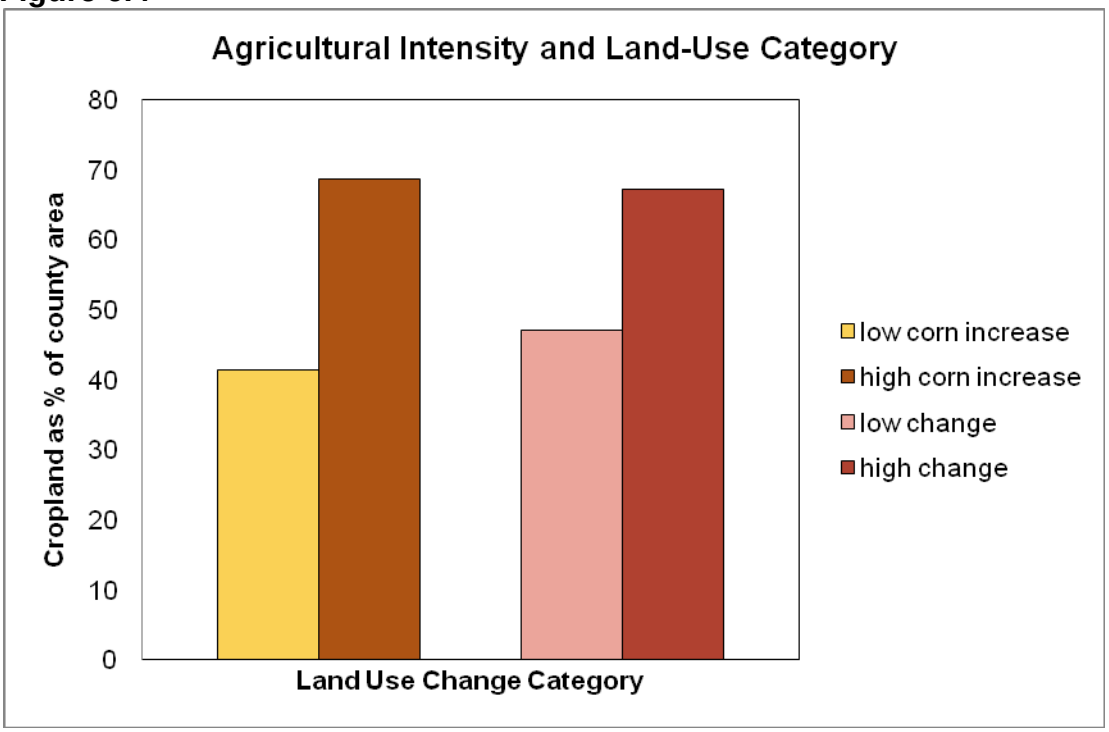


Interestingly, the number of indicator birds on low corn increase routes was significantly higher than on high corn increase routes, independent of period (p<0.001 for both 2005 and 2008). This is likely a reflection of the amount of available habitat in the routes' counties; counties with high corn increase may be counties that have had previously high levels of agriculture and thus be able to support fewer birds to begin with.

Using the USDA's 2007 Census of Agriculture, we calculated what percent of each county was harvested cropland in 2007 and found this pattern to be true. Our analysis revealed a fundamental difference between high and low corn increase and high and low Habitat Change Index value

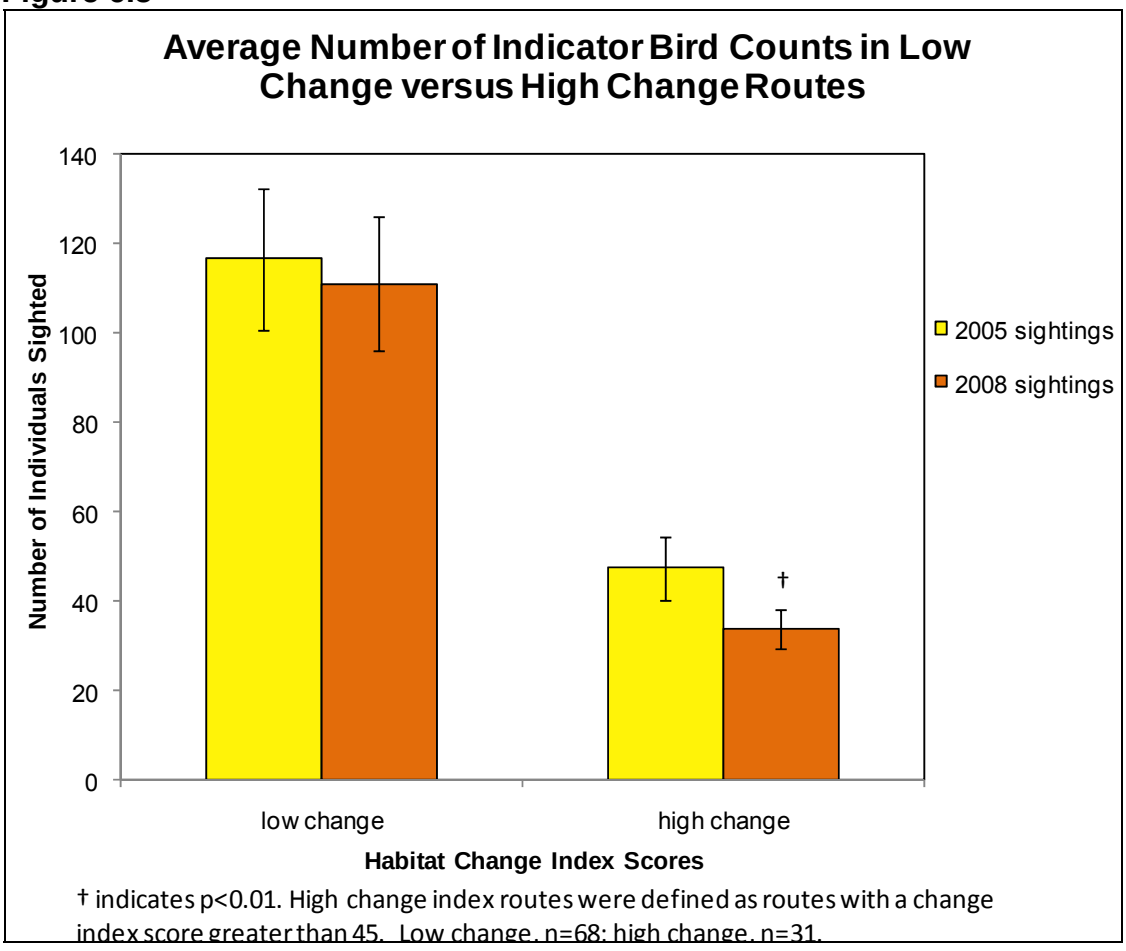
counties. High corn increase counties averaged 68.59% of total county area in harvested cropland in 2007, as compared to 41.31% for low corn increase counties. Similarly, high Habitat Change Index value counties averaged 67.14% of total county area in harvested cropland in 2007, while low Habitat Change Index value counties averaged only 47.11% (See Figure 6.4). High corn increase and high Habitat Change Index counties have a much greater percentage of their total county area dedicated to cropland, reducing total available habitat.

Figure 6.4



Results of the indicator species analysis were similar when we examined the number of indicator birds on routes in counties with high Habitat Change Index scores versus those with low Habitat Change Index scores. The average number of indicator birds on routes with low Habitat Change Index scores was not significantly different between 2005 and 2008 (p=0.37). The average number of indicator birds on routes with high Habitat Change Index scores was found to decline significantly from 47.4 individuals per route to 33.8 individuals per route between 2005 and 2008 (p=0.001, Figure 6.5). This was a 28.7% decline on high change routes, compared to a non-significant decline of 4.7% on low change routes. Again, the differences between indicator bird counts in the low change routes versus the high change routes was highly significant (p<0.001 for both 2005 and 2008).

Figure 6.5



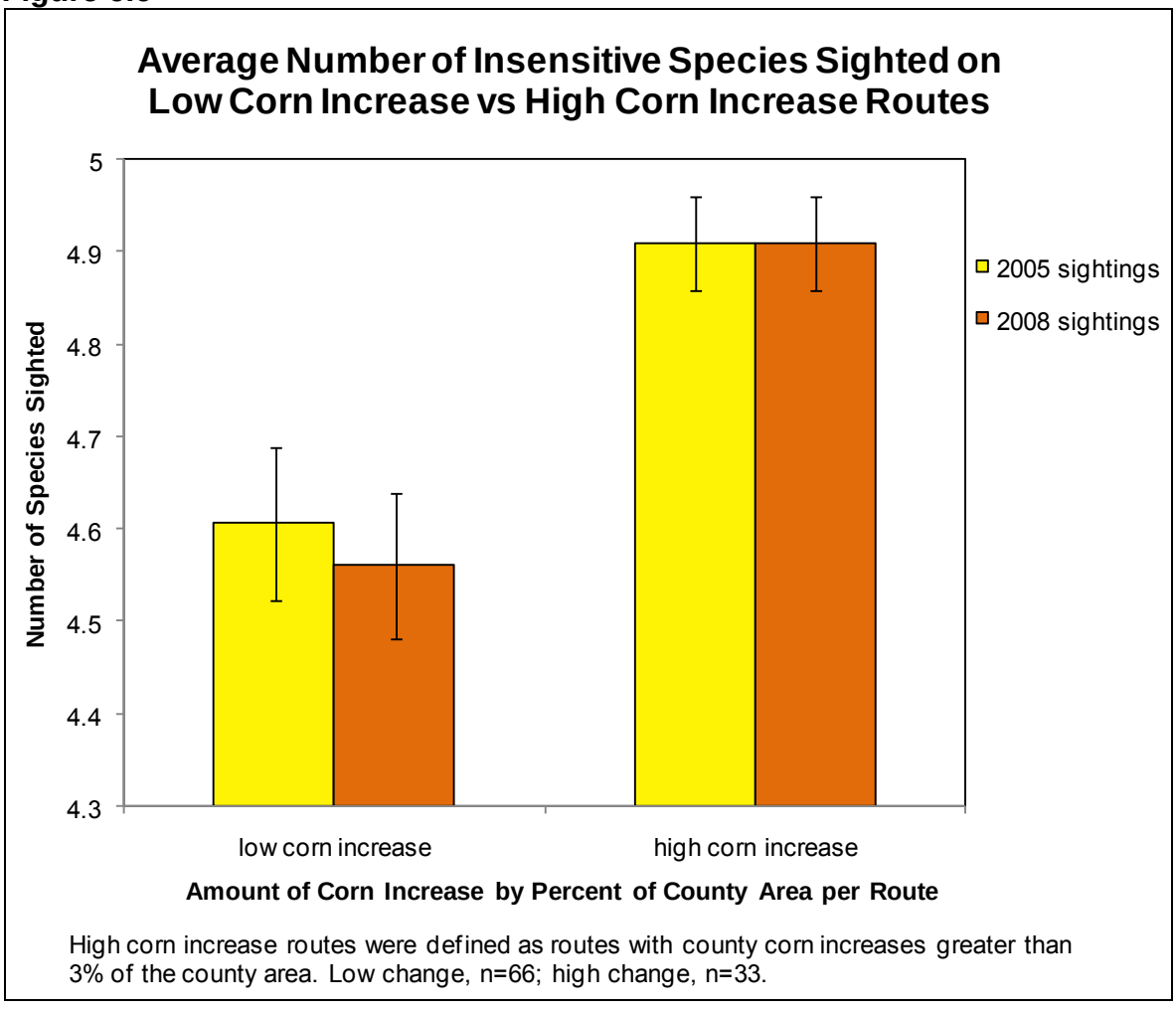
† indicates p<0.01. High change index routes were defined as routes with a change index score greater than 45. Low change, n=68; high change, n=31.

Control "Insensitive" Species Results

To determine whether the trends we observed were specific to obligate grassland breeders or occurring across all bird populations in the region, we ran the same analysis on the five previously selected control, or "insensitive," species. The results for the insensitive species were very different than those for the sensitive species.

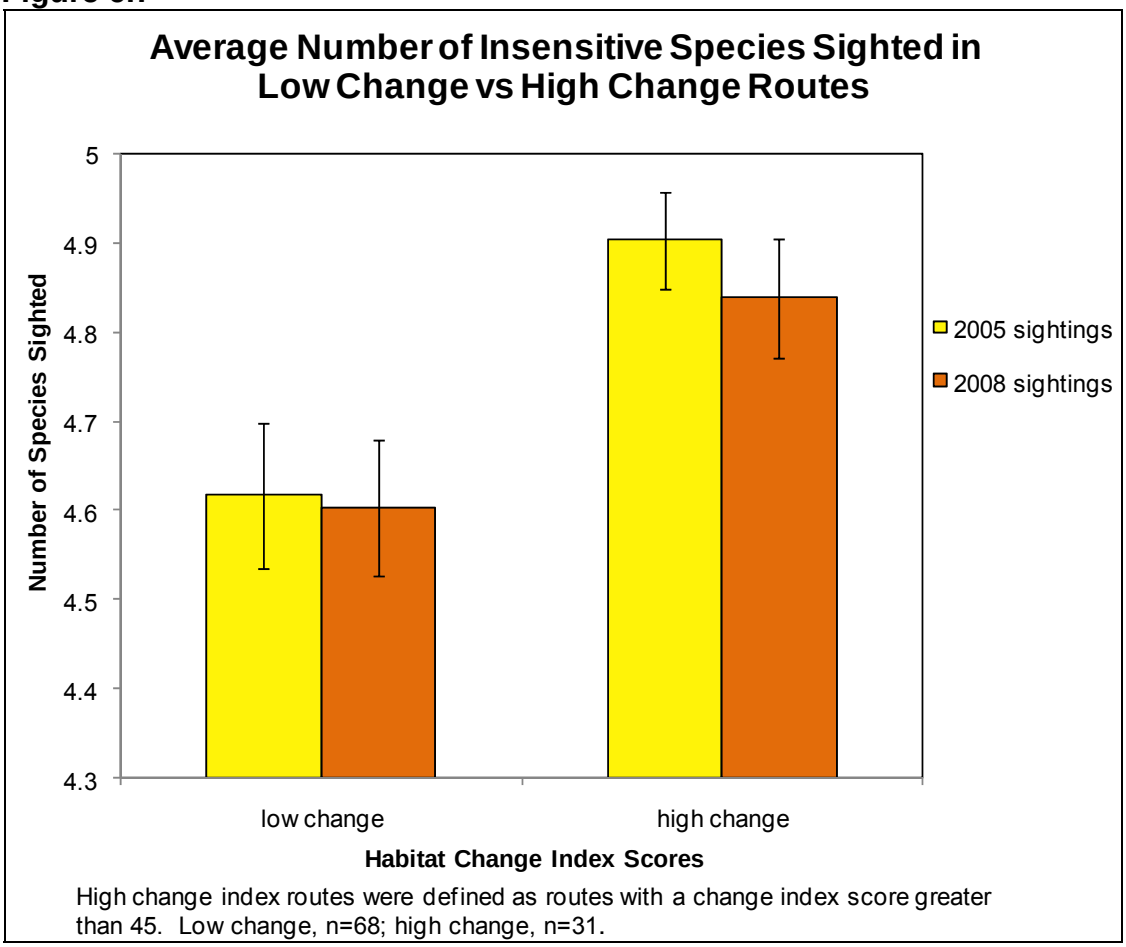
The average number of insensitive species per route did not significantly change between 2005 and 2008 for either the low corn increase or the high corn increase routes (p=1). The average number of insensitive species on routes in counties of high corn increase was the same between 2005 and 2008 (p=1). Over the same time period, the average number of insensitive species on the low corn increase routes had a small but non-significant decline (p=0.49, Figure 6.6).

Figure 6.6



Analyzing the number of insensitive species by Habitat Change Index score instead of by corn increase yielded a slightly different trend, although the results were still non-significant. The average number of insensitive species per route did not significantly change between 2005 and 2008 for either the low change or the high change routes. The average number of insensitive species on routes with low Habitat Change Index scores was approximately the same between 2005 and 2008 (p=0.81), and the average number of insensitive species had a slight but non-significant decline on the high change increase routes (p=0.42, Figure 6.7).

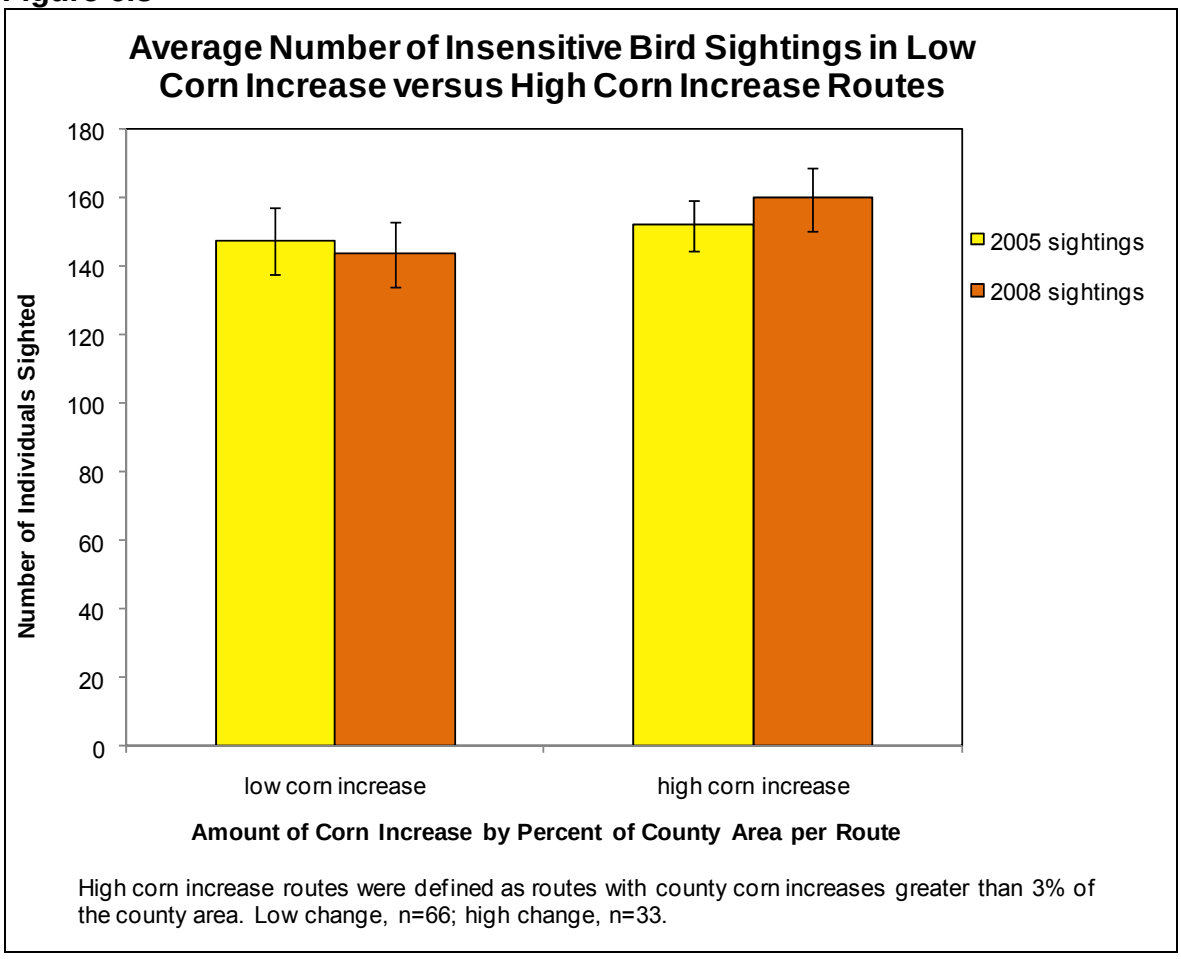
Figure 6.7



High change index routes were defined as routes with a change index score greater than 45. Low change, n=68; high change, n=31.

Examining the number of insensitive individuals further illustrated the differences between indicator and insensitive species. While we found significant decreases in the number of indicator birds on high corn increase routes between 2005 and 2008, we found no significant trends for insensitive birds on either high corn increase or low corn increase routes over the same time period. The average number of insensitive individuals counted on high corn increase routes had a slight non-significant increase from an average of 152 to 159.8 birds per route between 2005 and 2008 (a 5.1% increase, p=0.25). The average number of insensitive birds counted on low corn increase routes had a slight non-significant decrease of 2.6% over the same period, from 147.5 birds in 2005 to 143.7 birds per route in 2008 (p=0.66, Figure 6.8).

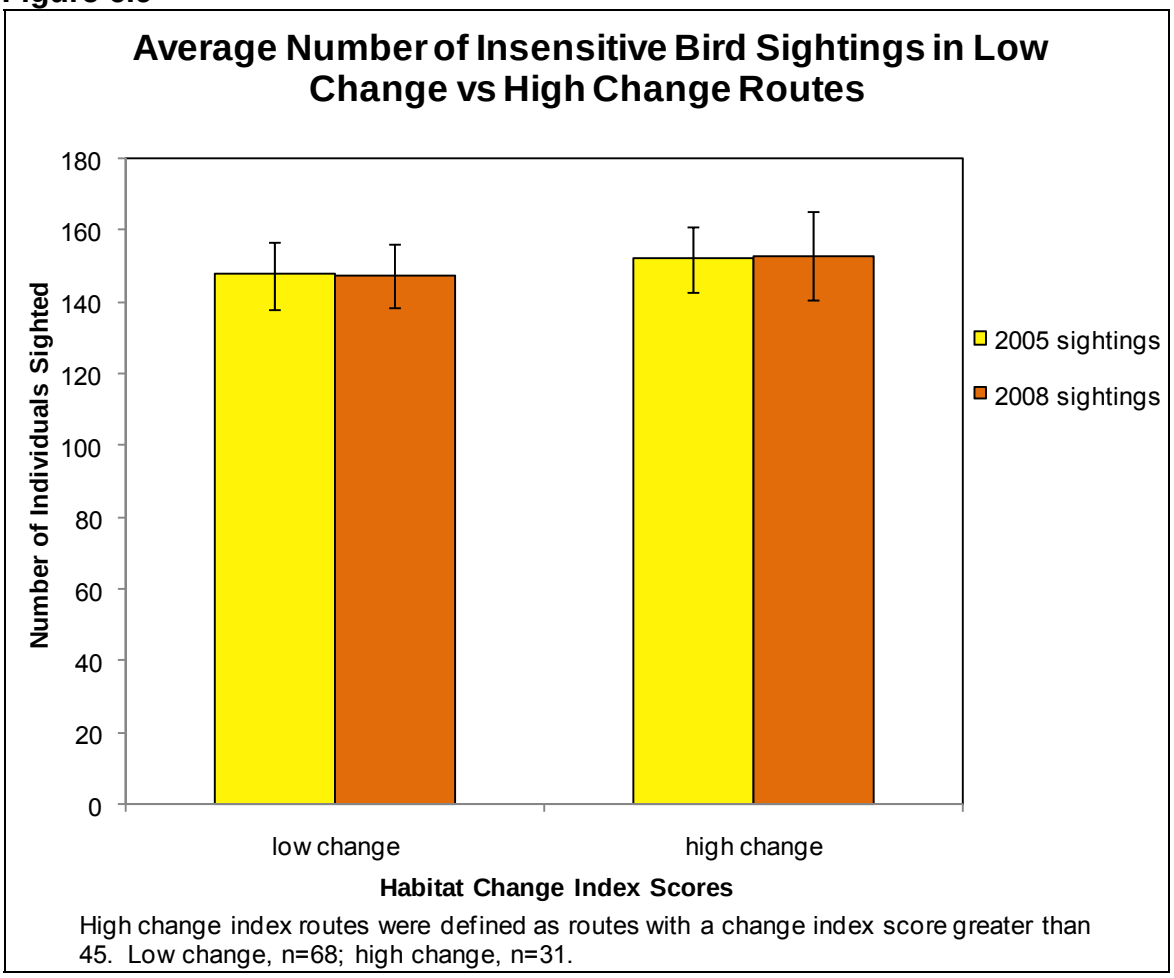
Figure 6.8



High corn increase routes were defined as routes with county corn increases greater than 3% of the county area. Low change, n=66; high change, n=33.

Similar to the results of the previous analysis, we found no significant trends when comparing the number of insensitive birds on routes with high Habitat Change Index scores and low Habitat Change Index scores. The average number of insensitive individuals counted was essentially unchanged between 2005 and 2008 (less than a 1% difference) for both the low change (p=0.97) and the high change routes (p=0.93, Figure 6.9). Additionally, there was no significant difference in number of insensitive bird counts between low change and high change routes for either 2005 or 2008.

Figure 6.9



High change index routes were defined as routes with a change index score greater than 45. Low change, n=68; high change, n=31.

Micro-Analysis

Methodology

In addition to doing a grouped analysis for sensitive indicator species, we also examined the effects of corn increases and habitat change on our five individual indicator species: Dickcissels, Grasshopper Sparrows, Sedge Wrens, Upland Sandpipers, and Western Meadowlarks. To understand the effect of land-use change on these species, we examined population changes between 2005 and 2008 for each species along a gradient from low change to high change and from low corn increase to high corn increase. We performed regressions and Spearman correlations. Our dependent variable was percent change in population (2005-2008) and the two independent variables we used were our two indicators of land-use change: corn increase as percent of county area (2004-2007) and Habitat Change Index value (based on change in CRP and corn increase, 2004-2007). Each route was considered to be a different case. Outliers reflecting increases in the species sightings of a route by greater than 200% over this 3 year period were considered to be biologically unlikely and removed from the analysis. In some cases, inclusion of these data points further strengthened the observed patterns. For each species we performed the regressions and correlations for routes in all four states, as well as for routes that were only in the PPR.

We tested the hypothesis that, for each indicator species, increased corn plantings and increased habitat change would be correlated with population declines. Routes with lowest land-use change would have steady or increasing populations, and routes with highest land-use change would have decreasing populations.

Results

Results of the regressions and correlations between the two indicators of land-use change and change in population of indicator species are presented in Table 6.1. Of the five indicator species, only Dickcissels and Western Meadowlarks had significant relationships to increases in corn plantings in the general vicinity, while several other taxa showed marginally non-significant associations ($0.05 < p < 0.1$, Table 6.1). In general, R^2 values were quite low, likely as a result of the high variability of the data. BBS data is affected by variations in observer, temperature, precipitation, and many other factors.

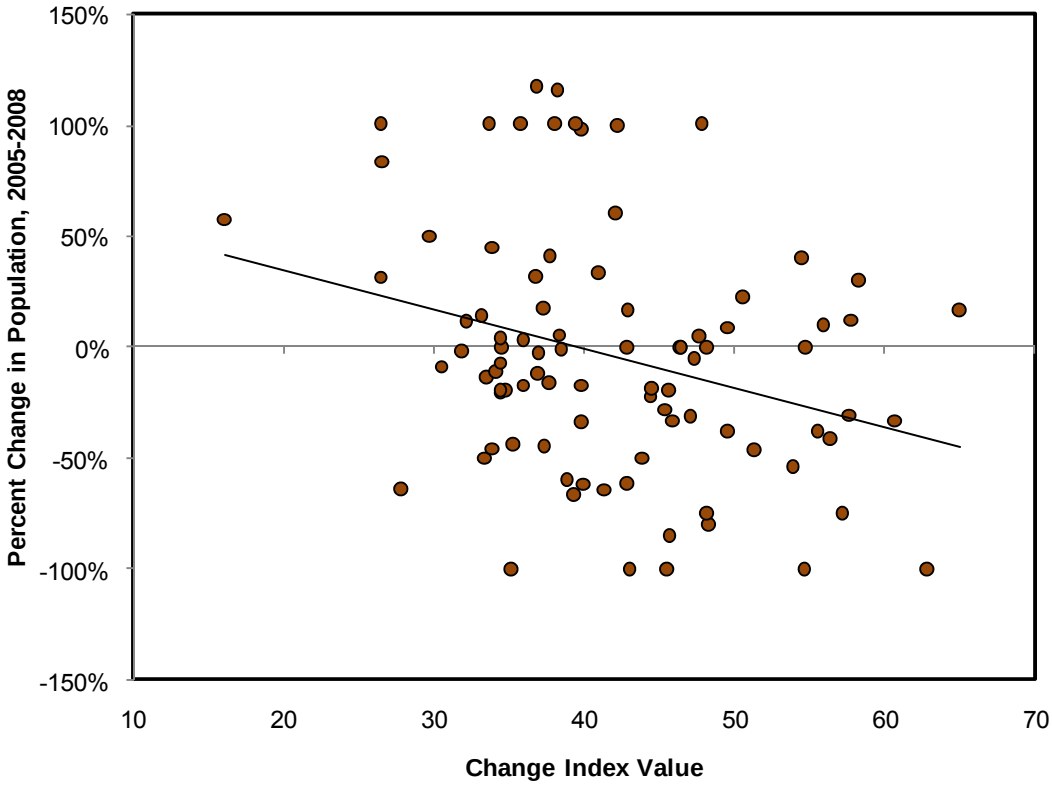
Table 6.1

Indicator Species Correlations and Regressions						
Species	**Analysis Type**	**N (routes)**	**# of sightings in 2005**	**# of sightings in 2008**	**Increase in Corn Plantings as % of County Area**	**Change Index Value**
Dickcissel	All 4 states	56	1009	609	R^2 = .006 p=.47	R^2 = .006 p=.575
	PPR only	32	435	236	R^2 = .097 p=.078	R^2 = .121 p=.032*
Grasshopper Sparrow	All 4 states	63	772	536	R^2 = 0 p=.947	R^2 = .005 p=.812
	PPR Only	32	300	246	R^2 = 0 p=.412	R^2 = .013 p=.171
Sedge Wren	All 4 States	67	658	341	R^2 = .014 p=.298	R^2 = .011 p=.665
	PPR Only	43	430	257	R^2 = .023 p=.239	R^2 = .005 p=.610
Upland Sandpiper	All 4 States	54	463	462	R^2 =.041 p=.058	R^2 =.049 p=.063
	PPR Only	33	224	226	R^2 =.001 p=.77	R^2 =.022 p=.29
Western Meadowlark	All 4 states	87	6384	6214	R^2 = .117 p=.010*	R^2 = .089 p=.012*
	PPR Only	51	2482	2442	R^2 = .110 p=.128	R^2 = .10 p=.080

Dickcissel population change was significantly correlated with the Habitat Change Index values in the PPR. On routes with higher Habitat Change Index scores, Dickcissels were more likely to have population losses (R^2 = .121, p=.032). In other words, 12.1% of the variability in Dickcissel population changes along BBS routes in the PPR between 2005 and 2008 can be explained by the Habitat Change Index values for the routes.

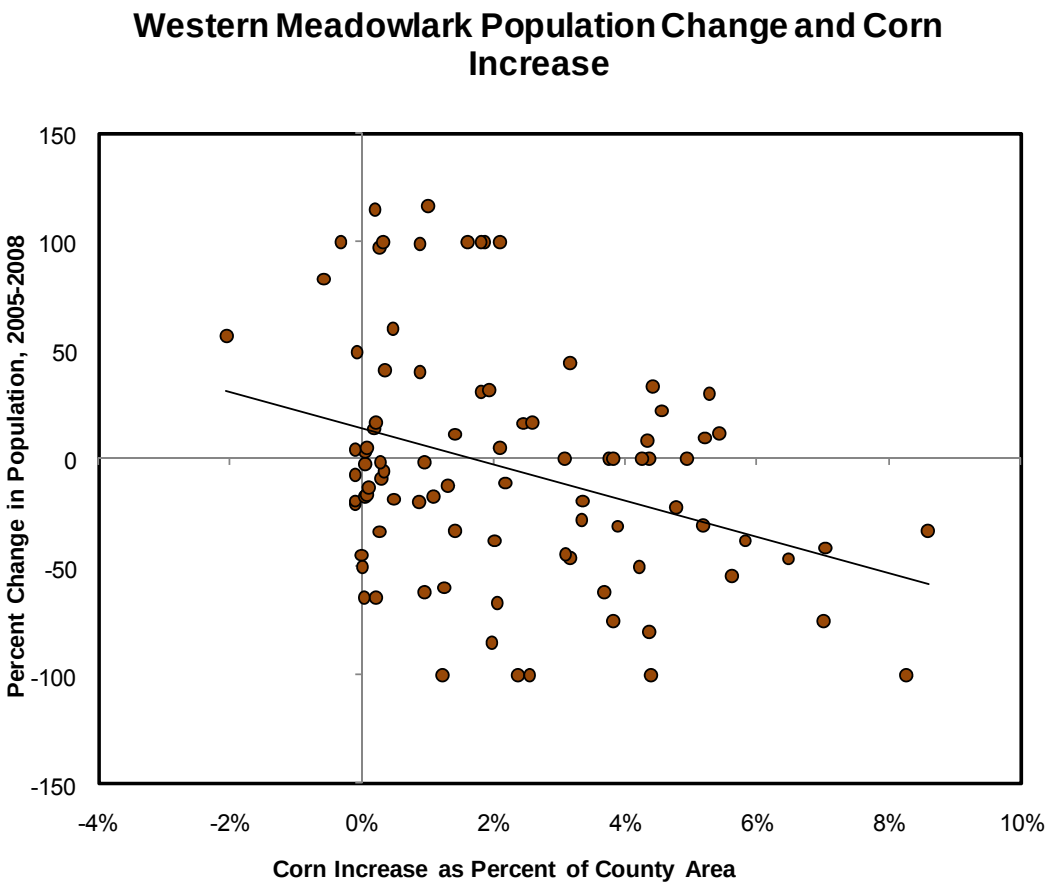
Western Meadowlarks also showed a significant correlation with the Habitat Change Index value (R^2 = .089, p=.012; Figure 6.10). These results were significant for the four-state region, but did not quite achieve statistical significance for the PPR area, presumably due to smaller sample size. The increase in corn plantings as percent of county area was also a significant predictor of Western Meadowlark population change between 2005 and 2008 (R^2 = .117, p=.01; Figure 6.11). In other words, 11.7% of the variability in Western Meadowlark population changes between 2005 and 2008 on BBS routes in the four-state study region can be explained by increases in corn acreage.

Figure 6.10



R^2 = 0.09, p=.012 (calculated using Spearman correlation), n=87. Three routes with population increases of 200% or greater were considered outliers and removed. Routes that decreased to 0 birds in 2008 were considered to have a 100% decline, and routes that increased from 0 in 2005 were considered to have a 100% increase.

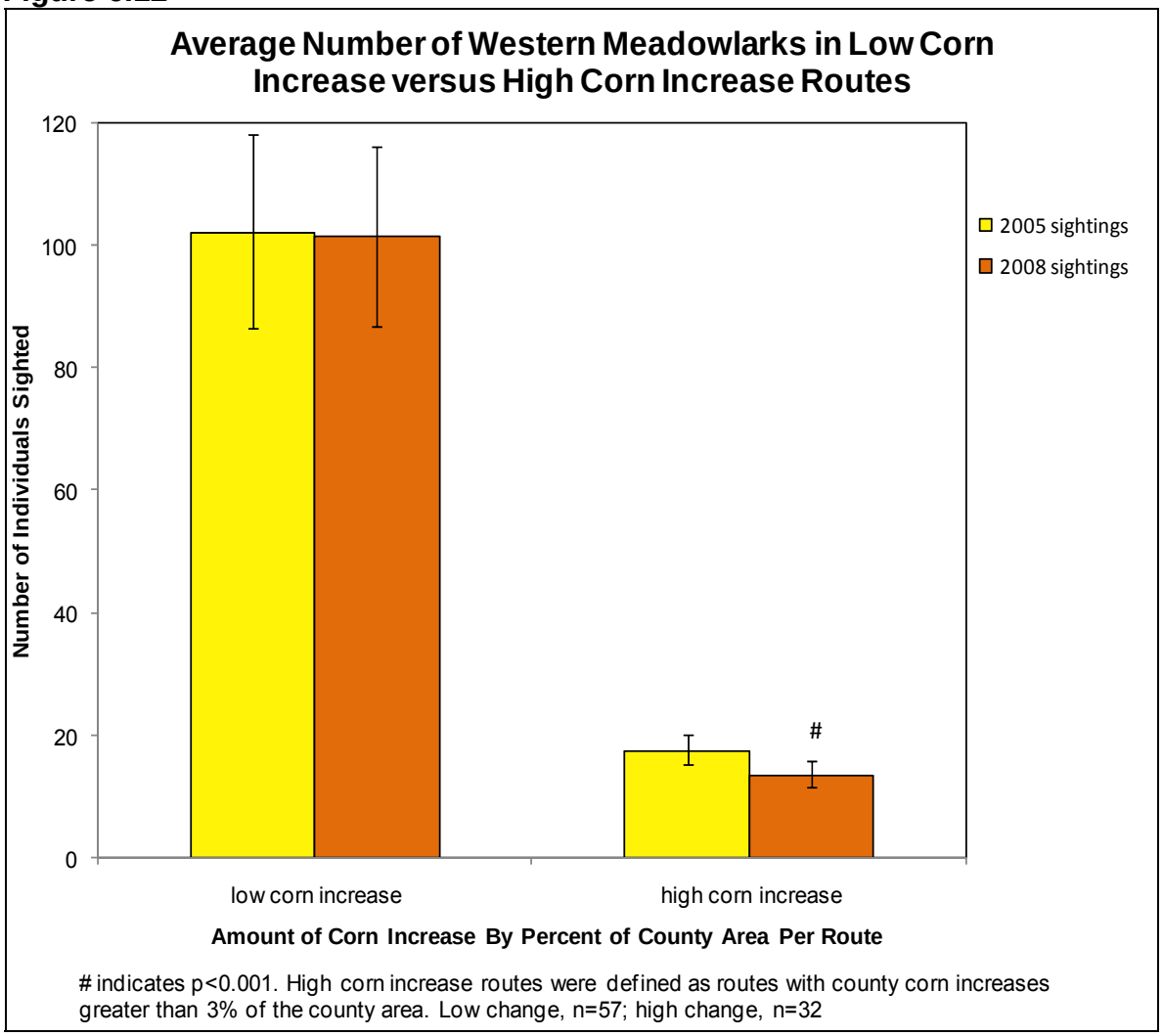
Figure 6.11



$R^2 = 0.12$, p=.010 (calculated using Spearman correlation), n=87. Three routes with population increases of 200% or greater were considered outliers and removed. Routes that decreased to 0 birds in 2008 were considered to have a 100% decline, and routes that increased from 0 in 2005 were considered to have a 100% increase.

To further understand this correlation between Western Meadowlark population change and corn increase, we ran a paired t-test on the change in average number of Western Meadowlarks on low corn increase and high corn increase routes between 2005 and 2008 (Figure 6.12). We found that the average number of Western Meadowlarks counted on high corn increase routes significantly decreased between 2005 and 2008. There was no significant difference in Meadowlark counts on the low corn increase routes over this same period. The average number of Western Meadowlarks on routes in areas with high corn increase was found to decline significantly from 17.5 birds per route to 13.4 birds per route between 2005 and 2008 ($p=0.0005$, Figure 6.12). This change represents a decrease of 23% on high corn increase routes, compared to a non-significant decrease of less than 1% on low corn increase routes. The 23% decline in Western Meadowlarks is similar to the overall decline in indicator species (28.7%) on high corn increase routes.

Figure 6.12



# indicates $p<0.001$. High corn increase routes were defined as routes with county corn increases greater than 3% of the county area. Low change, n=57; high change, n=32

Similar to the trends exhibited by the indicator species, there was a striking difference between Western Meadowlark counts in the low corn increase routes and the high corn increase routes ($p<0.001$ for both 2005 and 2008). This may be a reflection of the amount of available habitat in the area surrounding the routes; counties with high corn increase may have had previously high levels of agriculture and therefore provided less suitable habitat for Western Meadowlarks.

Conclusions

Using both a macro- and a micro-level approach, our results demonstrate that areas of high corn increase and high Habitat Change (as defined by changes in corn plantings and CRP enrollment) have marked decreases in both the number of sensitive grassland species and the number of sensitive grassland individuals. Our five indicator species (Dickcissels, Grasshopper Sparrows, Sedge Wrens, Upland Sandpipers, and Western Meadowlarks) appear to be especially sensitive to the loss and degradation of habitat driven by increasing corn production and losses in CRP. The number of indicator individuals was shown to have dropped by almost 30% between 2005 and 2008 on high corn increase and high Habitat Change Index routes. Our five control species (American Crows, American Robins, Bank Swallows, Brown-headed Cowbirds, and Mourning Doves) showed no changes in that time period on these same high corn increase and high Habitat Change Index routes, indicating that this is not a trend across all bird species, only obligate grassland breeding species.

Our micro-level approach yielded significant results for only two of the five indicator species, the Western Meadowlark and the Dickcissel. The Western Meadowlark was found to have declined 23% on high corn increase routes between 2005 and 2008. Although we did not find significant results for the other three species, we did see insignificant declines for many of the analyses that we ran. The lack of significance is probably attributable to the high variability in BBS data and low sample sizes for rarer species, not because other indicator species are unaffected by corn increases and changes in CRP enrollment.

Discussion

In addition to meeting our data and habitat criteria for analysis, four of the five indicator species we chose (Dickcissels, Grasshopper Sparrows, Sedge Wrens, and Upland Sandpipers) are species of conservation concern in three of our four study states (Iowa, Minnesota, and North Dakota). Western Meadowlarks are not considered species of conservation concern in our study states, as they are a fairly common species with a distribution that is larger than many of the other species. Table 6.1 shows that in our four study states, Western Meadowlarks were sighted in much greater quantities than the other indicator species. This larger sample size may be one of the reasons we were able to detect significant trends in the Western Meadowlarks but not the other species.

A study of grassland bird species done by the U.S. Geological Survey's Northern Prairie Wildlife Research Center looking at the importance of CRP to grassland breeding birds in North Dakota predicted that if all the land in CRP in the state were converted back to cropland, grassland birds

would face significant declines.[220] Specifically, they predicted that Sedge Wrens would be reduced by 25.8%, Grasshopper Sparrows would be reduced by 20.5%, and Dickcissels would be reduced by about 17.1%. Indeed, these predicted declines are within the range of declines that we reported seeing on high Habitat Change and high corn increase routes in North Dakota and our other three study states.

Our analysis used 2005 and 2008 Breeding Bird Survey data to quantify changes in wildlife populations. However, 2008 was the first year that dramatic losses in CRP occurred in our focal states, and these losses have continued into 2009. The 2008 BBS data reflected habitat losses in 2007, but losses that began in 2008 were generally not reflected in the BBS data. This is because habitat losses in one year affect the population in the subsequent year. As such, our analysis did not reflect changes in bird populations due to the dramatic losses of CRP land that began in 2008. The effects of these losses are only beginning to be felt in grassland bird populations. Therefore, the actual declines may be even greater than we found.

In order to conduct statistical analyses, our study includes only indicator species that were common enough to be detected at least 500 times on at least 40 routes in either 2005 or 2008. There are many sensitive obligate grassland breeders that did not meet these criteria because they are rarer or more difficult to detect using the BBS. Although we did not have data to analyze the population trends of these species, such species may be facing the same declines in areas of high habitat change and high increases in corn plantings. Other obligate species in our four state study region include Le Conte's Sparrow, Baird's Sparrow, the Greater Prairie Chicken, and Sprague's Pipit. These are all species of conservation concern in most, if not all, of our study states. Furthermore, some are state threatened or endangered species, such as Baird's Sparrow, which is endangered in Minnesota.

While our study only investigated trends in five grassland bird species, the results carry implications for other wildlife. Birds are mobile and can shift habitats if an area becomes unsuitable, and therefore they are somewhat protected from local land-use changes. The significant declines we detected in grassland bird populations suggest that less mobile species such as mammals, amphibians, and plants may feel these impacts even more acutely.

Grassland birds are among the fastest and most consistently declining birds in North America. In light of the severity of the situation for grassland bird populations, the finding that corn expansion may be further contributing to the decline of grassland birds is especially relevant and concerning. With losses of sensitive species between 2005 and 2008 as great as almost 30% in areas with high corn increases and high habitat change, continued increases in corn expansion will likely continue to cause detrimental effects on sensitive grassland species.

Chapter 7: Iowa State Profile

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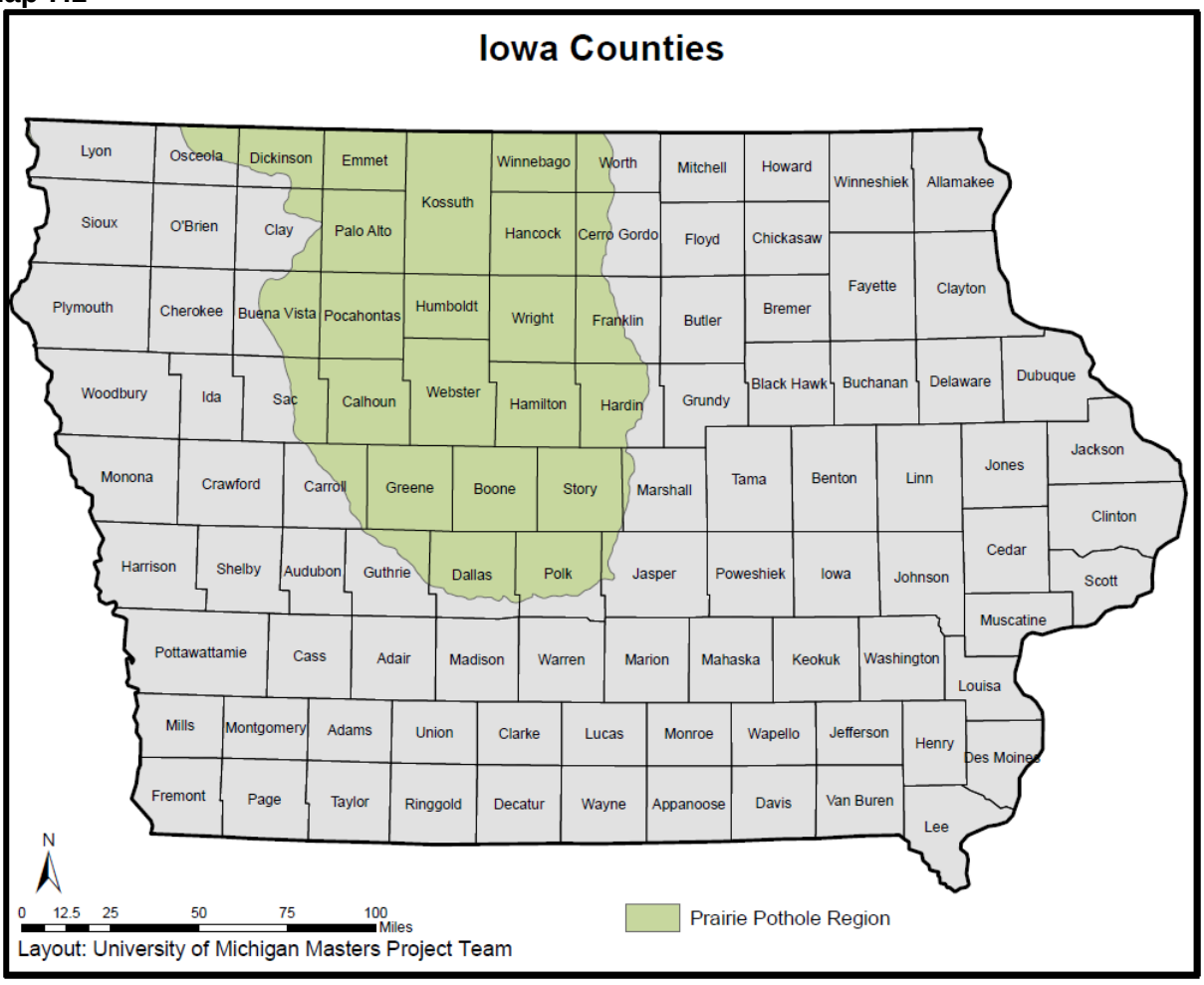
Corn Field in Iowa's Loess Hills
Photo: U.S. Geological Survey Bureau and Iowa Department of Natural Resources.

Map 7.1


Iowa Counties
Lyon
Osceola
Dickinson
Emmet
Kossuth
Winnebago
Worth
Mitchell
Howard
Winneshiek
Allamakee
Sioux
O'Brien
Clay
Palo Alto
Hancock
Cerro Gordo
Floyd
Chickasaw
Fayette
Clayton
Plymouth
Cherokee
Buena Vista
Pocahontas
Humboldt
Wright
Franklin
Butler
Bremer
Woodbury
Ida
Sac
Calhoun
Webster
Hamilton
Hardin
Grundy
Black Hawk
Buchanan
Delaware
Dubuque
Monona
Crawford
Carroll
Greene
Boone
Story
Marshall
Tama
Benton
Linn
Jones
Jackson
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Harrison
Shelby
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Guthrie
Dallas
Polk
Jasper
Poweshiek
Iowa
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Cedar
Scott
Muscatine
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Adair
Madison
Warren
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Mahaska
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Louisa
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Montgomery
Adams
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Clarke
Lucas
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Ringgold
Decatur
Wayne
Appanoose
Davis
Van Buren
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0 12.5 25 50 75 100
Miles
Prairie Pothole Region
Layout: University of Michigan Masters Project Team

Chapter 7

Iowa State Profile

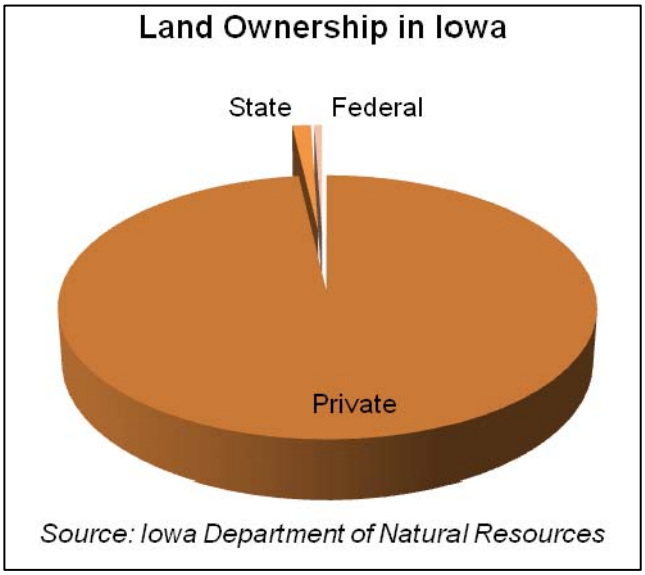
Iowa produces more corn than any other state in the country. It also has the most state-level incentives for corn ethanol in the United States[221] and produces a quarter of the nation's corn ethanol. To accommodate agricultural expansion, the state's landscape has changed dramatically from pre-settlement times. Over the 200-year period from 1780 to 1980, Iowa lost 89% of its wetlands.[222] In the 1850s, 69% of Iowa's land cover (23 million acres) was native tallgrass prairie. One hundred fifty years later, less than 0.1% of the state's native prairie (30,000 acres) remains.[223] The practitioners we interviewed throughout the state readily pointed to increases in corn price as the main driver of increased corn plantings, but were more hesitant to single out corn ethanol as the sole cause of corn price inflation. Nonetheless, most practitioners described corn ethanol as a threat to habitat because it creates additional pressure to convert the wetlands, pastureland, and Conservation Reserve Program (CRP) lands that support Iowa's wetland and prairie wildlife. Because Iowa already has so little habitat, practitioners were particularly concerned by recent declines in CRP enrollment. The success of Iowa NGOs in acquiring land or facilitating donations for permanent protection is particularly important in the face of CRP losses in the state. These acquisition efforts are aided by state tax incentives for conserving land. Practitioners also expressed concern about deteriorating water quality from pesticide and fertilizer runoff as wetlands and pasture are converted to cropland.

The following chapter discusses Iowa's land use, ethanol industry and incentives, the status of habitat and wildlife issues, the threats posed by ethanol expansion, and the conservation successes and challenges described by Iowa practitioners.

Land Ownership and Usage

Over 98% of Iowa's 35.8 million acres (56,272 square miles) are held by private landowners. Only Kansas has a higher percentage of its total area in private land.[224] About 1.8% of Iowa's total land area is public, with 0.54% (195,000 acres) owned by the federal government and 1.3% (456,000 acres) owned by the state or counties (Figure 7.1).[225]

Figure 7.1



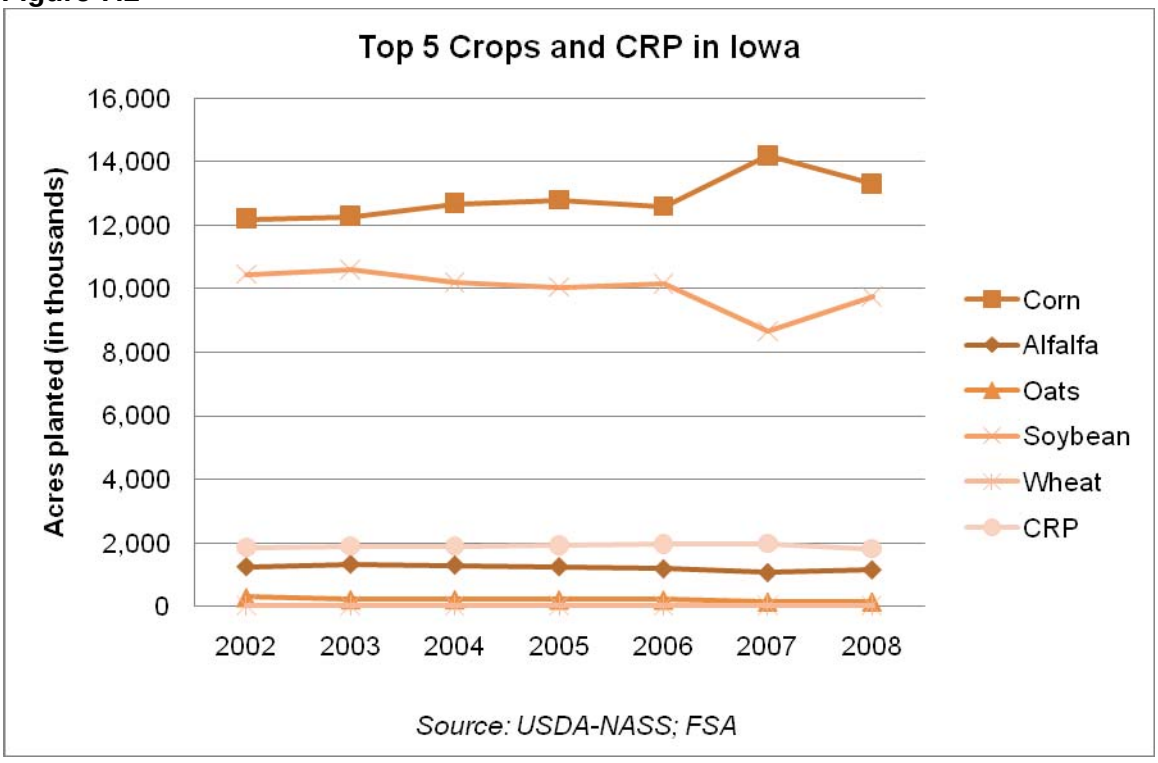
The U.S. Fish and Wildlife Service (USFWS) manages seven National Wildlife Refuges and one Wetland Management District in Iowa, totaling about 100,000 acres.[226] Two of these National Wildlife Refuges—De Soto and Neal Smith—are on the USFWS's list of Important Bird Areas.[227] The vast majority of Iowa's

remaining federal land resides in four flood control reservoirs that are owned by the U.S. Army Corps of Engineers.[228] The federal government manages, but does not own, another 57,000 acres of conservation land through Wetland Reserve Program (WRP) easements.[229]

Most of the 456,000 acres owned by the state and counties are preserved for habitat or recreation purposes. The Iowa Department of Natural Resources (DNR) has 322,000 acres in state-protected preserves, state forests, and Wildlife Management Areas.[230] County conservation boards own an additional 134,000 acres across the state.[231] Over 85,000 additional acres of land in Iowa are protected through the eight land trusts that operate in the state. These land trusts own a total of 12,400 acres and protect another 75,300 acres through easements or other protection measures.

In 2007, 86% (30.7 million acres) of Iowa's total land was in farms. Of this farmland, 85.6%, or 26.3 million acres, was cropland. Another 6.2% (1.92 million acres) was pasture, and the remaining 8.2%, 2.51 million acres, was in other uses. The five field crops with the most acreage planted in Iowa are corn, soybeans, alfalfa, oats, and wheat (Figure 7.2). In 2007, these crops made up 54.0%, 32.9%, 4.3%, 0.55%, and 0.13%, respectively, of Iowa's total cropland.[232]

Figure 7.2



Iowa experienced a steady increase in total acreage enrolled in CRP between 2000 and 2007. Total CRP enrollment in the state increased from 1.60 million acres in 2000 to 1.97 million acres in 2007. As in the other states in our study area, this trend reversed in 2008, with enrollment falling to 1.81 million acres in FY 2008. By January 2009, Iowa's CRP enrollment had fallen to 1.70 million acres.[233]

Corn Ethanol Industry

Iowa's corn ethanol production capacity has grown steadily over the past three decades, making Iowa a national leader in the ethanol industry. In early 2009, Iowa accounted for 23% of the nation's ethanol capacity.[234] There are 41 refineries in the state, 11 of which are not currently operating. Of the 11 non-operational plants, 5 are owned by the recently bankrupt VeraSun (Table 7.1).[235]

In 2006, 25% of the state's corn harvest (550 million bushels) was processed into ethanol.[236] By 2008, this had increased to 863 million bushels or 35% of the harvested corn crop.[237] The United States as a whole put 17% of its corn crop toward ethanol production in 2008.[238]

Iowa is ranked 9th in the nation for ethanol consumption, with 128 million gallons of pure ethanol used in 2005, and 1.2 billion gallons of E10 and E85 blends used in 2007.[239] Ethanol is now mixed into 78% of all fuel sold in the state. As of September of 2007, Iowa had approximately 95,000 flex-fuel vehicles on the roads.[240] The state also ranked fourth in the nation in availability of E85 at fueling stations, with 71 stations carrying the blend.[241]

Table 7.1

Iowa Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[r]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[s]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
Absolute Energy, LLC	Y	St. Ansgar	100	100	37.0	302.3	0
Amaizing Energy, LLC	Y	Atlantic	110	Not Operating	N/A	N/A	0
Amaizing Energy, LLC	Y	Denison	48	48	17.8	145.1	0
Archer Daniels Midland	N	Cedar Rapids	Unknown	Not Operating	N/A	N/A	0
Archer Daniels Midland	N	Clinton	Unknown	Not Operating	N/A	N/A	0
Big River Resources, LLC	Y	West Burlington	92	92	34.1	278.2	0
Cargill, Inc.	N	Eddyville	35	35	13.0	105.8	0
Corn, LP	Y	Goldfield	55	55	20.4	166.3	0
Global Ethanol/Midwest Grain Processors	N	Lakota	97	97	35.9	293.3	0

[r] mgy denotes million gallons per year of ethanol produced.
[s] Estimates are based on 1 bushel of corn yielding approximately 2.7 gallons of ethanol and 18 lbs of DDGS.

Table 7.1

Iowa Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[r]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[s]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
Golden Grain Energy, LLC	Y	Mason City	115	115	42.6	347.7	0
Grain Processing Corp.	N	Muscatine	20	20	7.4	60.5	0
Green Plains Renewable Energy	N	Shenandoah	55	55	20.4	166.3	0
Green Plains Renewable Energy	N	Superior	55	55	20.4	166.3	0
Hawkeye Renewables, LLC	N	Fairbank	120	120	44.4	362.8	0
Hawkeye Renewables, LLC	N	Iowa Falls	105	105	38.9	317.5	0
Hawkeye Renewables, LLC	N	Menlo	110	110	40.7	332.6	0
Hawkeye Renewables, LLC	N	Shell Rock	110	110	40.7	332.6	0
Homeland Energy	N	New Hampton	100	Not Operating	N/A	N/A	0
LDCommodities	N	Grand Junction	100	Not Operating	N/A	N/A	0
Lincolnway Energy, LLC	Y	Nevada	50	50	18.5	151.2	0
Little Sioux Corn Processors, LP	Y	Marcus	92	92	34.1	278.2	0
Penford Products	N	Cedar Rapids	45	45	16.7	136.1	0
Pine Lake Corn Processors, LLC	N	Steamboat Rock	30	30	11.1	90.7	0
Platinum Ethanol, LLC	Y	Arthur	110	110	40.7	332.6	0
Plymouth Ethanol, LLC	Y	Merrill	50	50	18.5	151.2	0
POET Biorefining	N	Ashton	56	56	20.7	169.3	0
POET Biorefining	N	Coon Rapids	54	54	20.0	163.3	0

Table 7.1

Iowa Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[r]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[s]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
POET Biorefining	N	Corning	65	65	24.1	196.5	0
POET Biorefining	N	Emmetsburg	55	55	20.4	166.3	0
POET Biorefining	N	Gowrie	69	69	25.6	208.6	0
POET Biorefining	N	Hanlontown	56	56	20.7	169.3	0
POET Biorefining	N	Jewell	69	69	25.6	208.6	0
Quad-County Corn Processors	Y	Galva	30	30	11.1	90.7	0
Siouxland Energy & Livestock Coop	Y	Sioux Center	60	60	22.2	181.4	0
Southwest Iowa Renewable Energy, LLC	Y	Council Bluffs	110	110	40.7	332.6	0
Tate & Lyle	N	Ft. Dodge	105	Not Operating	N/A	N/A	0
VeraSun Energy Corp.	N	Dyersville	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corporation	N	Albert City	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corporation	N	Charles City	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corporation	N	Ft. Dodge	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corporation	N	Hartley	Unknown	Not Operating	N/A	N/A	0
Xethanol BioFuels, LLC	N	Blairstown	5	5	1.9	15.1	0
Total			**2,538.0**	**2,123.0**	**786.3**	**6,418.7**	**0.0**

Source: Renewable Fuels Association, February 2009

The Iowa corn ethanol industry benefits from a large variety of federal and state incentives. Iowa has more state-level incentives for ethanol than any other state in the United States.[242] Figure 7.3 shows the combination of state and federal programs that drive demand for corn ethanol in Iowa. In addition, Table 7.2 describes the state-level laws and incentives and their funding levels.

Figure 7.3 System Diagram of Corn Ethanol Laws, Incentives, and Programs in Iowa

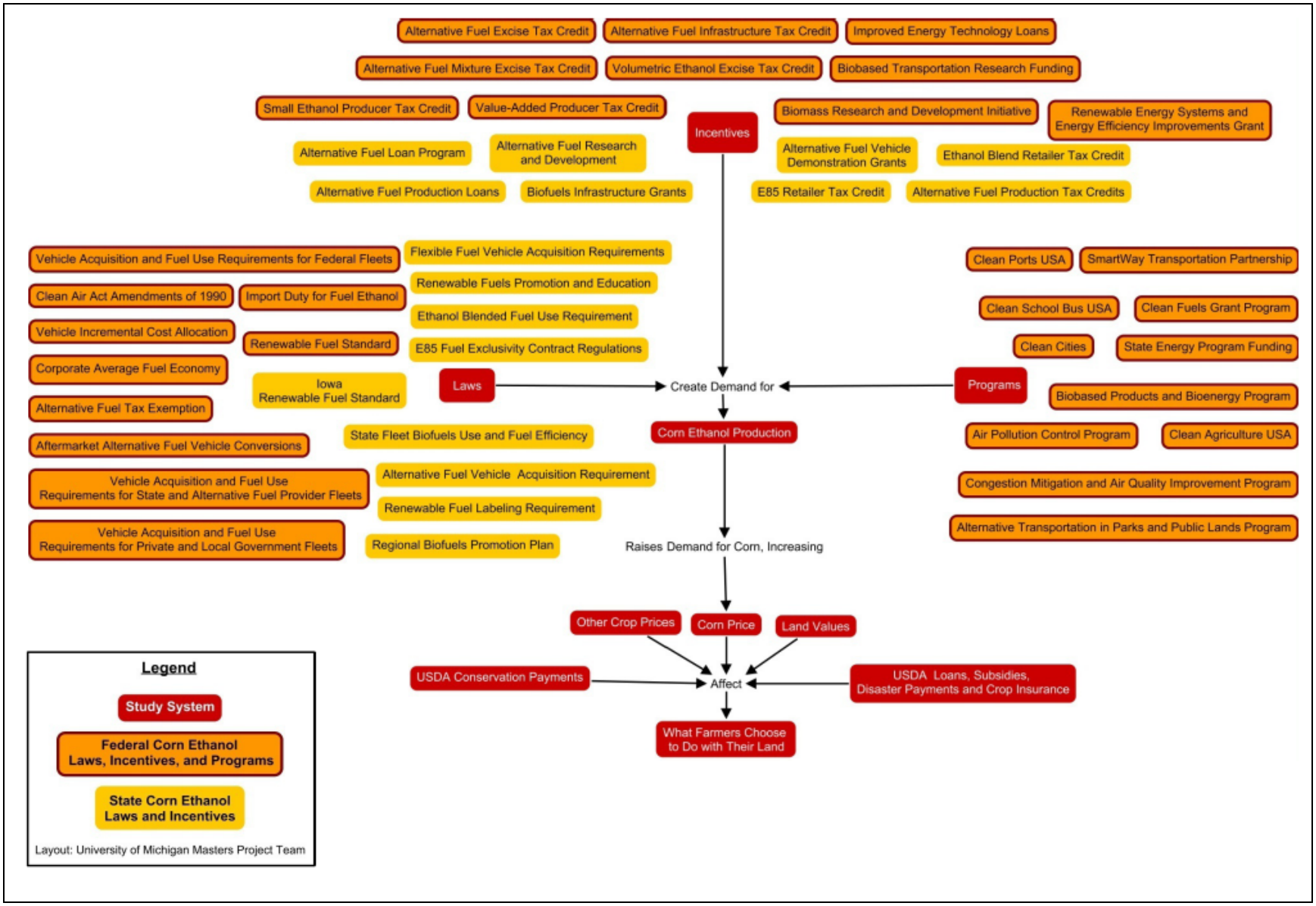


Table 7.2

Iowa Ethanol Incentives, Laws, and Regulations		
Name	**Description**	**Funding**
Ethanol Blend Retailer Tax Credit & Ethanol Promotion Tax Credit (Iowa Code 422.11C, 422.11N, and 422.33)	From 2006 to 2008, a tax credit of $0.025 per gallon existed for retail service stations at which more than 60% of gasoline sold was blended with ethanol. "Beginning January 1, 2009, an Ethanol Promotion Tax Credit replaced the retailer tax credit. Any retailer meeting the Iowa state Renewable Fuel Standard (RFS) schedule for a given year now receives a $0.065 tax credit. For retailers within 2% and 4% of meeting the RFS schedule, the tax credit is $0.045 and $0.025, respectively, for every gallon of ethanol sold." This incentive is in place until 2020.[243]	N/A
E85 Retailer Tax Credit (Iowa Code 422.11O)	"A tax credit is available to retail stations dispensing E85 for use in motor vehicles in the amount of $0.25 per gallon sold in calendar year 2008, $0.20 per gallon for calendar years 2009 and 2010, and $0.10 per gallon in calendar year 2011. After 2011, the tax credit decreases by $0.01 per year and expires after December 31, 2020. Taxpayers claiming the E85 tax credit may also claim the tax credit available for retail ethanol blends for the same tax year and same gallons of fuel." [244]	N/A
Biofuels Infrastructure Grants (Iowa Code 15G.203-15G.204)	The Renewable Fuel Infrastructure Program is a three year program started in 2006, with the goal of funding 30 E85 pumps and 4 biodiesel blending facilities. The program provides cost-share grants for retailers to upgrade or install new E85 or biodiesel infrastructure, up to 70% of the total cost of the project or $50,000, whichever is less. Applicants may also qualify for supplemental incentives to upgrade or replace an E85 fueling dispenser, up to 75% of the cost of making the improvement or $30,000, whichever is less. [245,246]	The program was allocated $13 million to spend between 2006 and 2009. 2006: Grants were made to 15 E85 retailers for E85 pumps and 2 biodiesel blending facilities. 2007: Grants were made to 13 retailers for E85 pumps and 1 biodiesel blender totaling more than $300,000.[247]
Alternative Fuel Vehicle Demonstration Grants (Iowa Code 214A.19)	"The Iowa DNR conducts marketing and education outreach to encourage the use of alternative fuels and, contingent upon funding, also awards demonstration grants to individuals who purchase vehicles that operate on alternative fuels, including, but not limited to, high ethanol content blends, compressed natural gas, electricity, solar energy, or hydrogen." [248]	Funded through the federal Clean Cities Program.

Table 7.2

Iowa Ethanol Incentives, Laws, and Regulations		
Name	**Description**	**Funding**
Alternative Fuel Loan Program (Iowa Code 476.46)	"The Alternate Energy Revolving Loan Program was established in 1996 for alternative energy projects and is administered by the Iowa Energy Center. Through a participation agreement with the project lender, the program provides up to half the cost of biomass or alternative fuels related fuel production projects, up to a maximum of $1 million per facility. The funds are provided at 0% interest with the lender's funds bearing market interest. Fuel production facilities must be located in Iowa." [249]	Initial funding of $5.9 million in 1996 came from the gross intrastate operating revenues of Iowa's investor-owned gas and electric utilities and resulted in a three-year assessment of alternative energy projects. Since that time, the program has provided loans of more than $11.4 million in support of 88 renewable energy projects having total construction costs of $145 million. Nineteen of the projects were for biomass.[250]
Alternative Fuel Production Loans	"The Value-Added Agricultural Products and Processes Financial Assistance Program offers a combination of forgivable and traditional low-interest loans for business projects involving the production of alternative fuels. The mixture of forgivable and low-interest loans varies according to the size of the award. Research and development projects are not eligible." [251] The program began in 1994 but it was not until 2004 that biomass and alternative energy projects were funded through this program." [252]	Since its inception in 1994, the program has committed over $56.6 million to 396 value-added agriculture businesses in Iowa.[253] Ethanol specific data not available.
Alternative Fuel Production Tax Credits (Iowa Code 469.9)	"The Enterprise Zone Program and the High Quality Job Creation Program offer state tax incentives to business projects for the production of biomass or alternative fuels. Depending on the program, incentives may include: an investment tax credit equal to a percentage of the qualifying investment, amortized over five years; a refund of state sales, service, or use taxes paid to contractors or subcontractors during construction; a doubling of the state's refundable research activities credit; additional funding for training new employees; and a local property tax exemption of up to 100% of the value added to the property." [254]	From July 1998 through December 2006, approximately $442 million in tax credits were awarded to businesses and housing developers through the Iowa Enterprise Zone Program. Businesses were awarded $348 million in return for obligations to create 11,116 jobs and make a total of $3.5 billion in capital investments.[255] Ethanol specific data not available.

Table 7.2

Iowa Ethanol Incentives, Laws, and Regulations			
Name	**Description**	**Funding**	
Alternative Fuel Research and Development (Iowa Code 469.9)	"The Iowa Power Fund, administered through the Office of Energy Independence, supports research, development, commercialization, and deployment of biofuels, renewable energy technologies, and energy efficiency technologies, while seeking to cut greenhouse gas emissions. The fund will educate the public about these technologies with the goal of increasing the demand for them. The $100 million fund will be run by an 18-member board, with oversight from a seven-member committee of legislative and university leaders." [256]	The fund was established in 2007 with an initial endowment of $100 million. To date, five biofuel projects have been funded: 1. Cellencor: $1.5 million commercial grant 2. POET: $9.75 million commercial grant 3. Novecta: $66.5 thousand R&D grant 4. REG: $740 thousand R&D grant 5. ISU Bioeconomy Con: $12.5 thousand grant.[257]	
Renewable Fuels Promotion and Education (House File 2689, 2008)	"The Iowa Office of Energy Independence is directed to develop a renewable fuels marketing plan to promote the state's biofuels industry and present it to the governor and the general assembly by March 15, 2009. The plan will include research efforts to identify barriers to increased use of renewable fuels, such as infrastructure limitations and consumer awareness. Additionally, the Office of Energy Independence conduct(ed) a direct marketing campaign to promote the use of ethanol and biodiesel blends, which was completed by December 15, 2008. As part of this campaign, they provided consumers with information including, but not limited to, fueling station locations, cold weather handling and use of biodiesel, and engine warranty statements." [258]	Not funded.	
E85 Fuel Exclusivity Contract Regulations (Iowa Code 323A)	"Any motor fuel franchise contract entered into or renewed on or after May 30, 2006, must allow for the delivery of E85 at any time demanded by the motor fuel dealer or allow the dealer to purchase E85 from another source. If a contract is already in effect on May 30, 2006, and does not have an expiration date, the franchisor must provide for the delivery of E85 at times demanded by the franchisee or allow the franchisee to purchase those volumes of E85 at those times from another source." [259]	N/A	
Renewable Fuel Standard (Iowa Code 422.11N)	"The goal of the Iowa Renewable Fuel Standard is to replace 25% of gasoline in the state with biofuels (ethanol or biodiesel) by January 1, 2020. One provision of the standard is to require retailers to sell a certain percentage of renewable fuels as part of	**Year:** **% Biofuel Use**	**Year:** **% Biofuel Use**
		2009: 10%	2014: 15%
		2010: 11%	2015: 17%

Table 7.2

Iowa Ethanol Incentives, Laws, and Regulations			
Name	**Description**	**Funding**	
	their total gasoline sales." [260]	2011: 12%	2016: 19%
		2012: 13%	2017: 21%
		2013: 14%	2018: 23%
Renewable Fuel Labeling Requirement (Iowa Code 214A.16)	"If motor vehicle fuel blended with a renewable fuel is sold from a motor vehicle fuel dispenser, the dispenser must have a decal affixed identifying the name of the renewable fuel." [261]	N/A	
Regional Biofuels Promotion Plan	Iowa, along with IN, KS, MI, MN, OH, SD, and WI has adopted the Energy Security and Climate Stewardship Platform Plan, with the following goals: "1. Produce commercially available cellulosic ethanol and other low-carbon fuels in the region by 2012. 2. Increase E85 availability at retail fueling stations in the region to 15% of stations by 2015, 20% by 2020, and 33% of all fueling stations in the region by 2025. 3. Reduce the amount of fossil fuel that is used in the production of biofuels by 50% by 2025; 4. By 2025, at least 50% of all transportation fuels consumed by the Midwest will be from regionally produced biofuels and other low-carbon transportation fuels." The Platform also establishes a regional biofuels corridor program…(which) directs state transportation, agriculture, and regulatory officials to develop a system of coordinated signage across the Midwest for biofuels and advanced transportation fuels. "[262]	Biofuels Corridor Funding: The U.S. Department of Energy gave $1.3 million in grant money to the Indiana Office of Energy and Defense Development, which is coordinating the project through the Clean Cities Program.[263]	
State Fleet Biofuels Use and Fuel Efficiency (Executive Order 6, 2008)	"As part of the Green Government Initiative, the Iowa Office of Energy Independence, Department of Administrative Services, Department of Natural Resources, and Department of Transportation will lead a Biofuels Task Force. The Biofuels Task Force is directed to focus on issues including: increasing the use of biofuels by state agencies to the maximum amount feasible; and increasing the fuel efficiency of the state's vehicle fleet." [264]	Not funded.	

Table 7.2

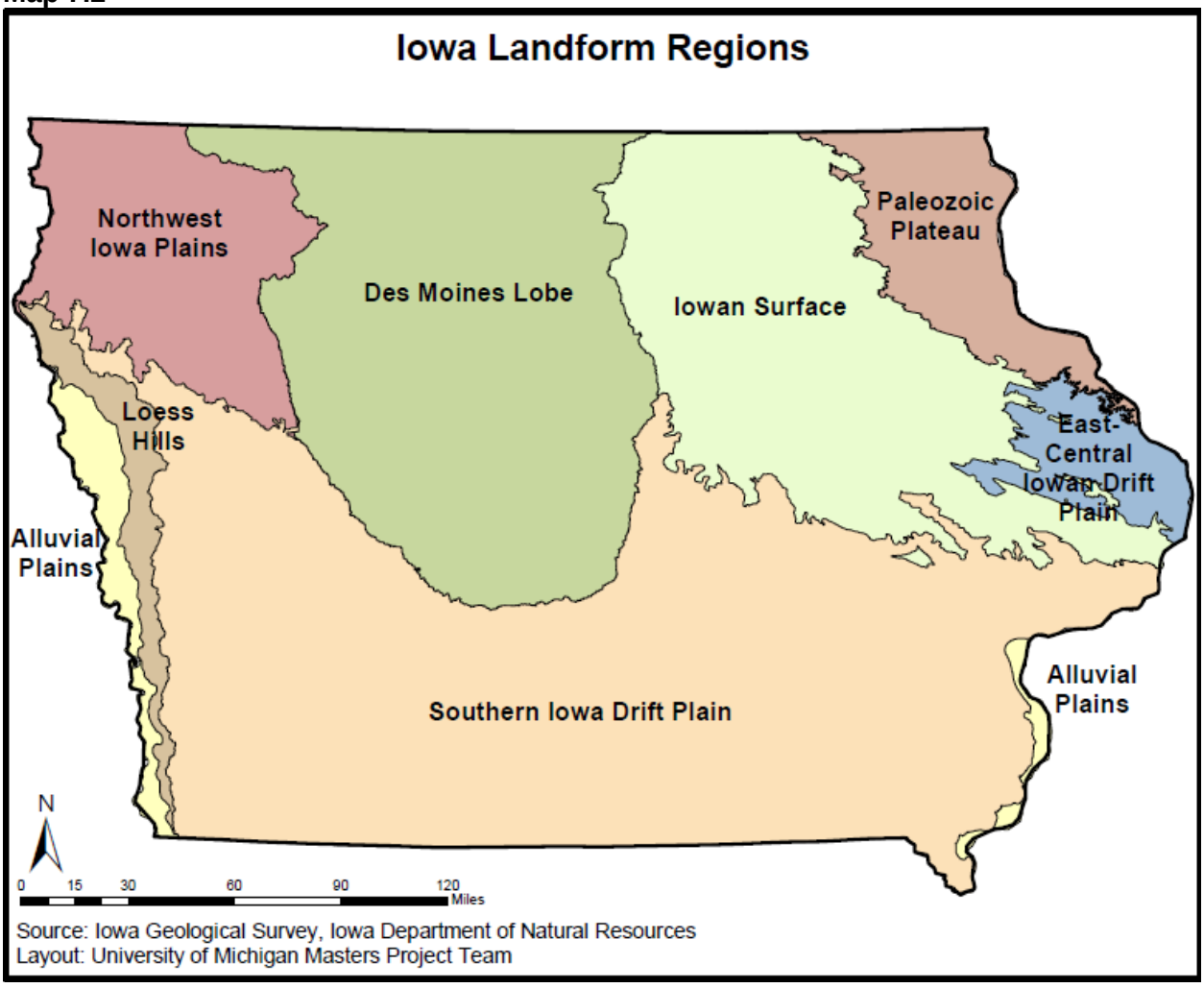
Iowa Ethanol Incentives, Laws, and Regulations		
Name	**Description**	**Funding**
Ethanol Blended Fuel Use Requirement (Iowa Code 8A.362)	"State fleet gasoline vehicles may not operate using fuel other than ethanol blended gasoline, unless under emergency circumstances. Vehicles must be affixed with a brightly visible sticker that notifies the public that the motor vehicle uses ethanol blended gasoline." [265]	N/A
Flexible Fuel Vehicle (FFV) Acquisition Requirements (Executive Order 3, 2007)	"By June 30, 2009, at least 60% of fuel purchased for use in the state's fleet of FFVs must be E85. A "State Government E85 Use Plan" must be created and detail how this fuel use goal will be met and how the state and retailers will work together to ensure that all E85 purchases are electronically coded and reported accurately." [266]	Not funded. The State Government E85 Use Plan was completed on December 31, 2007 with policy recommendations to reach the 60% goal.
Alternative Fuel Vehicle Acquisition Requirements (Iowa Code 216B.3, 260C.19A, 262.25A, 307.21 and 904.312A)	"A minimum of 10% of new light-duty vehicles purchased by institutions under the control of the state fleet administrator, Iowa Department of Transportation administrator, board of directors of community colleges, state board of regents, commission for the blind, and department of corrections must be capable of using alternative fuels. Vehicles and trucks purchased and directly used for law enforcement, off-road maintenance work, or to pull loaded trailers are exempt from this requirement."[267]	No information available.

Ecological Background

In the 1850s, 69% of Iowa (23 million acres) was covered in tallgrass prairie and 12% (4 million acres) was comprised of prairie potholes. As of 2005, less than 0.1% of Iowa's native prairie (30,000 acres) and 5% of its wetlands (422,000 acres) remain.[268] Most of this prairie is scattered in extremely small and fragmented plots throughout the state.

The Iowa State Wildlife Action Plan (SWAP), "Securing a Future for Fish and Wildlife: a Conservation Legacy for Iowans," identifies eight landform regions in the state, based on geology, soils, and land use (Map 7.2). The Des Moines Lobe landform region is the primary region that falls within the Prairie Pothole Region (PPR) in Iowa. While this region was once entirely made up of prairie potholes, most of the potholes within the Des Moines Lobe were drained with ditching and underground tile lines to make way for the massive agricultural expansion that the region experienced. According to the SWAP, around 89% of the Des Moines Lobe is comprised of agricultural land, 8% is wooded, 3% is remaining grassland, and only 2% is remaining wetlands.[269]

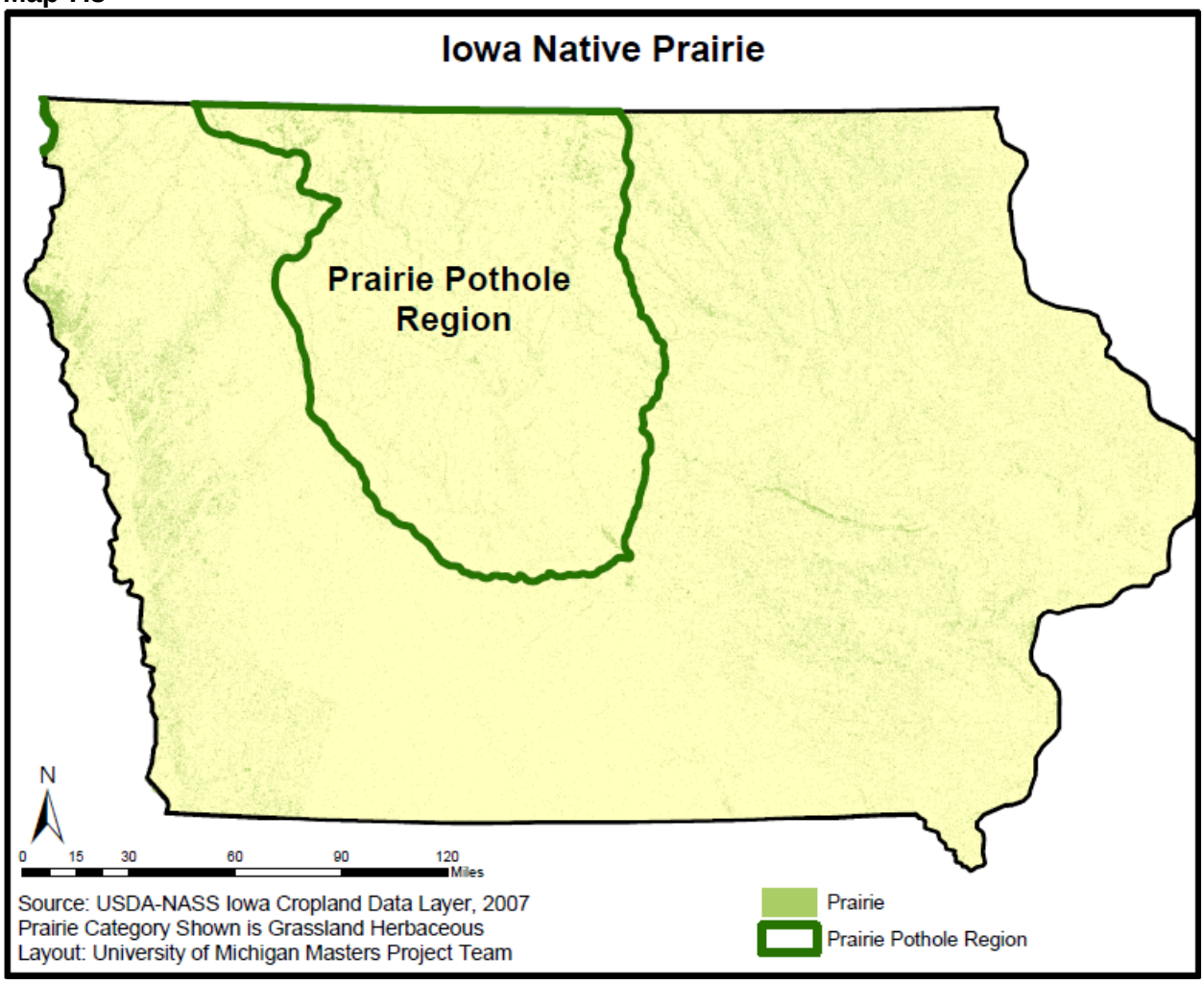
Map 7.2



Remaining Native Prairie

Map 7.3 shows an approximation of remaining native prairie in Iowa based on satellite data of herbaceous grassland. As shown in the map, very little of Iowa's landscape is still native prairie. What native prairie does remain is scattered throughout the state in small fragments. According to one practitioner in the state, most of these fragments are restored prairie, rather than undisturbed prairie remnants. Although Iowa lacks large swaths of native prairie to protect, state conservationists are still concerned about the potential for the conversion of remaining prairie fragments into cropland.

Map 7.3



Species of Conservation Concern

The SWAP examined almost 1,000 species in the state (comprising the majority of the state's wildlife) and found that nearly one third of these species need conservation to prevent them from declining further into threatened or endangered status. The plan identifies 297 species as "species in greatest conservation need." These species include 68 species of fish, 67 breeding birds, 31

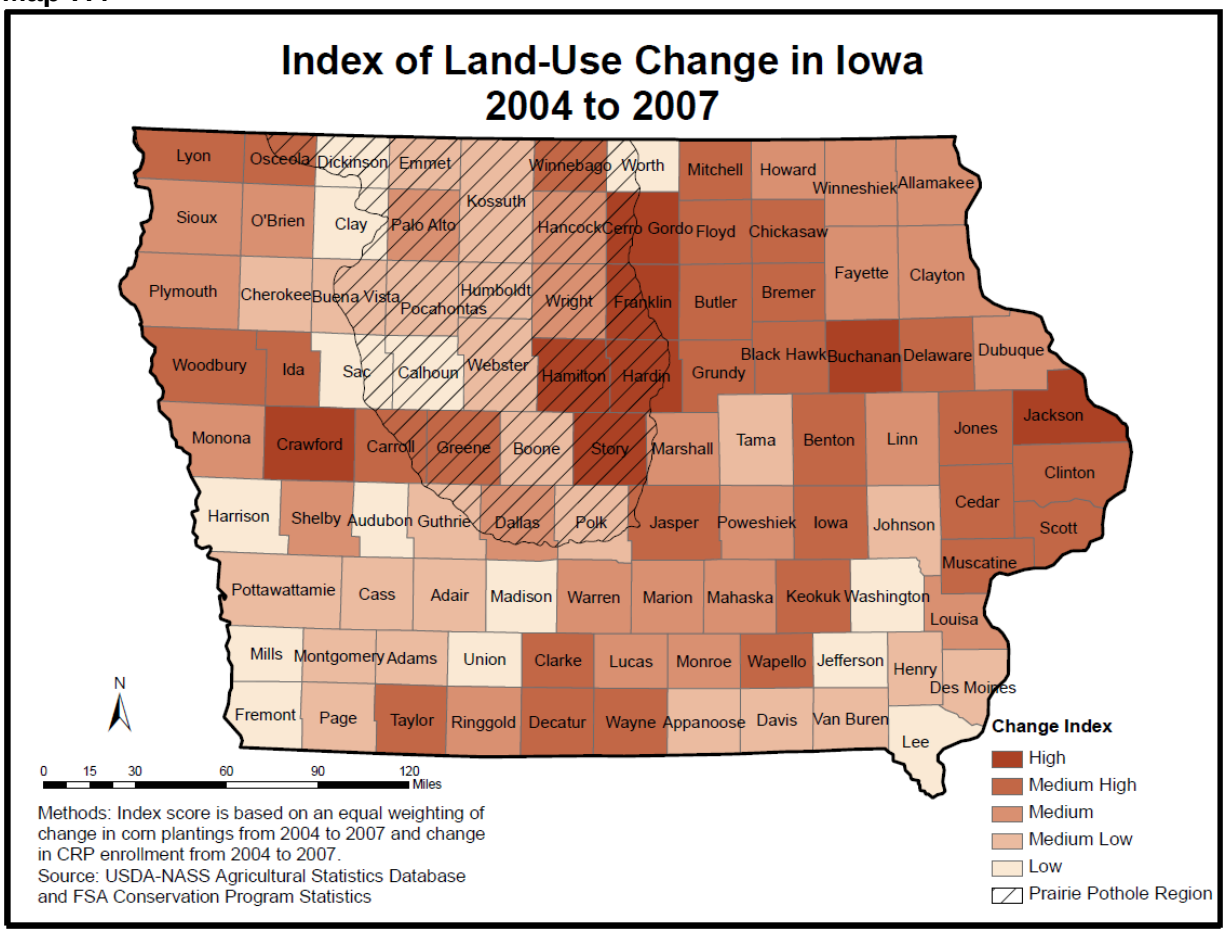
amphibians and reptiles, 30 butterflies, 29 mussels, 38 dragonflies and damselflies, 18 migratory birds, 18 mammals, and 8 land snails.

Some of the major threats to species of conservation concern in Iowa's remaining wetlands and prairies include: habitat loss due to conversion to row crops and draining of wetlands; habitat fragmentation and loss of connectivity; and habitat degradation through pesticide and fertilizer runoff. Grassland obligate species[t] such as prairie chickens, Sharp-tailed Grouse, Short-Eared Owls, and Bobolinks have very little remaining habitat in the state. In some areas in the state, the only grassland found is in roadside ditches, which may be suitable for grassland generalist species such as the redwing blackbird, but not the more sensitive obligate species.[270]

Land-Use Change Hotspot Analysis

In order to determine which areas of Iowa have experienced the most land-use change associated with corn expansion and therefore where habitat might be affected most, we undertook a GIS analysis of relevant land-use changes in the state (Map 7.4). Chapter 1 explains our methodology for calculating Iowa's land-use change index.

Map 7.4



[t] Obligate grassland breeders are species that require grassland habitat to successfully reproduce.

Our change analysis reveals that several high-change counties—Cerro Gordo, Franklin, Hamilton, Hardin, and Story—coincide with the PPR of Iowa. Most practitioners believed that the high index scores for these counties are due to increased corn plantings from crop-switching, and not from CRP acreage. CRP is predominantly in the southern portion of the state. Practitioners confirmed that pastureland is being converted to cropland throughout Iowa, although spatially explicit data are not available; therefore it is difficult to analyze the overlap of increased corn production and habitat conversion.

Effective Conservation Programs and Policies

Many of the policy and wildlife practitioners with whom we spoke explained that there is virtually no pristine habitat in Iowa, and what remains is highly fragmented. Furthermore, most grasslands and wetlands that serve as habitat are highly degraded. Understanding which conservation programs are working effectively will be critical in mitigating the effects of current and future land-use changes in the state. Both state and federal programs contribute to habitat preservation in Iowa. Tables 7.3, 7.4, and 7.5 describe the scope, impacts, and funding levels of federal and state conservation programs and policies in the state, and Figure 7.4 shows how they interact to conserve wildlife and habitat. Through discussions with policy and wildlife practitioners, several of these programs emerged as being the most effective. Chapter 1 contains a list of all organizations with staff interviewed for this report.

Land Retirement

CRP was described as the most far-reaching conservation program, providing the vast majority of habitat in the state. Respondents' comments were similar to sentiments found in published reports and studies on the benefits of CRP. For example, one publication on CRP quotes Richard Bishop, the Wildlife Division Chief at the Iowa DNR, as saying, "Quite simply the CRP is the largest and best wildlife conservation program ever implemented by USDA in Iowa."[271] In the 14 years prior to the implementation of CRP in the state, pheasant populations were declining at a rate of 2.6 birds per year per Breeding Bird Survey route. In the 14 years after CRP was implemented, pheasant populations were found to be increasing at a rate of 1.2 birds per year.[272] Upland game hunting in Iowa is a major source of income for the state, so CRP's impact on pheasants is highly important to the state's economy. The Iowa DNR estimates that, as of 2004, 3.8 million pheasants are produced on CRP land per year. Expiring and broken contracts will likely lead to significant losses in Iowa pheasant populations.

As in other states in the study area, CRP enrollment has declined sharply since 2007, and most interview respondents blamed low rental rates and lack of a general CRP sign-up.
One successful program under continuous CRP sign-up is the State Acres For wildlife Enhancement (SAFE) program. This program is designed to protect high-value wildlife species specific to each participating state or region.[273] Respondents noted that SAFE is increasing habitat and helping certain wildlife species in Iowa, and that demand for SAFE acres remains strong. One practitioner explained that the agency filled all of its allotted SAFE acres, enrolling 20,000 SAFE acres in one year. However, another practitioner explained that these gains do not compensate for the recent large losses in CRP. Multiple people interviewed for this study stated

that the limited number of acres under conservation was the greatest threat to wildlife in Iowa. Therefore, while small programs like SAFE and Conservation Reserve Enhancement Program (CREP) are clearly valuable for wildlife and habitat conservation, they are only partial solutions to an immense problem.

The Wetland Reserve Program currently protects about 80,000 acres in Iowa, and multiple practitioners noted that the program is very important to the PPR and its wildlife. One respondent believed that many more landowners would enroll in WRP if funding were available.

Technical and Cost-Share Assistance

Given the large amount of land in agricultural production in the state, technical assistance and cost-share programs are of particular importance in Iowa. One DNR practitioner explained that Iowa landowners have historically demonstrated an interest in protecting environmental quality, and that this interest remains strong today, particularly when the environmental impacts are felt by landowners. For example, heavy rainfall in 2008 caused substantial erosion and had a visible impact on water quality, renewing interest in programs like the Environmental Quality Incentives Program (EQIP). EQIP is both popular and effective, but one agency practitioner noted that the Natural Resources Conservation Service (NRCS) receives far more applications than it can accept at current funding levels.

Several respondents mentioned the benefits of the Conservation Stewardship Program (CSP), a voluntary working lands program administered by NRCS. CSP provides financial and technical assistance to promote protection of soil, water, air, and plant and animal life on agricultural lands.[274] In order to be eligible for CSP, landowners must be located within selected priority watersheds chosen by NRCS (see page 52 for full description of program).

Partnerships

Many respondents pointed to the importance of partnerships between public agencies and nonprofit groups. The Private Lands Program represents one such partnership. Maintained by the DNR Wildlife Bureau, the program's goal is to enroll private land in both state and federal conservation programs. In addition to providing technical assistance for wetland and grassland restoration, the program helps connect landowners to the federal programs for which they are eligible.[275] The Private Lands Program involves partnerships with NRCS, FSA, the Soil and Water Conservation Districts, Pheasants Forever, and The Nature Conservancy. The cooperation between DNR and NRCS is particularly important. Many of DNR's private land specialists (biologists) are housed in the NRCS offices. A DNR respondent noted the effectiveness of this "tight relationship" with NRCS, and likewise, an NRCS representative explained that working with DNR enabled them to have more specialists out in the field.

In some cases, DNR has partnered with nonprofit organizations to compensate for lack of public funding for programs. The Wildlife Diversity Program, which focuses on monitoring non-game wildlife species, providing small grants, training surveyors, and overseeing implementation of the SWAP, is funded primarily through voluntary donations of residents' tax refunds. According to the DNR website, "few other Midwestern states' 'non-game' programs are as poorly funded as

Iowa's."[276] To remain functional, DNR receives additional funding from Iowa State University, the Audubon Society, Pheasants Forever and others.[277]

Respondents also highlighted the effectiveness of Iowa nonprofits in acquiring land or facilitating donations for permanent protection. Groups active in land acquisition include Pheasants Forever, Ducks Unlimited, The Nature Conservancy, the county conservation board system, and the Iowa Natural Heritage Foundation (INHF). A representative of INHF explained that their success relies not only on the generosity of Iowa landowners but also on the extent to which the government incentivizes conservation through tax breaks. He believes that a new Iowa tax credit, passed in 2008, will boost donations and provide much-deserved rewards to landowners who are generous enough to donate land. INHF's website explains that tax credits are generally more valuable than tax deductions. Whereas a tax deduction reduces the amount of income to which tax rates are applied, the tax credit is a direct reduction of how much income tax a landowner pays. The new Iowa tax credit applies to 50% of the fair market value of the donated property interest, with a maximum tax credit of $100,000.[278]

Figure 7.4 System Diagram of Conservation Policies and Programs in Iowa

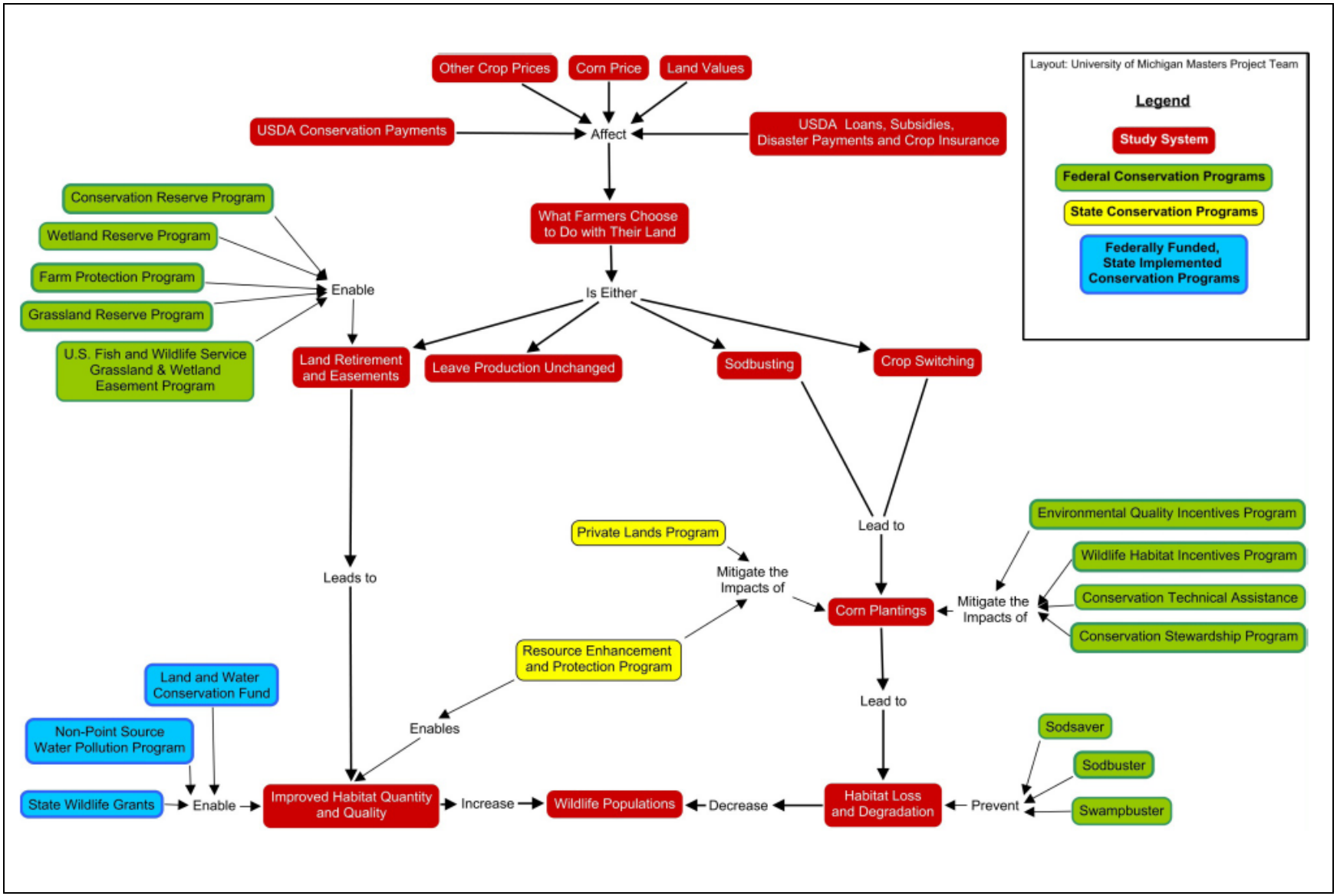


Table 7.3

Federally Funded and Implemented Programs in Iowa				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Conservation Reserve Program	FSA/NRCS	FY08	$201,954,095 in rental payments[279]	1,815,949 acres as of 9/08[280]
		FY07	$209,163,000 in rental payments[281]	1,970,486 acres as of 10/07[282]
		FY06	$206,318,000 in rental payments[283]	1,958,883 acres as of 10/06[284]
		FY05	$199,928,000 in rental payments[285]	1,917,479 acres as of 10/05[286]
Wetland Reserve Program	NRCS	FY07	$10,531,327 allocated to IA[287]	5,719 acres added[288]
		FY06	$11,460,232 allocated to IA[289]	3,534 acres added[290]
		FY05	$12,558,700 allocated to IA[291]	4,367 acres added[292]
Grassland Reserve Program	NRCS	FY07	Unknown	Unknown
		FY06	$0 obligated for contracts[293]	0 acres added[294]
		FY05	$1,422,576 obligated for contracts[295]	3,382 acres added[296]
Conservation Stewardship Program	NRCS	FY08	$727,831 approved by IA[297]	Unknown
		FY07	Unknown	Unknown
		FY06	$644,648 approved by IA[298]	35,523 acres added[299]
		FY05	$12,720,420 approved by IA[300]	678,641 acres added[301]
Wildlife Habitat Incentive Program	NRCS	FY08	$1,380,534 allocated to IA[302]	8,667 acres added[303]
		FY07	$406,763 allocated to IA[304]	1,774 acres added[305]
		FY06	Unknown	4,311 acres added[306]
		FY05	$440,181 allocated to IA[307]	3,130 acres added[308]
Environmental Quality Incentives Program	NRCS	FY07	$26,331,712 allocated to IA[309]	1,501 contracts added[310]
		FY06	Unknown	1,563 contracts added[311]
		FY05	$25,856,704 allocated to IA[312]	1,468 contracts added[313]
Technical Assistance	NRCS	FY07	$22,024,713 allocated to IA[314]	Unknown
		FY06	$24,916,985 allocated to IA[315]	Unknown
		FY05	$26,276,426 allocated to IA[316]	Unknown
Grassland Easement Program	USFWS	All	Unknown	Unknown

Table 7.4

Federally Funded and State Implemented Programs in Iowa				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Land and Water Conservation Fund	IA Department of Natural Resources	FY08	$306,053 apportioned to state[317]	No State Parks created[318]
		FY07	$370,704 apportioned to state[319]	3 State Parks created[320]
		FY06	$370,704 apportioned to state[321]	1 State Park created[322]
Non-Point Source Pollution Program	IA Department of Natural Resources; IA Department of Agriculture and Land Stewardship	All	The U.S. EPA has allocated roughly $4.6 million annually to the DNR to implement the NPS Program.[323] The DNR also partners with the NRCS, Conservation Districts, and Department of Agriculture to fund local watershed projects.[324]	44 Watershed Projects in 2008[325]
State Wildlife Grants	IA Department of Natural Resources	FY08	$761,278 allocated to state[326]	
		FY01-08 Annual Average	$763,744 allocated to state[327]	On-the-ground wildlife and habitat conservation, restoration, and mitigation.

Table 7.5

State Funded and Implemented Programs in Iowa				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Description**
Resource Enhancement and Protection Program (REAP)	IA Department of Natural Resources; Department of Agriculture and Land Stewardship; Department of Cultural Affairs, State Historical Society; Department of Transportation	FY09	$19,050,000[328]	REAP consists of eight sub-programs. Each year, the first $350,000 of funding goes toward conservation education. Twenty-eight percent of the balance is allocated for prairie, woodland, and other open space acquisition and development. Twenty percent is allocated for soil and water enhancement, 20 percent for county-level conservation efforts, 15 percent for city parks, 9 percent for DNR land management, 5 percent for the conservation of historical resources, and 3 percent for roadside vegetation.[329] REAP is funded with state gaming receipts and revenue generated from the sale of license plates. The state is authorized to spend $20 million annually on the Program through 2021.[330] According to the DNR, the Program "contains very extensive public participation procedures." There are county REAP committees in most counties, regional REAP assemblies, and a REAP congress.[331]
		FY08	$16,550,000[332]	
		FY07	$12,056,000[333]	
		FY06	$11,897,303[334]	
		FY05	$11,696,807[335]	
Private Lands Program	IA Department of Natural Resources	All	Unknown	Through outreach and financial and technical assistance, the Private Lands Program helps landowners implement conservation programs on their land. The program is made up of a number of sub-programs, such as the Shelterbelt Program, which provides up to 75 percent of the cost of establishing a tree- or shrub-based windbreak on private land.[336] The program also provides technical assistance to landowners wishing to restore wetlands and grasslands.[337] The program is managed by DNR management biologists, as well as five private lands biologists, five wildlife specialists, four AmeriCorps members, and five habitat specialists stationed in local NRCS offices.[338]

Conclusion

The Iowan landscape has long been dominated by corn agriculture, and state-level support for corn ethanol production has only increased the importance of corn to the state's economy. Corn acreage in the state increased 500,000 acres between 2005 and 2008; today, almost 37% of the state's total area is planted with corn. Because there is so little native habitat remaining in the state, even moderate agricultural expansion may have profound impacts on wildlife populations.

With little native prairie remaining and declining amounts of pastureland, CRP is especially important for conserving habitat for wildlife in Iowa. State practitioners agree that CRP is the most important conservation program in Iowa and that it has been particularly helpful in restoring populations of economically important game bird species. The effectiveness of the program in the state, however, is threatened by the recent reduction of the national CPR acreage cap and the fact that CRP rental rates are no longer competitive with corn prices. Practitioners emphasized the need to conserve remaining CRP land, noting that the program is an important source of revenue for both farmers and for the state, which benefits from hunting of pheasants on CRP land.

According to one DNR official, focus in recent years has shifted from general land retirement to practice-specific conservation and working lands programs. While continuous CRP sign-ups are valuable, they do not make up for losses of larger, contiguous blocks of habitat previously enrolled as general CRP acres. Working land programs such as EQIP were described as being critical to conservation efforts given the large amount of acreage in production. Demand for such programs outstrips availability of funds.

Despite large and growing threats to wildlife and habitat in the state, some public support for conservation does exist. Private funding and donations are particularly important to land conservation in Iowa. The Iowa DNR lacks adequate public funding, and is supported by voluntary tax refund donations, Iowa State University, the Audubon Society, and Pheasants Forever. Additional private conservation is incentivized by tax breaks for private citizens who donate land for conservation.

Chapter 8: Minnesota State Profile

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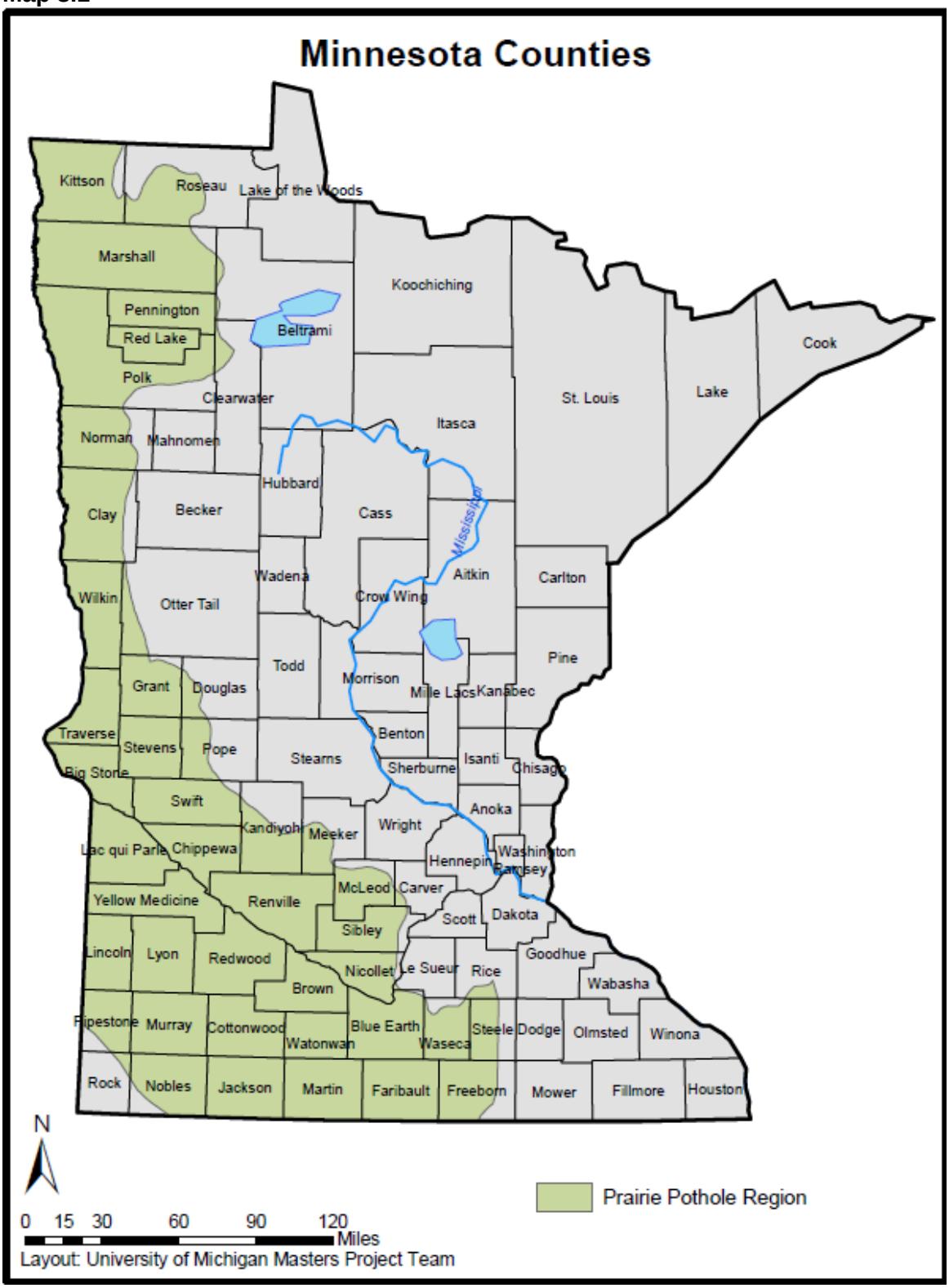
Restored Wetland at Glacial Ridge, MN Funded by the Wetland Reserve Program
Photo: Minnesota Natural Resources Conservation Service

Map 8.1


Minnesota Counties
Kittson
Roseau
Lake of the Woods
Marshall
Koochiching
Pennington
Red Lake
Beltrami
Cook
Polk
Clearwater
St. Louis
Lake
Norman
Mahnomen
Itasca
Hubbard
Clay
Becker
Cass
Mississippi
Wadena
Aitkin
Carlton
Wilkin
Otter Tail
Crow Wing
Pine
Todd
Morrison
Grant
Douglas
Mille Lacs
Kanabec
Traverse
Stevens
Pope
Benton
Stearns
Sherburne
Isanti
Chisago
Big Stone
Swift
Anoka
Kandiyohi
Meeker
Wright
Lac qui Parle
Chippewa
Hennepin
Washington
Ramsey
Yellow Medicine
Renville
McLeod
Carver
Scott
Dakota
Sibley
Lincoln
Lyon
Redwood
Nicollet
Le Sueur
Rice
Goodhue
Brown
Wabasha
Pipestone
Murray
Cottonwood
Watonwan
Blue Earth
Waseca
Steele
Dodge
Olmsted
Winona
Rock
Nobles
Jackson
Martin
Faribault
Freeborn
Mower
Fillmore
Houston
N
Prairie Pothole Region
0 15 30 60 90 120
Miles
Layout: University of Michigan Masters Project Team

Chapter 8

Minnesota State Profile

In 2008, Minnesota's ethanol refineries exceeded a production capacity of 800 million gallons of ethanol, requiring nearly 20.4 million acres of corn annually.[339] This high level of ethanol production has coincided with dramatic increases in corn plantings in the state. Practitioners disagree about the degree to which ethanol demand has directly threatened habitat and wildlife in Minnesota. Most conservation practitioners we interviewed acknowledged that the direct impact is difficult to quantify. However, they described ethanol as a threat to habitat because it creates additional pressure to convert wetlands, pastureland, Conservation Reserve Program (CRP) land, and the remaining fragments of native prairie that support Minnesota's wetland and prairie wildlife.

Habitat loss and wildlife declines are major concerns for conservation practitioners in Minnesota. CRP land is being lost at an alarming rate, wetlands are being degraded and drained, and the current status of Minnesota's remaining native prairie is dire by most standards. Prior to European settlement, more than 18 million acres of prairie land covered Minnesota, stretching from the northwest to the southeast of the state. As of 2008, fewer than 170,000 acres of prairie remain, with an estimated 56% of it not protected and therefore at risk of being lost.[340] Because so little native prairie remains, interview respondents describe CRP as critically important to sustaining wildlife populations. Although practitioners report wetland and prairie restoration has been successful in the state, increased demand for crop production threatens to undermine these efforts. Our interviews reveal that in the face of these threats, Minnesota residents, nonprofits, and agencies have demonstrated a strong commitment to land conservation. Innovative partnerships between federal, state, and nonprofit actors have made the most of tight funds. Most practitioners argue that the way to protect habitat from conversion to agriculture production, whether for biofuels or other crops, lies in making conservation an economically attractive option for landowners.

The following chapter discusses Minnesota's land use, ethanol industry and incentives, the status of habitat and wildlife issues, the threats posed by ethanol expansion, and the conservation successes and challenges described by Minnesota practitioners.

Land Ownership and Usage

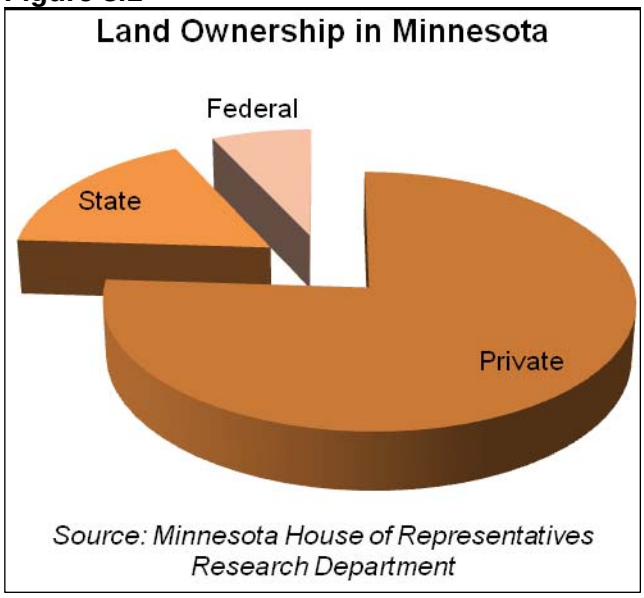
Minnesota contains approximately 51.2 million acres of land and 2.6 million acres of water. About 76% of the state's land is privately owned. The state government manages 17% (8.4 million acres) of Minnesota's land, and the federal government manages the other 7% (3.4 million acres) (Figure 8.1).[341]

The U.S. Department of Agriculture (USDA) Forest Service manages most of Minnesota's federal land. Almost all of this land is in Chippewa and Superior National Forests, in the northeastern portion of the state. The U.S. Fish and Wildlife Service (USFWS) manages roughly half a million acres in the state, consisting of 12 National Wildlife Refuges (214,000 acres) and 8 Wetland Management Districts (267,000 acres).[342]

The Minnesota Department of Natural Resources (DNR) manages over 90% of Minnesota's state land. Most of this land is state forest and is concentrated in the heavily forested northeastern region of the state.[343] The remaining state land is managed by state university systems, the state Department of Transportation, the Department of Military Affairs, the Department of Administration, and the Department of Human Services.

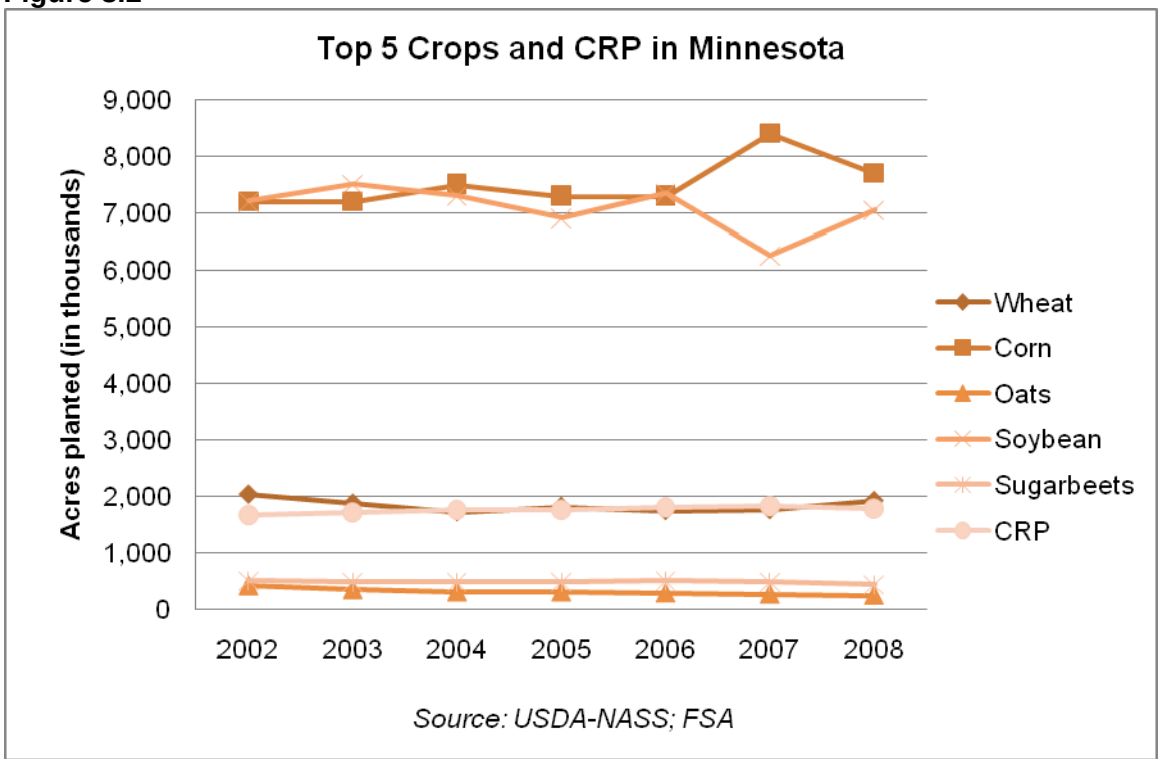
Minnesota has five land trusts, which own a total of 2,170 acres in the state. These land trusts protect an additional 24,500 acres via conservation easements.[344] The Minnesota Board of Water and Soil Resources (BWSR) holds additional conservation easements on private lands.[345] As of February 2009, over 75,000 acres were enrolled in BWSR's Reinvest in Minnesota program.[346]

Figure 8.1



A little over half of all Minnesota's land (26.9 million acres) is in farms. Of this farmland, 81.54% (21.9 million acres) is cropland, 6.92% (1.86 million acres) is woodland, 5.64% (1.52 million acres) is pasture, and 6.08% (16.4 million acres) is in other uses. The five field crops with the most planted acreage in Minnesota are corn, soybeans, wheat, sugarbeets, and oats. In 2007, these crops made up 33.3%, 28.5%, 8.0%, 2.2% and 1.2%, respectively, of all Minnesota cropland (Figure 8.2).[347]

Figure 8.2



Minnesota experienced an increase in the total number of acres enrolled in CRP between 2000 and 2007. Total CRP enrollment increased from 1.46 million acres in 2000 to 1.83 million acres in 2007. This trend reversed in 2008, but Minnesota's total CRP enrollment is still above 2000 levels. Total CRP enrollment fell to 1.78 million acres in FY 2008. By January of 2009, Minnesota's enrollment had fallen even further, to 1.69 million acres.[348]

Corn Ethanol Industry

Minnesota's ethanol industry came into existence largely because of the state's ethanol programs, particularly the direct per gallon production incentive for ethanol producers (Table 8.2), which was enacted in 1987.[349] Following the creation of this subsidy, Minnesota's first biorefinery came online in 1988. As in other states, the industry experienced steady growth throughout the 1990s. As of early 2009, there were 22 plants in the state, and Minnesota was 4th in the nation for ethanol production capacity (Table 8.1).[350] The production incentive enacted in 1987 is set to expire in 2010, and plants constructed after 2008 are not eligible for the program. An interview with a Department of Agriculture official clarified that it is unlikely that this incentive will be renewed.

The "Minnesota Model" of ethanol production is known around the world and refers to the state's strong support for small, farmer-owned ethanol refineries. Of the 22 refineries currently operating in Minnesota, 9 are locally owned.[351] In this cooperative model, farmers pledge to provide the refinery with a certain amount of corn each year. Ethanol ownership patterns in the

state have shifted in recent years as large agribusiness and other investors have entered the industry and as farmers have retired but not sold their shares in farmer cooperatives.

Minnesota is also a leader in ethanol consumption. In 2005, approximately 276 million gallons of ethanol were consumed in the state, placing Minnesota 4th in the nation.[352] Minnesota's consumption is catalyzed by a statewide mandate for 10% ethanol content in nearly all gasoline sold in the state. This mandate will increase to 20% ethanol content by August 30, 2013, provided that the federal government approves the use of E20 by the end of 2010.[353] High consumption of ethanol in Minnesota also reflects the large availability of E85 in the state. Minnesota leads the nation in number of E85 fueling stations, with 310 E85 fueling locations spread across the state.[354]

Table 8.1

Minnesota Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[u]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[v]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
Agri-Energy, LLC	Y	Luverne	21	21	7.8	63.5	0
Al-Corn Clean Fuel	Y	Claremont	42	42	15.6	127.0	0
Archer Daniels Midland	N	Marshall	Unknown	Not Operating	N/A	N/A	0
BioFuel Energy - Buffalo Lake Energy, LLC	N	Fairmont	115	115	42.6	347.7	0
Bushmills Ethanol, Inc.	Y	Atwater	50	50	18.5	151.2	0
Central MN Ethanol Coop	Y	Little Falls	21.5	21.5	8.0	65.0	0
Chippewa Valley Ethanol Co	Y	Benson	45	45	16.7	136.1	0
Corn Plus, LLP	Y	Winnebago	44	44	16.3	133.0	0
DENCO, LLC	N	Morris	24	Not Operating	N/A	N/A	0
Granite Falls Energy, LLC	Y	Granite Falls	52	52	19.3	157.2	0
Heartland Corn Products	Y	Winthrop	100	100	37.0	302.3	0

[u] mgy denotes million gallons per year of ethanol produced.
[v] Estimates are based on 1 bushel of corn yielding approximately 2.7 gallons of ethanol and 18 lbs of Dry Distillers Grains.

Table 8.1

Minnesota Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[u]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[v]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
Heron Lake BioEnergy, LLC	N	Heron Lake	50	50	18.5	151.2	0
Highwater Ethanol LLC	N	Lamberton	Unknown	Not Operating	N/A	N/A	50
Minnesota Energy	Y	Buffalo Lake	18	18	6.7	54.4	0
Otter Tail Ag Enterprises	N	Fergus Falls	57.5	57.5	21.3	173.8	0
POET Biorefining	N	Bingham Lake	35	35	13.0	105.8	0
POET Biorefining	N	Albert Lea	42	42	15.6	127.0	0
POET Biorefining	N	Lake Crystal	56	56	20.7	169.3	0
POET Biorefining	N	Preston	46	46	17.0	139.1	0
VeraSun Energy Corp.	N	Janesville	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corp.	N	Welcome	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corp.	N	Welcome	Unknown	Not Operating	N/A	N/A	0
Total			**819.0**	**795.0**	**294.4**	**2,403.6**	**50.0**

Source: Renewable Fuels Association, February 2009

The Minnesota corn ethanol industry benefits from a variety of federal and state incentives. Figure 8.3 shows the combination of state and federal programs that drive demand for corn ethanol in Minnesota. In addition, Table 8.2 describes the state-level programs and their funding levels.

Figure 8.3 System Diagram of Corn Ethanol Laws, Incentives, and Programs in Minnesota

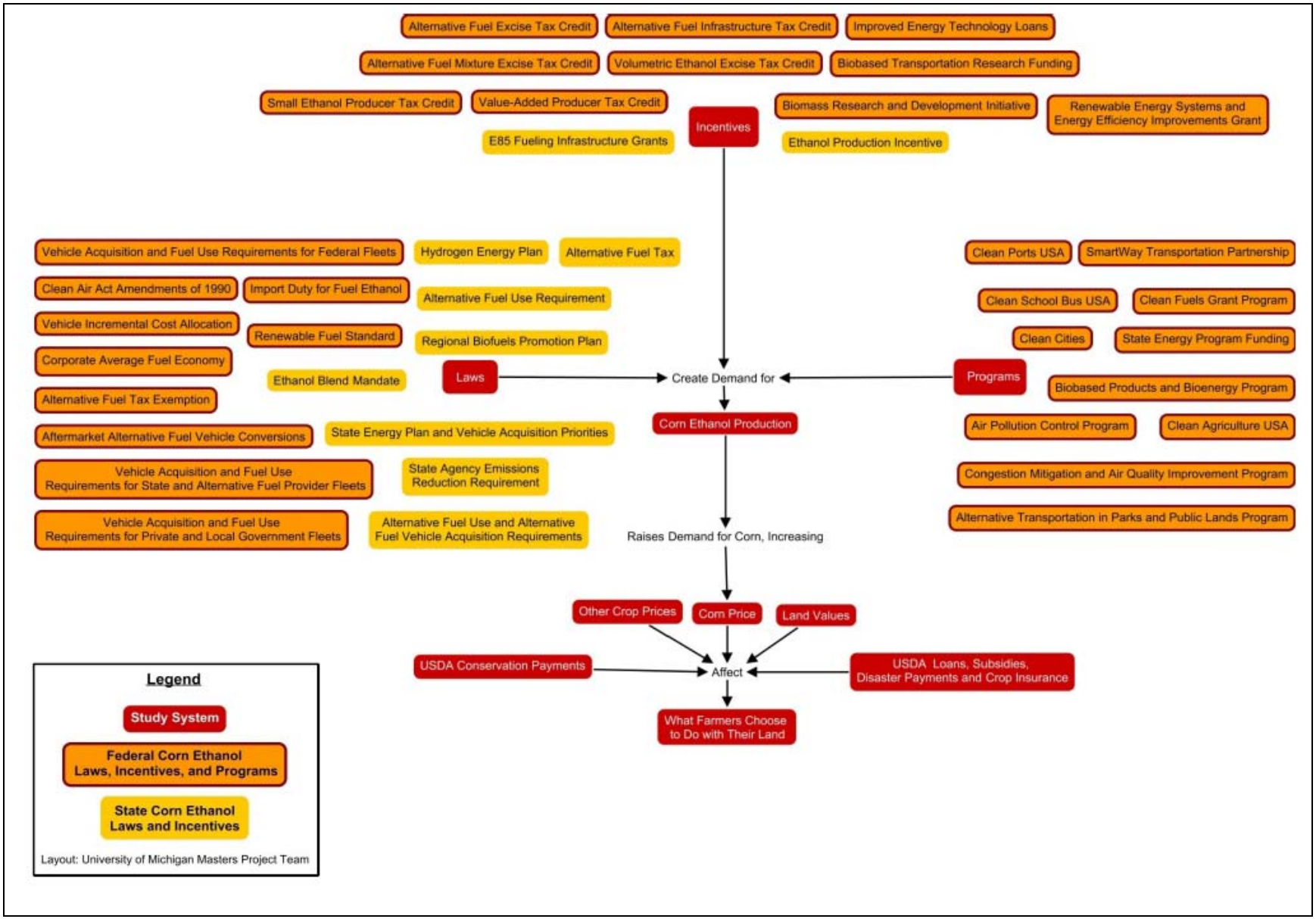


Table 8.2

Minnesota Ethanol Incentives, Laws, and Regulations				
Name	**Description[355]**	**Funding**		
E85 Fueling Infrastructure Grants	"Grants administered by the Minnesota E85 Team are available to service stations installing equipment or converting existing equipment for dispensing E85 fuel to flexible fuel vehicles. Cost eligibility and grant amounts vary according to grant sponsorship." [356]	No data available.		
Ethanol Production Incentive (Minnesota Statutes 41A.09)	"Through June 30, 2010, an ethanol production incentive of $0.20 per gallon of ethanol produced is available to qualified facilities that began production before June 30, 2000. Annual payments are limited to $3 million to any one producer." [357] *Estimated future payments	**Year**	**Regular[358]**	**Deficiency[359]**
		FY04	$22,339,431.47	N/A
		FY05	$19,786,325.77	N/A
		FY06	$16,787,739.93	N/A
		FY07	$13,318,312.28	N/A
		FY08	$15,122,695.20	$45,304.80
		FY09*	$7,351,756.40	$7,506,243.60
		FY10*	$1,150,534.40	$14,017,465.60
		FY11*	N/A	$15,168,000.00
		FY12*	N/A	$13,790,304.71
Regional Biofuels Promotion Plan "The Energy Security and Climate Stewardship Platform Plan"	Minnesota along with IN, IA, KS, MI, OH, SD, and WI, has adopted the Energy Security and Climate Stewardship Platform Plan, with the following goals: "1. Produce commercially available cellulosic ethanol and other low-carbon fuels in the region by 2012; 2. Increase E85 availability at retail fueling stations in the region to 15% of stations by 2015, 20% by 2020, and 33% of all fueling stations in the region by 2025; 3. Reduce the amount of fossil fuel that is used in the production of biofuels by 50% by 2025; 4. By 2025, at least 50% of all transportation fuels consumed by the Midwest will be from regionally produced biofuels and other low-carbon transportation fuels. The Platform also establishes a regional biofuels corridor program…(which) directs state transportation, agriculture, and regulatory officials to develop a system of coordinated signage across the Midwest for biofuels and advanced transportation fuels." [360]	Biofuels Corridor Funding: The U.S. Department of Energy gave $1.3 million in grant money to the Indiana Office of Energy and Defense Development, which is coordinating the project, through the Clean Cities Program.[361]		

Table 8.2

Minnesota Ethanol Incentives, Laws, and Regulations		
Name	**Description**[355]	**Funding**
Ethanol Blend Mandate (Minnesota Statutes 239.791)	"All gasoline sold or offered for sale in the state must contain at least 10% ethanol by volume (E10). Effective August 30, 2013, all gasoline sold or offered for sale in the state must contain at least 20% ethanol by volume (E20), unless ethanol has already replaced 20% of all motor vehicle fuel sold in the state by December 31, 2010 or federal approval has not been granted for the use of E20. Certain exemptions apply." [362]	N/A
Alternative Fuel Use Requirement (Executive Order 06-03, 2006)	"State agencies are required to take all reasonable actions necessary to strengthen the infrastructure for increasing the availability and use of E85 and biodiesel throughout the state. Employees using state vehicles are expected to use E85 fuel when operating flexible fuel vehicles, whenever E85 is reasonably available. The state's SmartFleet Committee is directed to develop a plan to facilitate the use of E85 and biodiesel in state vehicles, including actively pursuing the establishment of additional E85 fueling facilities at public retail outlets throughout the state." [363]	N/A
Hydrogen Energy Plan (Minnesota Statutes 216B.811 to 216B.815)	"The Department of Commerce is authorized to accept federal funds, expend funds, and participate in projects to design, develop, and construct multi-fuel hydrogen fueling stations…that accommodate a wide variety of vehicle technologies and fueling platforms, including hybrid, flexible fuel, and fuel cell vehicles. They may offer, but not be limited to, gasoline, diesel, ethanol (E85), biodiesel, and hydrogen." [364]	No data available.
Alternative Fuel Use and Alternative Fuel Vehicle (AFV) Acquisition Requirements (Minnesota Statutes 16C.135)	"State agencies are required to use alternative fuels, including… E70-E100 ethanol blends… to operate state motor vehicles if reasonably available at comparable costs to conventional fuels" [365] Additionally, state agencies are required to purchase alternative fuel vehicles, if reasonably available at comparable costs to other vehicles. [366]	No data available.
State Agency Energy Plan and Vehicle Acquisition Priorities (Executive Order 04-10, 2004, and Minnesota Statutes 16C.137)	"Using 2005 as a baseline, the state is required to achieve a 25% and 50% reduction in gasoline used to operate state agency owned on-road vehicles by 2010 and 2015, respectively…Each state agency will, whenever legally, technically, and economically feasible, ensure that at least 75% of all new on-road vehicles purchased operate on alternative fuels, including E70-E100 ethanol blends…"[367]	No data available.

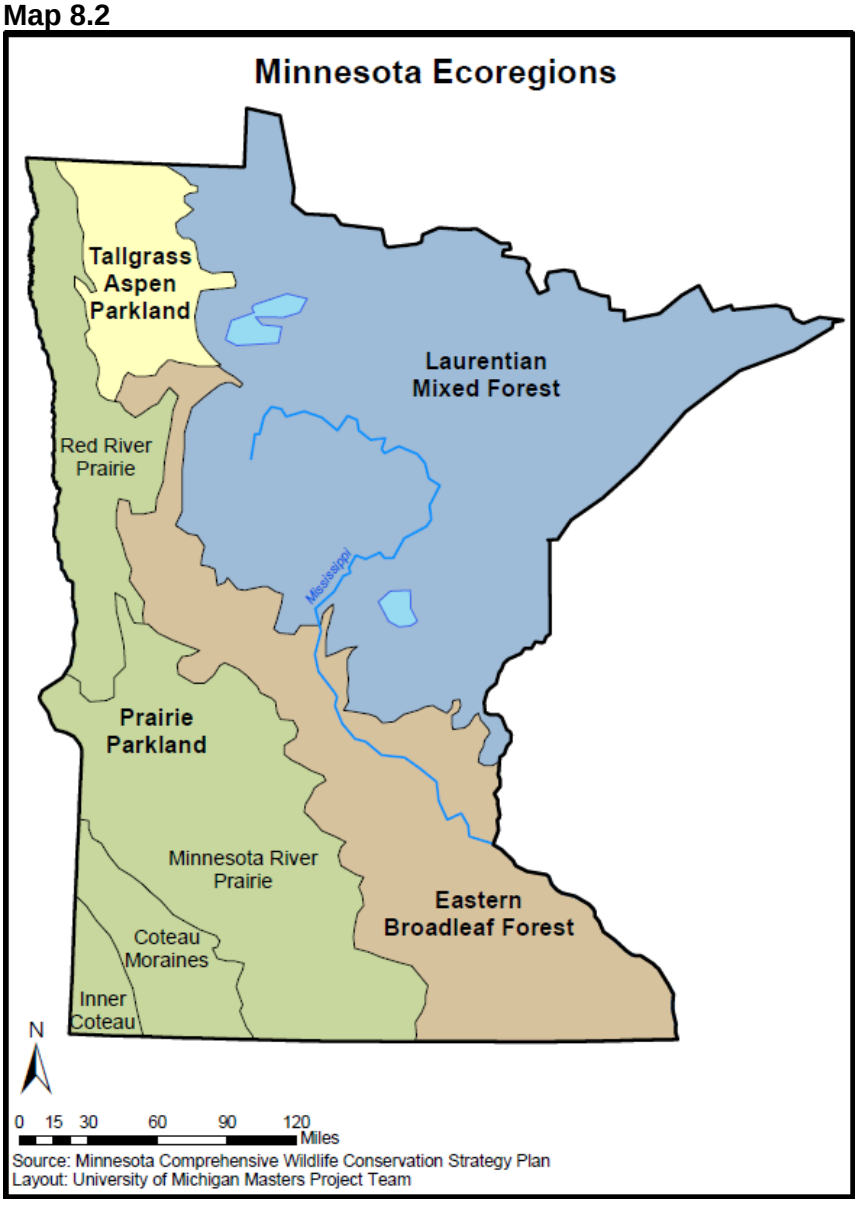
Table 8.2

Minnesota Ethanol Incentives, Laws, and Regulations		
Name	**Description**[355]	**Funding**
Alternative Fuel Tax (Minnesota Statutes 296A.07 and 296A.08)	"An excise tax is imposed on the first licensed distributor who receives E85 fuel products in the state and on distributors, special fuel dealers, or bulk purchasers of other alternative fuels. E85 is taxed at a rate of $0.142 per gallon, liquefied petroleum gas is taxed at $0.15 per gallon, liquefied natural gas is taxed at $0.12 per gallon, and compressed natural gas is taxed at the rate of $1.739 per thousand cubic feet or $0.20 per gasoline gallon equivalent. Gasoline is taxed at the rate of $0.20 per gallon." [368]	N/A

Ecological Background and Species of Conservation Concern

Known as the Land of 10,000 Lakes, Minnesota has many different habitat types and with that, a diversity of wildlife. Four ecological regions make up the state's habitat (Map 8.2). Broadleaf forests dominate the southeastern-most region while coniferous forests comprise the northeast. The Prairie Parkland and the Tallgrass Aspen Parklands Ecoregions are the two grassland regions within the state's Prairie Pothole Region (PPR). Minnesota's Comprehensive Wildlife Conservation Strategy, the "Strategy for Tomorrow's Habitat for the Wild and Rare," lists 292 species as "species in greatest conservation need" in the state.[369] These include species from all major taxonomic groups. Of these species, 139 are found in the Prairie Parkland region and 85 are found in the Tallgrass Aspen Parklands. There are 20 unique species that are found only within these PPR regions and not in any other part of the state. The major threats to these species are habitat loss and habitat degradation.

Map 8.2



Before European settlement, the Prairie Parkland region was covered predominantly by tallgrass prairie and wetlands. Due to intense agricultural production and urbanization, less than 1% (150,000 acres) of the original 18 million acres of prairie remains. Within the Prairie Parkland region, there are four subsections based on habitat type. These are the Inner Coteau, the Coteau Moraines, Minnesota River Prairie, and Red River Prairie. All of these regions include grassland, wetlands, and river habitats. As shown in Table 8.3, these regions have many important species in greatest conservation need, including significant numbers of species that are listed on federal or state endangered, threatened, or special concern species lists. Generally, these species are threatened by habitat loss and habitat degradation, particularly the loss of grassland habitat and degradation of wetland water quality due to pesticide and fertilizer runoff. While much of these regions were once native prairie, very little currently remains. Similarly, where subsections used to be comprised of 10% or 20% wetlands, now only 1-2%, or less, remains. Conservation of the few remnants of prairie and wetlands is a major priority within these subsections.[370]

Table 8.3

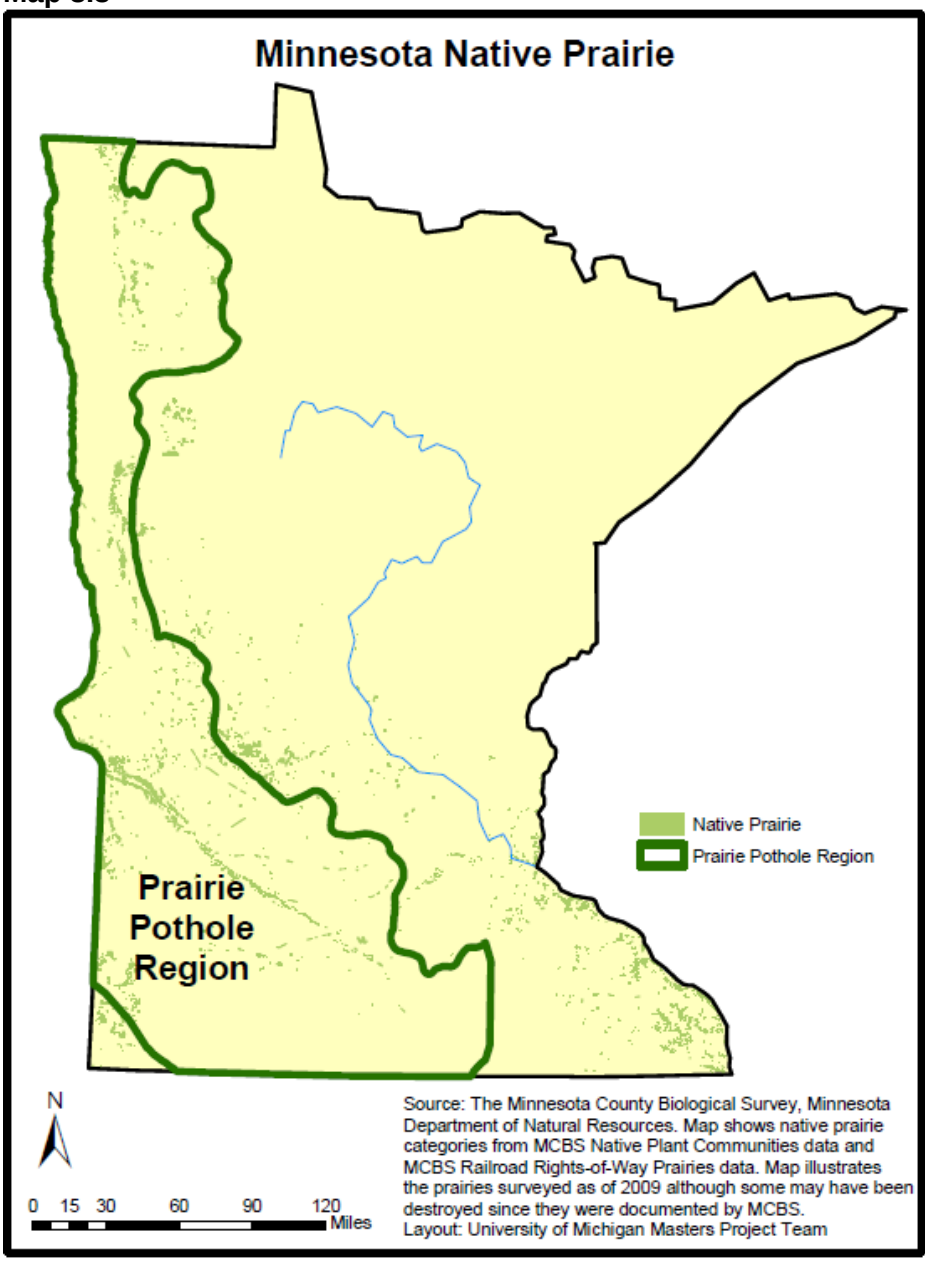
Ecological Profiles of Minnesota PPR Subsections								
Subsection	Number of Species		Percent of Species Threatened by		Percent of Region			
	Greatest Conservation Need	Federal or State Lists	Habitat Loss	Habitat Degradation	Native Prairie	Grassland	Wetlands	Cropland
Inner Coteau	78	33	88%	92%	0%	22.7%	0.1%	75.9%
Coteau Moraines	78	30	88%	92%	0%	12.7%	1.0%	82.2%
Minnesota River Prairie	116	52	87%	90%	0%	9%	1.9%	83%
Red River Prairie	83	36	90%	94%	0.6%	4.6%	1.5%	90.2%
Tallgrass Aspen Parklands	85	30	89%	94%	0%	7.5%	8.5%	65.6%

Source: MN Comprehensive Wildlife Conservation Strategy Plan

Remaining Native Prairie

Map 8.3 shows the remaining native prairie in Minnesota. The map illustrates the prairies surveyed by the Minnesota County Biological Survey (MCBS) as of 2009, although some prairie may have been destroyed since documentation by MCBS. As shown by the map, Minnesota lacks large conterminous swaths of native prairie. Small native prairie fragments are scattered throughout the western and southern regions of the state, most within the boundaries of the PPR. An estimated 56% of Minnesota's remaining native prairie is not protected, and therefore is at risk of being converted for crop production.[371]

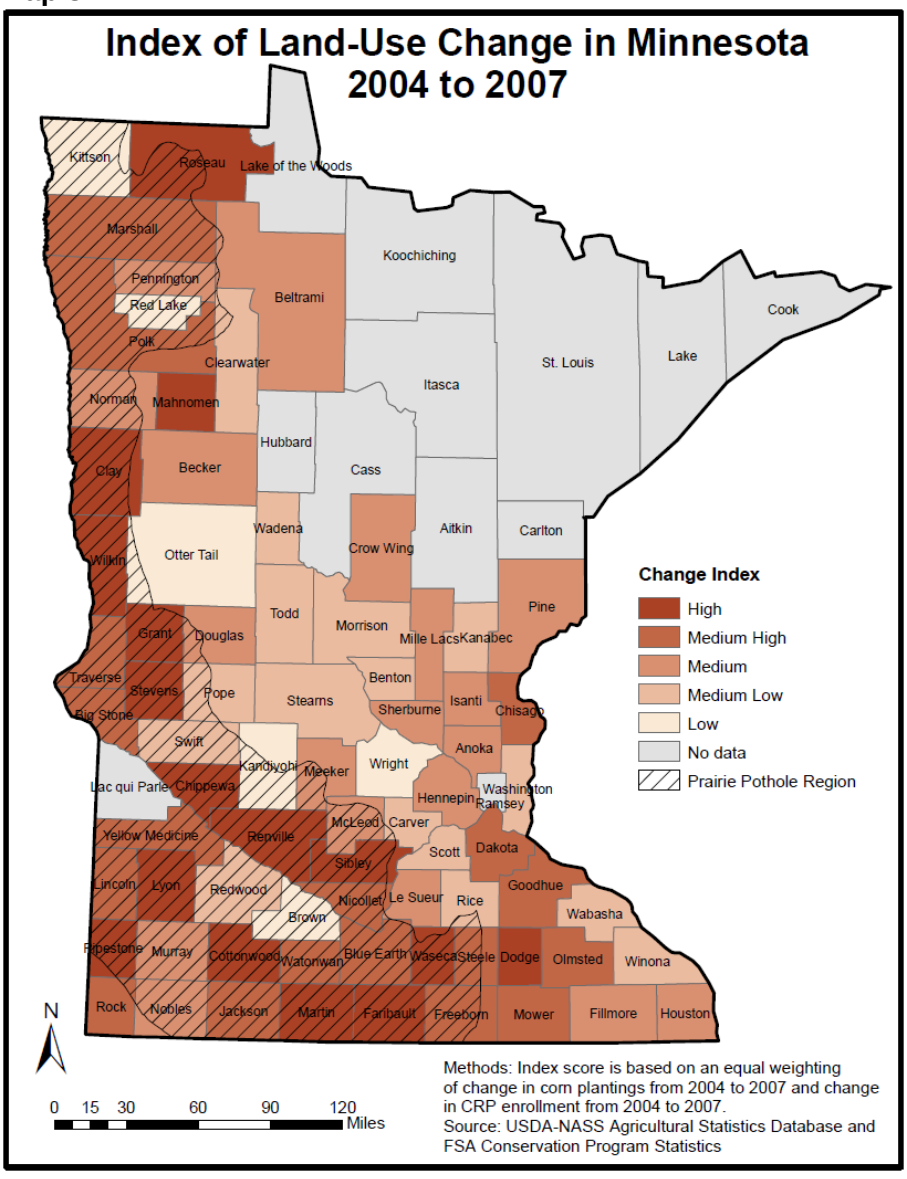
Map 8.3



Land-Use Change Hotspots

In order to determine which areas of Minnesota have experienced the most land-use change associated with corn expansion and therefore where habitat might be affected most, we undertook a GIS analysis of land-use changes of concern in the state (Map 8.4). Chapter 1 explains our methodology for calculating Minnesota's land-use change index.

Map 8.4



Our change analysis reveals that high-change counties are dispersed across the PPR of Minnesota, rather than clustered in a particular area of the state. The high-change counties closely correspond with Minnesota's five prairie subregions, specifically, the Inner Coteau, the Coteau Moraines, the Minnesota River Prairie, the Red River Prairie, and the Tallgrass Aspen Parklands.

Effective Conservation Programs and Policies

Both federal and state conservation programs are critical to the preservation of wildlife habitat in Minnesota. Tables 8.4, 8.5, and 8.6 describe the scope, impacts, and funding levels of federal and state conservation programs and policies in Minnesota, and Figure 8.4 shows how they interact to conserve wildlife and habitat. Through discussions with policy and wildlife practitioners in Minnesota, several programs and policies emerged as being the most effective in protecting habitat and environmental quality in the state. Chapter 1 contains a list of all organizations with staff interviewed for this report. All programs described help to mitigate habitat loss or degradation and will play a critical role as agricultural land-use changes continue to occur.

Land Retirement and Easements

Both federal Farm Bill conservation programs and state-level easement programs play a substantial role in conserving grassland and wetland habitat in Minnesota.

CRP has been a popular land retirement program in Minnesota with approximately 1.69 million acres enrolled as of early 2009.[372] As with other states in the region, Minnesota saw a sharp decline in CRP enrollment between 2008 and 2009, losing nearly 91,000 acres.[373] This decline threatens to reverse the substantial benefits CRP has provided for wildlife populations. For example, Minnesota's CRP grasslands are considered high quality breeding habitat for many bird species. The Greater Prairie Chicken has been documented nesting in CRP fields in Minnesota, and studies have found that Greater Prairie Chicken leks[w] in the state are associated with areas containing higher amounts of CRP grasslands.[374] Overall, populations of the Greater Prairie Chicken significantly increased in response to increasing amounts of CRP grasslands in the state. CRP land has also been associated with a slight increase in Sharp-tailed Grouse populations in northwestern Minnesota. According to published written communication from G. Merriam of the Minnesota Department of Natural Resources, "CRP has restored more wildlife habitat than any other program" for Minnesota's pheasant population.[375] Increases in CRP acreage were associated with a 34% increase in the fall pheasant harvests in the state compared to pre-CRP pheasant seasons. See page 43 for a national overview of CRP.

The Wetland Reserve Program (WRP) has also been a popular program for private landowners interested in retiring marginal farmland and restoring wetlands on that land. This program, administered by the Natural Resources Conservation Service (NRCS), has provided substantial wetland protection in Minnesota. There are over 600 easements on more than 70,000 acres in Minnesota, making the state one of the highest in the country for WRP enrollment. According to one official, funding for this program has not kept up with the number of landowners interested in enrolling their land. See page 48 for a national overview of WRP.

One conservation practitioner in Minnesota criticized the short-term nature of some land retirement programs. This practitioner observed that landowners "get the plow out again as soon as the payments are lower than crop prices." As a result, all environmental and habitat benefits

[w] A lek is a common breeding ritual in grouse and prairie chicken species that entails a gathering of male birds for the purpose of a competitive mating display.

that were achieved are quickly lost, meaning that the money paid to the landowner over the length of the contract provides what the practitioner describes as "limited returns."

Several state agencies administer easement programs that protect both native prairie and retired, restored cropland. In contrast to federal programs, these state programs emphasize permanent easements over shorter-term contracts. One of the most effective easement programs is the Reinvest in Minnesota (RIM) program, administered by the BWSR. Under RIM, landowners receive payments to permanently retire cropland from production and to plant native vegetation and restore previously drained wetlands. A variety of land types are enrolled in RIM, including wetland areas, riparian areas, marginal cropland, pastured hillsides, and areas important for groundwater protection. Land enrolled in RIM is managed under a conservation plan that determines wetland restoration practices and planting of native grass and trees. In addition to the easement payment, landowners receive funds for implementing these restoration practices on their land, although some landowners must contribute a small amount if the establishment cost exceeds the maximum amount covered by the program.[376] As of February 2009, approximately 76,000 acres were enrolled in the RIM program.[377]

RIM's success is due in part to the state's ability to leverage federal dollars. Through a partnership with NRCS, BWSR combines perpetual RIM easements with 30-year federal WRP easements. Eligible landowners therefore receive easement payments under both programs, providing additional economic incentives to retire their land. NRCS pays 75% of the cost of establishing conservation practices on the land, and BWSR contributes most or all of the remaining costs.[378] Under this partnership with NRCS, approximately 6,700 acres have been enrolled in the RIM program as of February 2009.[379] Similarly, RIM has also been used to supplement the Conservation Reserve Enhancement Program (CREP), administered by the USDA's Farm Service Agency (FSA). CREP is a voluntary land-retirement program that targets specific geographic areas and conservation objectives within a state. Whereas CREP retires land for only 10 or 15 years, the addition of a RIM easement protects the land perpetually. In this case, FSA provides up to 50% of the eligible costs to install conservation practices.[380]

RIM is funded primarily through state bonds, although some funding comes from general funds and the state lottery. In November 2008, Minnesota voters approved a new sales tax, which will generate an estimated $300 million per year. Thirty-three percent of this money will go toward enhancing water quality, while another thirty-three percent will go toward the newly created Outdoor Heritage Fund for the purpose of preserving wildlife habitat. The legislature also established an advisory council, composed of eight members of the public and four legislative members, which will provide recommendations for how the funds should be used. The council, which must submit its recommendations to the state legislature by April 1, 2009, is set to recommend an additional $9 million for the Reinvest in Minnesota program.[381] According to one official, the increased sales tax will probably amount to $80–90 million each year for habitat purposes and will likely become the primary funding source for RIM in the future.

Another effective conservation mechanism in Minnesota is the Native Prairie Bank Program, which allows landowners to protect native prairie on their land through a conservation easement with the Minnesota DNR. Easements must be for a minimum of 20 years, although permanent easements receive priority.

Figure 8.4 System Diagram of Conservation Policies and Programs in Minnesota

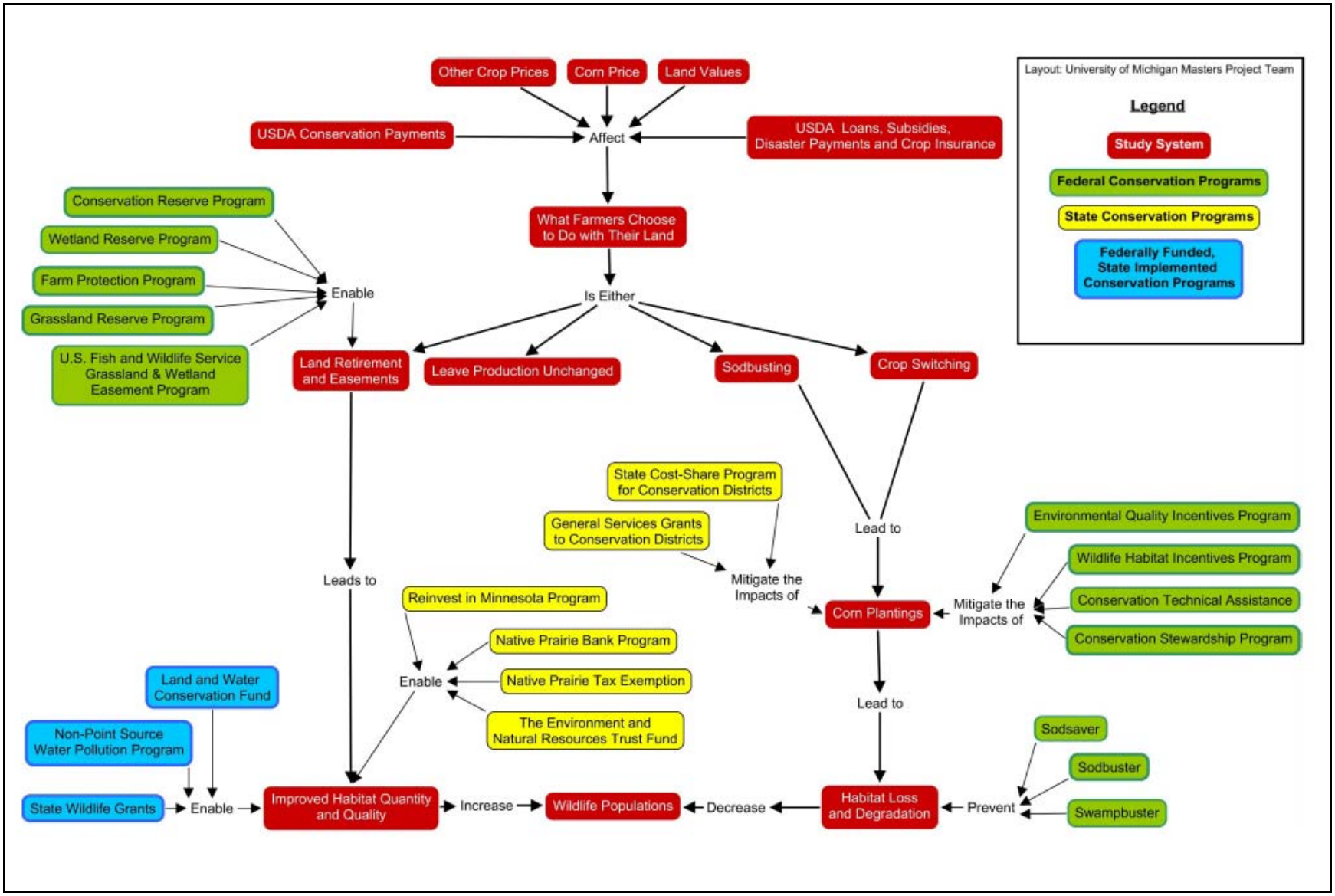


Table 8.4

Federally Funded and Implemented Programs in Minnesota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Conservation Reserve Program	FSA/NRCS	FY08	$109,921,113 in rental payments[382]	1,774,132 acres as of 9/08[383]
		FY07	$110,281,000 in rental payments[384]	1,829,428 acres as of 10/07[385]
		FY06	$107,017,000 in rental payments[386]	1,796,620 acres as of 10/06[387]
		FY05	$103,874,000 in rental payments[388]	1,762,971 acres as of 9/05[389]
Wetland Reserve Program	NRCS	FY07	$14,240,480 allocated to MN[390]	3,926 acres added[391]
		FY06	$14,783,121 allocated to MN[392]	14,500 acres added[393]
		FY05	$15,445,482 allocated to MN[394]	8,907 acres added[395]
Grassland Reserve Program	NRCS	FY07	Unknown	Unknown
		FY06	$305,153 obligated for contracts[396]	1,929 acres added[397]
		FY05	$1,052,843 obligated for contracts[398]	2,124 acres added[399]
Conservation Stewardship Program	NRCS	FY08	$133,451 approved by MN[400]	Unknown
		FY07	Unknown	Unknown
		FY06	$123,553 approved by MN[401]	7,566 acres added[402]
		FY05	$4,104,417 approved by MN[403]	140,886 acres added[404]
Wildlife Habitat Incentive Program	NRCS	FY08	$1,095,419 allocated to MN[405]	5,364 acres added[406]
		FY07	$440,730 allocated to MN[407]	2,157 acres added[408]
		FY06	Unknown	3,085 acres added[409]
		FY05	$477,304 allocated to MN[410]	2,185 acres added[411]
Environmental Quality Incentives Program	NRCS	FY07	$32,906,587 allocated to MN[412]	1,528 contracts added[413]
		FY06	Unknown	1,483 contracts added[414]
		FY05	$32,924,161 allocated to MN[415]	1,439 contracts added[416]
Technical Assistance	NRCS	FY07	$13,745,003 allocated to MN[417]	Unknown
		FY06	$13,116,082 allocated to MN[418]	Unknown
		FY05	$12,100,570 allocated to MN[419]	Unknown
Grassland Easement Program	USFWS	All	Unknown	Unknown

Table 8.5

Federally Funded and State Implemented Programs in Minnesota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Land and Water Conservation Fund	MN Department of Natural Resources	FY08	$405,455 apportioned to MN[420]	No State Parks created[421]
		FY07	$491,313 apportioned to MN[422]	No State Parks created[423]
		FY06	$491,313 apportioned to MN[424]	No State Parks created[425]
Non-Point Source Pollution Program	MN Pollution Control Agency; MN Department of Natural Resources; Board of Water & Soil Resources; MN Department of Agriculture	FY97-FY07	$34,835,609 Section 319 Funding; $56,803,219 MN Clean Water Partnership (grants and loans)[426]	TMDL Assessment; Watershed projects; Water quality projects; NPS Education; Monitoring; TMDL implementation projects; Demonstration projects; Technical assistance[427]
State Wildlife Grants	MN Department of Natural Resources	FY01-08 Annual Average	$1,218,287 allocated to MN[428]	On-the-ground wildlife and habitat conservation, restoration, and mitigation.
		FY08	$1,214,354 allocated to MN[429]	

Table 8.6

State Funded and Implemented Programs in Minnesota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Description**
Native Prairie Tax Exemption Program	MN Department of Natural Resources	All	N/A	Exempts native prairie from property taxes. The exemption is automatically renewed every year. The land must never have been plowed, and must not be active grazing land.[430]
State Cost-Share Program for Conservation Districts	MN Board of Water & Soil Resources	FY04	$177,284 among conservation districts[431]	The cost-share program provides conservation districts with funding to help private landowners reduce soil erosion and sedimentation. The BWSR will provide up to 75% of the cost of an approved conservation practice, such as strip cropping.
General Services Grants to Conservation Districts	MN Board of Water & Soil Resources	Annual average	$21,800 per conservation district[432]	Provides stability and funds for general operations of conservation districts.
The Environment and Natural Resources Trust Fund	State Board of Investment; allocation by Legislative-Citizen Commission on Minnesota Resources	FY08	$23.4 million[433]	Provides funding for land acquisition, land restoration, natural resource planning, inventory and analysis, research, and education.
		FY07	$22.9 million[434]	Provides funding for land acquisition, land restoration, natural resource planning, inventory and analysis, research, and education.
Reinvest in Minnesota Program	MN Board of Water & Soil Resources; Soil and Water Conservation Districts	FY08	$25 million approved by MN legislature[435]	Benefits of the program include perpetual prairie easements, marginal cropland retirement, native vegetation plantings, and wetland restoration.[436] As of February 2009, over 75,000 acres were enrolled in the RIM program.[437] The program is successful, in part, due to partnerships with federal programs. A partnership with the CRP doubled the acreage enrolled in the RIM reserve. In 2008, a RIM/WRP partnership enrolled acreage worth $24.5 million for wetland restoration.[438]
Native Prairie Bank Program	MN Department of Natural Resources	All	Funding and staff resources are scarce. Demand for the program consistently outstrips supply.[439,440]	The DNR purchases native prairie easements from private landowners. Perpetual easements receive priority. Only land that has never been plowed qualifies.[441]

Conclusions

Ranked fourth in the country for both corn ethanol production and consumption, ethanol is an integral part of Minnesota's economy. Multiple state-level incentives, in particular statewide blending requirements, insure that this status will continue in the future, driving demand for corn plantings. Many conservation practitioners we interviewed were concerned about what increased corn plantings mean for habitat and wildlife in the state. The prairie and wetland subregions of Minnesota are already dominated by agriculture, and numerous species that rely on the remaining wetlands and prairie fragments are listed as federal or state endangered, threatened, or species of concern. Given that the major threats to these species are habitat loss and habitat degradation from agricultural runoff, increased corn plantings will exacerbate threats to these populations.

Minnesota conservation practitioners pointed to the tremendous value of state and federal conservation programs in protecting wildlife habitat in Minnesota. Land retirement programs have been linked to population gains in Greater Prairie Chicken, Pheasants, and Sharp-tailed Grouse populations; however, these trends could reverse with continued CRP declines. More so than other states in the study area, interviews with Minnesota conservation practitioners revealed that there was a strong public commitment to conservation, as evidenced by the voter-approved sales tax increase that will generate upwards of $80 million a year for habitat protection and restoration. In addition, Minnesota state agencies have found ways to perpetually protect habitat by combining limited funds with shorter-term federal programs.

Chapter 9: North Dakota State Profile

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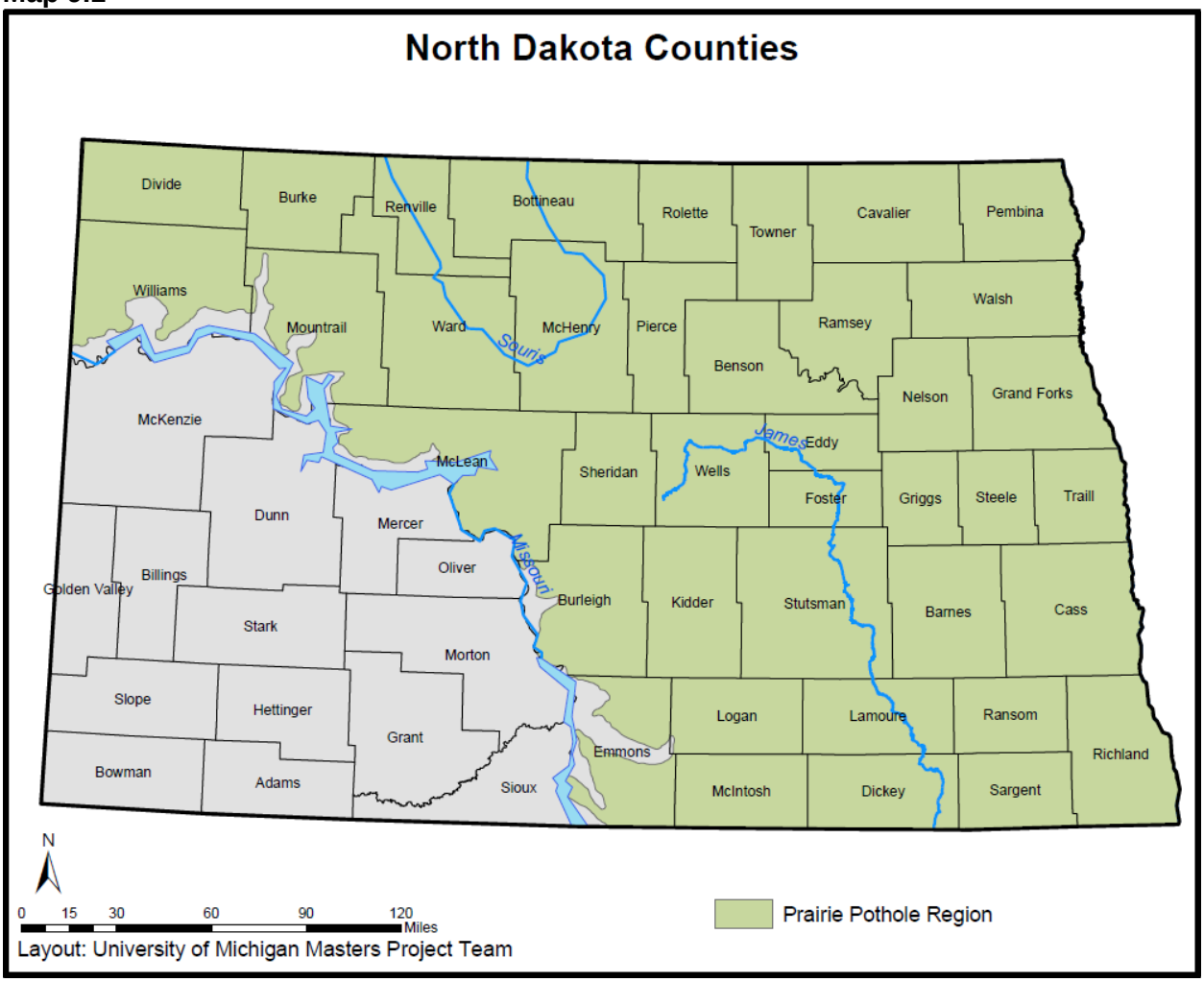
Long Lake National Wildlife Refuge, North Dakota
Photo: Aviva Glaser

Map 9.1


North Dakota Counties
Divide
Burke
Renville
Bottineau
Rolette
Towner
Cavalier
Pembina
Williams
Mountrail
Ward
McHenry
Pierce
Ramsey
Walsh
Benson
Nelson
Grand Forks
McKenzie
McLean
Sheridan
Wells
Eddy
Foster
Griggs
Steele
Traill
Dunn
Mercer
Oliver
Billings
Golden Valley
Stark
Burleigh
Kidder
Stutsman
Barnes
Cass
Morton
Slope
Hettinger
Grant
Logan
Lamoure
Ransom
Richland
Bowman
Adams
Sioux
Emmons
McIntosh
Dickey
Sargent
Missouri
James
Souris
N
0 15 30 60 90 120
Miles
Prairie Pothole Region
Layout: University of Michigan Masters Project Team

Chapter 9

North Dakota State Profile

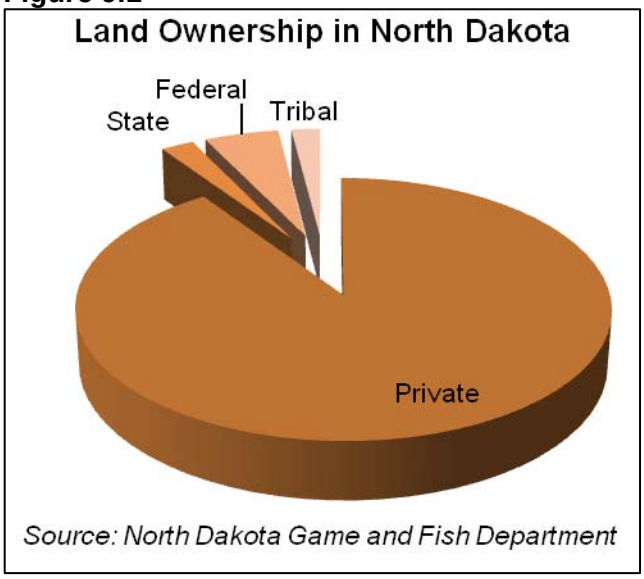
North Dakota's ethanol production is relatively small compared to other states in the Midwest. Though it has experienced a much higher rate of corn expansion over the past two decades, North Dakota has significantly fewer acres devoted to corn than Iowa or Minnesota. The average number of corn acres planted annually in the state increased by 95% between the 1990s and the 2000s. Between 2005 and 2008, corn acreage in the state increased 80% from 1.41 to 2.55 million acres. This dramatic increase in corn plantings has raised concerns about loss of important wildlife habitat in the state. In comparison to Iowa and Minnesota, North Dakota contains relatively large portions of remaining native prairie. While rapid agricultural expansion poses a challenge to the conservation of prairie in the state, practitioners and policymakers have an opportunity to protect habitats similar to those that have been lost in Iowa and Minnesota, which have very little remaining native prairie. State practitioners identified a number of challenges to conserving the state's remaining habitat, including a general resistance to conservation and state rules that make it almost impossible for private groups to protect land in perpetuity.

The following chapter discusses North Dakota's land use, ethanol industry and incentives, the status of habitat and wildlife issues, the threats posed by ethanol expansion, and the conservation successes and challenges described by North Dakota practitioners.

Land Ownership and Usage

Almost 90% of North Dakota's 45.3 million acres (70,800 square miles) is privately owned. The remaining ten percent is divided among the federal government (5.2 %), the state (2.3%), and tribal land trusts (2 %) (Figure 9.1).[442]

Figure 9.1



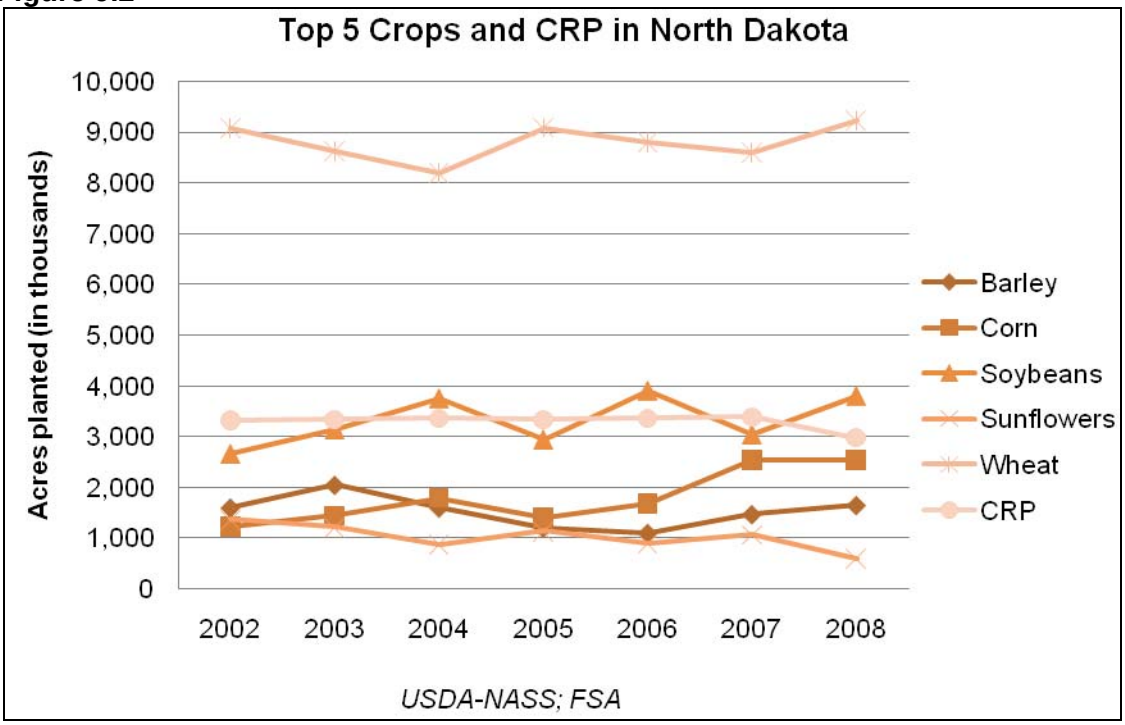
The U.S. Forest Service is the largest public landowner in North Dakota and manages the state's three National Grasslands. Collectively, the three grasslands are known as the Dakota Prairie Grasslands and consist of 1.26 million acres.[443] The U.S. Fish and Wildlife Service (USFWS) manages 63 National Wildlife Refuges and 11 Wetland Management Districts, totaling over half a million acres throughout the state.[444] The National Park Service manages a little over 70,000 acres[445] in the state. The Bureau of Reclamation, the Army Corps of Engineers, the Bureau of Land Management, and the United States Air Force manage the state's remaining federal land.

Ninety percent of North Dakota's state-owned land is managed by the Department of Transportation and the State Land Department for state institutions and mineral and energy development. The state Game and Fish Department, Forest Service, and Parks and Recreation Department manage another 100,000 acres throughout the state.[446]

It is illegal for landowners to donate or sell perpetual land conservation easements in North Dakota without approval from the governor.[447] The current process for approval also requires submitting an application to an advisory committee, consisting of the heads of the state Parks and Recreation Department, Game and Fish Department, Farmers Union, Farm Bureau, Stockmen's Association, as well as the state Agricultural commissioner, the state forester, and the chairman of the county commission in which the land is located.[448] North Dakota is the only state with such restrictions on selling land for conservation and the only state without any land trusts.[449] The Nature Conservancy owns and manages four preserves throughout the state, including the 7,000-acre Davis Ranch, which is one of the largest native prairies in the state.[450]

The vast majority of North Dakota's private land is in farms. According to the U.S. Department of Agriculture's 2007 Agricultural Census, North Dakota has 39.7 million acres in farms. This represents almost all of the state's privately owned land. Of this land, 69.4% (27.5 million acres) is cropland, 26.3% (17.3 million acres) is pasture, and 4.4% (3.97 million acres) is used for other purposes.[451] The five field crops with the most planted acreage in North Dakota are wheat, soybeans, barley, corn, and sunflower seeds. In 2007, these crops made up 32.7%, 10.7%, 5.6%, 5.5% and 4.0%, respectively, of all North Dakota cropland (Figure 9.2).[452] North Dakota had about 3.3 million acres of cropland enrolled in the Conservation Reserve Program (CRP) from 2001 to 2007. This number fell to slightly under 3 million in FY 2008.[453]

Figure 9.2



Corn Ethanol Industry

North Dakota has few ethanol refineries compared with other states in the Midwest. Today, there are three operating biorefineries in the state, two under construction, and a sixth owned by VeraSun Energy Corps, which has recently gone bankrupt (Table 9.1). The largest refinery, responsible for over 50% of total operating capacity in the state, is locally owned. Ethanol consumption is also small in comparison to our other focal states, but is growing. Approximately 18 million gallons of ethanol were used in 2005, placing North Dakota 27th in the nation for ethanol consumption. The relatively low demand for ethanol may be a reflection of the low number of E85 refueling stations in the state, though there has been high growth in the number of stations since 2005.[454]

Table 9.1

North Dakota Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[x]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[y]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
Alchem Ltd. LLP	N	Grafton	10	Not Operating	0.0	0.0	0
Archer Daniels Midland	N	Wallhalla	Unknown	0	0.0	0.0	0
Blue Flint Ethanol	N	Underwood	50	50	18.5	151.2	0
Red Trail Energy, LLC	N	Richardton	50	50	18.5	151.2	0
Tharaldson Ethanol	Y	Casselton	110	110	40.7	332.6	0
VeraSun Energy Corp.	N	Hankinson	Unknown	Not Operating	0.0	0.0	0
Total			**220.0**	**210.0**	**77.8**	**634.9**	**0.0**

Source: Renewable Fuels Association, February 2009

The North Dakota ethanol industry benefits from a variety of federal and state incentives. Figure 9.3 shows the combination of state and federal programs that drive demand for corn ethanol in North Dakota. In addition, Table 9.2 describes the state-level programs and their funding levels.

[x] mgy denotes million gallons per year of ethanol produced.
[y] Estimates are based on 1 bushels of corn yielding approximately 2.7 gallons of ethanol and 18 lbs of DDGS.

Figure 9.3 System Diagram of Corn Ethanol Laws, Incentives, and Programs in North Dakota

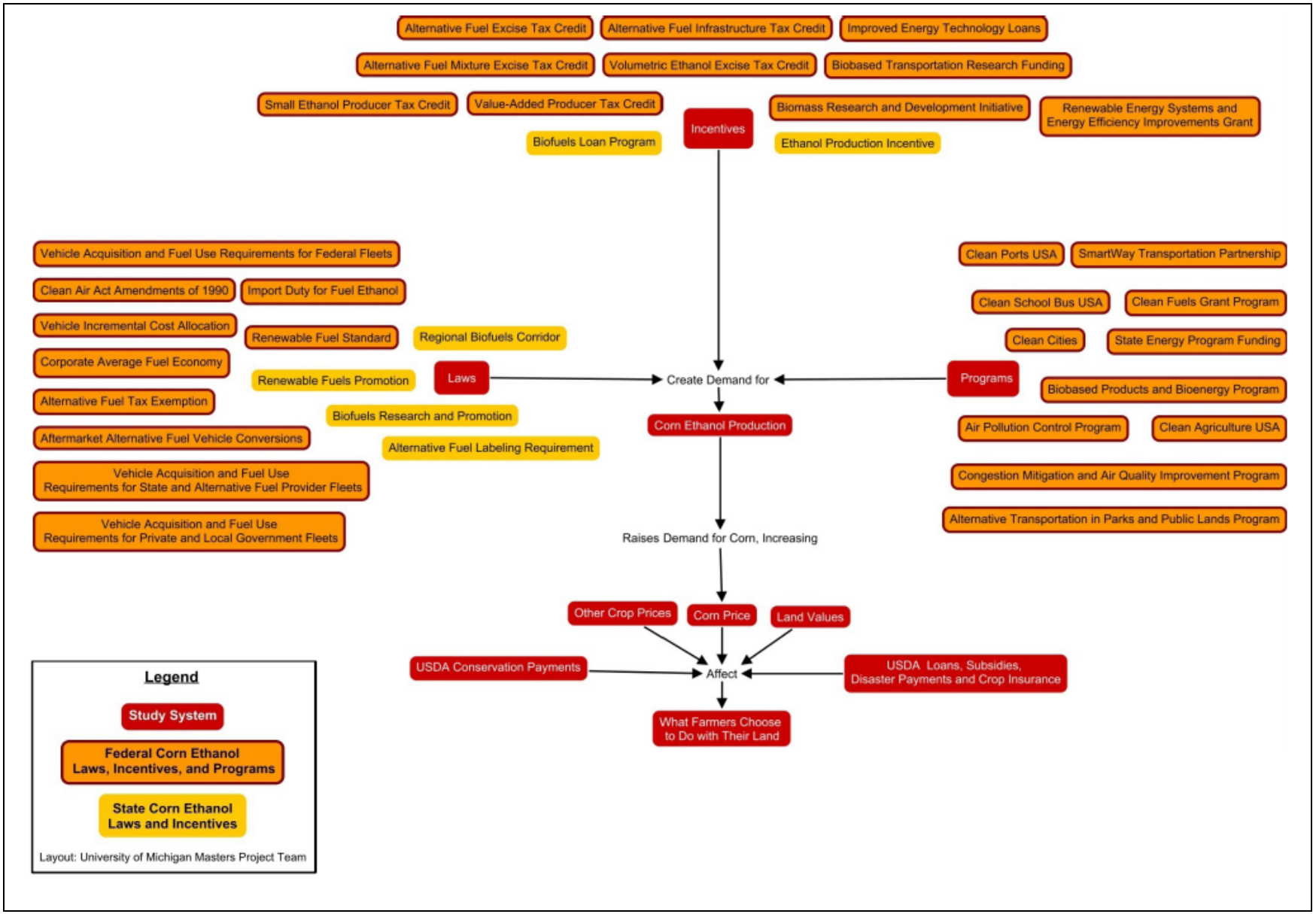


Table 9.2

North Dakota Ethanol Incentives, Laws, and Regulations		
Name	**Description**	**Funding**
Biofuels Loan Program (Senate Bill 2180, 2007, and North Dakota Century Code 6-09.17-02 through 6-09.17-04)	The Biofuels Loan Program provide a 5% interest buy down (so loan holders pay a lower than market interest rate) to biodiesel and ethanol production facilities; livestock operations feeding byproducts of a biodiesel or ethanol facility; biofuels retailers for refueling infrastructure installation; and grain handling facilities which provide condominium storage of grain used in biofuels production. [455]	2007-2009: Appropriation: $4.2 million. In addition, approximately $700,000 was transferred from the biodiesel PACE fund to the biofuels PACE fund at the end of the 2005-07 biennium for a total of $4.9 million for the biofuels PACE fund. [456] 2009-2011: Executive recommendation: $1.4 million[457]
Ethanol Production Incentive (North Dakota Century Code 4-14.1-07.1)	"The ethanol production incentive provides an incentive of $0.40 per gallon for ethanol produced and sold in North Dakota… Payment will be provided on a quarterly basis based on: a) the average North Dakota price per bushel of corn received by farmers during the quarter; and b) the average North Dakota rack price per gallon of ethanol during the quarter. The cumulative state ethanol payment amount received by any single ethanol production facility may not exceed $10,000,000." [458]	The incentives are paid from the Ethanol Production Fund, which receives up to $7.5 million annually from the registration of farm vehicles.[459] The Tax Commissioner will conduct an audit of the ethanol production incentive program during the 2009-11 biennium.[460]
Regional Biofuels Corridor "The Energy Security and Climate Stewardship Platform Plan"	North Dakota, Indiana, Iowa, Kansas, Michigan, Minnesota, Nebraska, South Dakota, and Wisconsin have adopted a cooperative initiative, which directs state transportation, agriculture, and regulatory officials to develop a system of coordinated signage across the Midwest for biofuels and advanced transportation fuels. [461]	The U.S. Department of Energy gave $1.3 million in grant money to the Indiana Office of Energy and Defense Development, which is coordinating the project, through the Clean Cities Program.[462]
Alternative Fuel Labeling Requirement (House Bill 1121, 2007, and North Dakota Century Code 19-10-03.3)	"Alternative fuels must be labeled at the retail dispensing unit with the price, name, and main components of the alternative fuel or fuel blend...A producer of alternative fuels may provide a label promoting the benefits of the alternative fuel if the label meets the requirements specified." [463]	N/A
Biofuels Research and Promotion (Senate Bill 2288, 2007)	"The North Dakota Board of Education is encouraged to establish a biomass energy center at an institution to conduct research and provide education and technical assistance related to biomass production, harvesting, transportation, and conversion." [464]	Not funded.

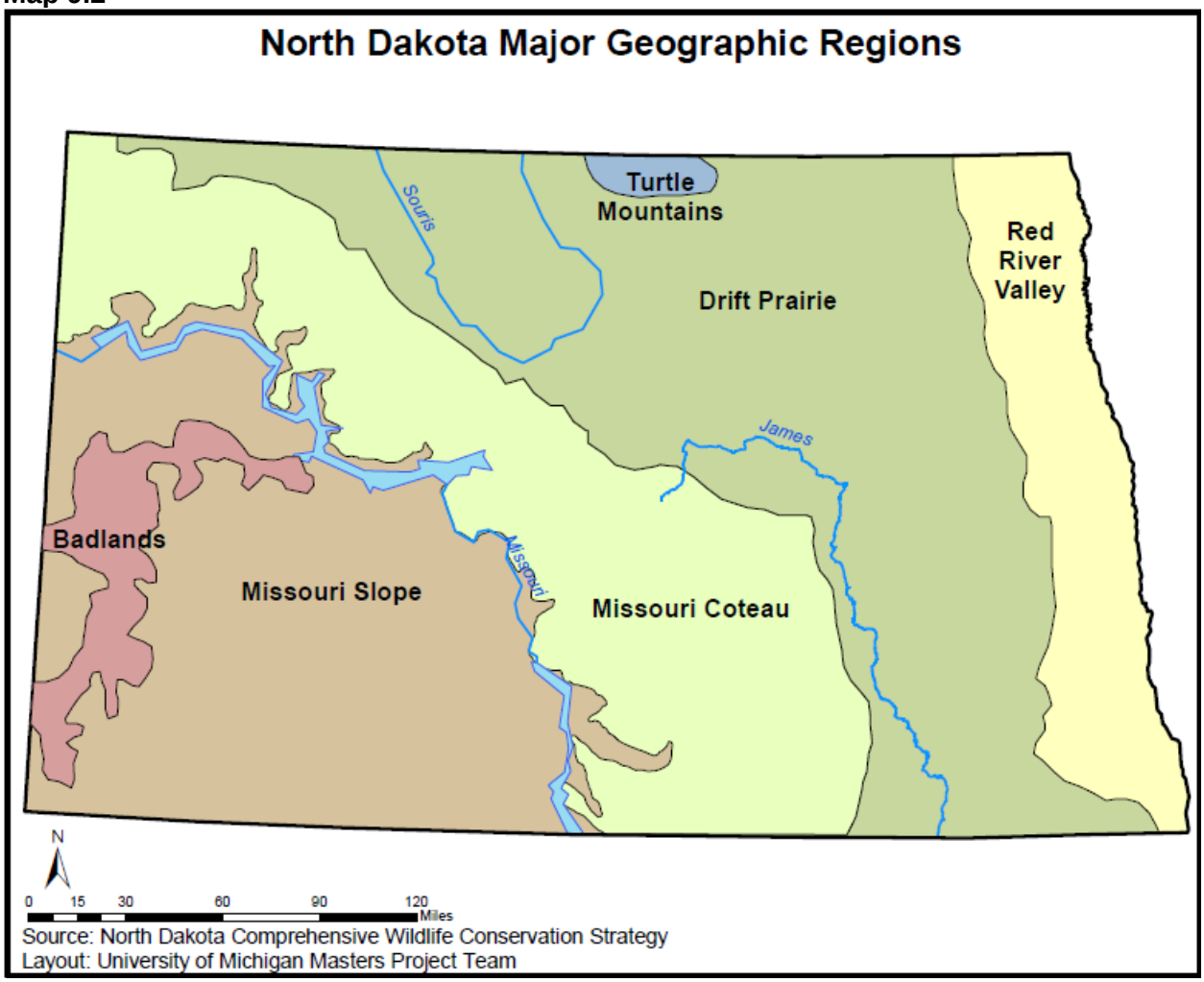
Table 9.2

North Dakota Ethanol Incentives, Laws, and Regulations		
Name	**Description**	**Funding**
Renewable Fuels Promotion (House Concurrent Resolution 3020, 2007, and North Dakota Century Code 17-01-01)	"The North Dakota Legislature adopts the goal that 25% of the nation's energy and consumption will come from renewable sources by the year 2025. Additionally, the Legislature supports the North Dakota energy corridor initiative to increase funding for research and development (of)…biofuels produced from biomass for long-term viability." [465]	No information available.

Ecological Background

Prior to major agricultural expansion in the state, the majority of North Dakota's natural habitat consisted of grassland prairies. In the glaciated eastern portion of the state, grassland prairie is interspersed with the prairie potholes which are characteristic of the region. According to North Dakota's State Wildlife Action Plan, also known as the North Dakota Comprehensive Wildlife Conservation Strategy (CWCS), it is estimated that 50% of the prairie and wetlands in the state have been plowed or drained.[466] Although swaths of native prairie still remain throughout the state, they are fragmented by roads and railroad tracks. The section of the Prairie Pothole Region (PPR) in North Dakota lies east of the Missouri River and includes three distinct ecological regions. From west to east, these three regions are the Missouri Coteau (mixed-grass prairie), the Drift Prairie (eastern mixed-grass prairie), and the Red River Valley (tallgrass prairie) (Map 9.2).

Map 9.2

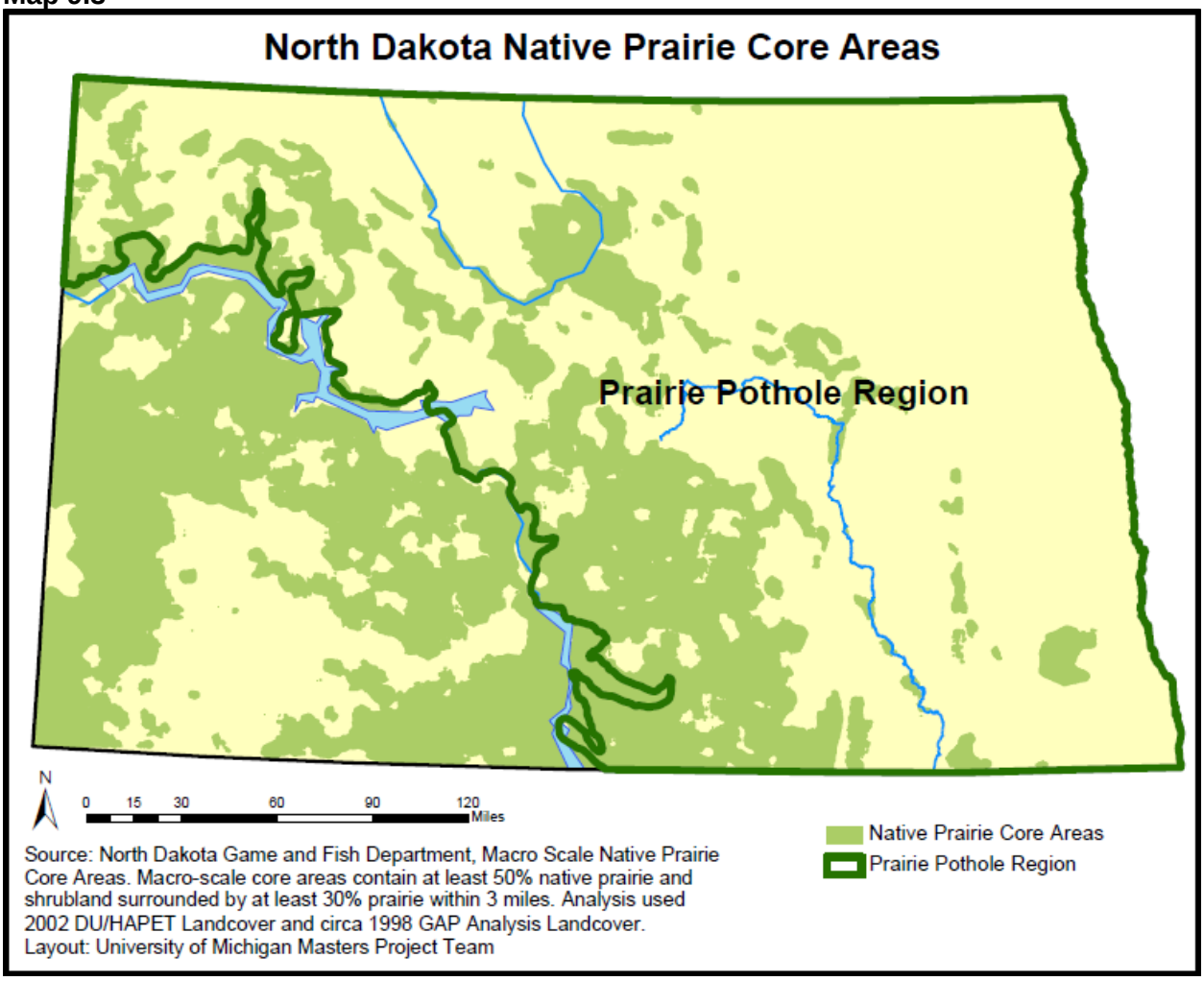


Remaining Native Prairie

Map 9.3 shows an approximation of the remaining native prairie in North Dakota. The areas highlighted on the map contain at least 50% native prairie and shrubland surrounded by at least

30% prairie within three miles. The data used to create the map are from 2002 and 1998, and thus recent losses of native prairie due to sodbusting have not been captured. Much of North Dakota's remaining grassland lies to the west of the Missouri River. However, large contiguous tracts of native prairie still exist in the state's PPR. These lands are critically important habitat in the state, and are also at the greatest risk for conversion. Genetically modified crops, new farming technology, and federal incentives are increasing the profitability of intensive agriculture in this region. Thus, there is significant risk for non-protected native prairie to be destroyed.

Map 9.3



Species of Conservation Concern

One hundred species of conservation priority were identified in the North Dakota CWCS. This list includes 45 birds, 22 fish, 15 mammals, 9 reptiles, 7 freshwater mussels, and 2 amphibians. Of these 100 species, 31 are associated with the three ecological regions that make up the PPR in North Dakota. Table 9.3 shows these species, their habitats (by PPR geographic region), and major relevant threats they face as identified in the CWCS. The majority of the species of conservation priority in the PPR are threatened by loss of native prairie habitat. Many are also sensitive to loss and degradation of wetland habitat and CRP land.

Table 9.3

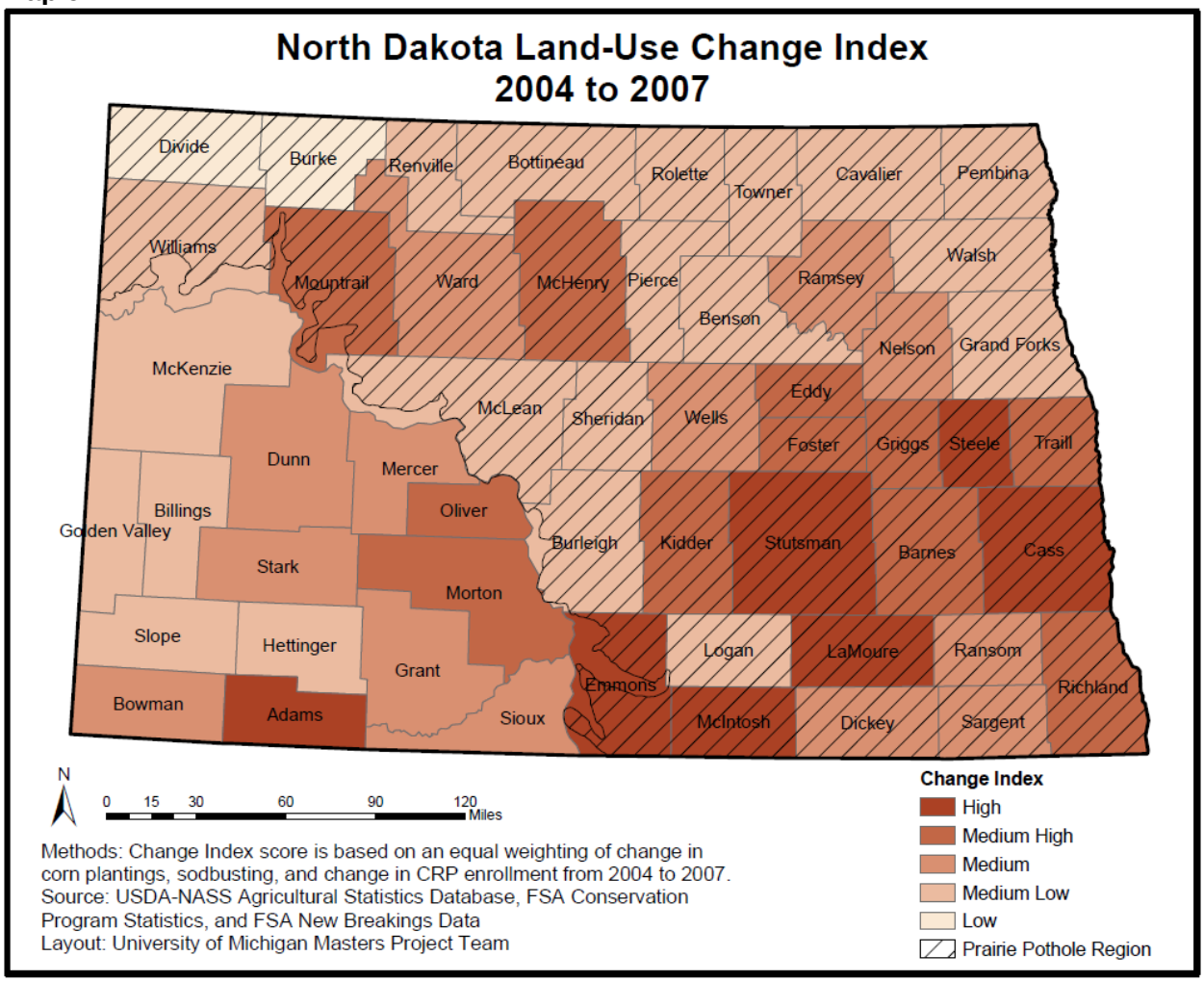
North Dakota Species of Conservation Concern in the PPR								
Birds	Habitat			Major Threats[z]				
	Drift Prairie	Red River Valley	Missouri Coteau	Prairie Loss	Wetland Loss	Wetland Degradation	Pesticides	Other Relevant Threats
American Bittern	●	●	●	●	●	●	●	Declining amphibian populations
Northern Pintail	●	●	●	●	●	●		Destruction of nests by farm machinery
Northern Harrier	●	●	●	●	●	●		
Swainson's Hawk	●		●					Declining mammal prey populations
Ferruginous Hawk	●		●	●				
Sharp-tailed Grouse	●	●	●	●				CRP losses
Willet	●	●	●	●	●	●	●	
Upland Sandpiper	●	●	●	●				
Marbled Godwit	●	●	●	●	●	●	●	
Wilson's Phalarope	●	●	●	●	●	●		
Short-eared Owl	●	●	●	●				CRP losses
Loggerhead Shrike	●		●	●			●	
Sedge Wren	●	●	●	●	●	●		CRP losses
Sprague's Pipit	●		●	●				
Lark Bunting	●		●	●				CRP losses
Grasshopper Sparrow	●	●	●	●				CRP losses
Baird's Sparrow	●		●	●				CRP losses
Le Conte's Sparrow	●	●	●					CRP losses
Nelson's Sharp-tailed Sparrow	●	●	●	●				
Chestnut-collared Longspur	●		●	●				
Dickcissel	●	●	●					CRP losses
Bobolink	●	●	●	●				CRP losses
Mammals								
Arctic Shrew	●	●			●		●	
Pygmy Shrew	●	●		●	●		●	
Richardson's Ground Squirrel	●	●	●	●				
Plains Pocket Mouse		●		●			●	
Reptiles/Amphibians								
Plains Spadefoot	●		●		●			Prairie fragmentation
Canadian Toad	●	●	●		●	●		
Smooth Green Snake	●	●	●	●				
Western Hognose Snake	●	●	●					
Northern Prairie Skink		●		●				Prairie fragmentation

[z] Only threats associated with increased corn plantings, new breakings, and CRP losses are included.

Land-Use Change Hotspots

Habitat loss and degradation are clearly one of the largest challenges facing wildlife in North Dakota. In order to determine which areas have experienced the most land-use change associated with corn expansion and therefore where habitat might be affected most, we undertook a GIS analysis of land-use changes in the state (Map 9.4). Chapter 1 explains our methodology for calculating North Dakota's Land-Use Change Index.

Map 9.4



Our change analysis revealed a hotspot of land-use change in the southeastern portion of North Dakota, primarily the area between the Missouri and James Rivers but also extending east of the James River. The counties with the highest change index scores are Adams, Cass, Emmons, LaMoure, McIntosh, Steele, and Stutsman counties. All of these counties experienced increases in corn plantings, with Cass, LaMoure, Steele, and Stutsman counties experiencing particularly dramatic increases. In these counties, as much as 5–9% of county land was brought into corn production between 2004 and 2007. The high scores for Adams, Emmons, McIntosh, and Stutsman counties are also due to the high percentage of county area converted from native grassland to cropland between 2004 and 2007. Adams, Emmons, LaMoure, and McIntosh

counties also ranked highly in terms of the amount of CRP conversion during that time. Discussions with wildlife and conservation practitioners confirmed that these counties are of particular concern in conserving wildlife due to grassland and CRP loss. The high-change values for Emmons, Kidder, McIntosh, and Stutsman counties are particularly concerning because these counties contain some of the highest quality prairie and wetland habitats in the PPR. Their high-change values underscore practitioners' concerns that corn production is expanding west into areas of great ecological importance.

Effective Conservation Programs and Policies

Federal conservation programs are critical to the preservation of wildlife habitat in North Dakota. A variety of state-level programs complement these federal programs, often working as cost-shares or adding incentives to existing federal conservation incentives. Tables 9.4, 9.5, and 9.6 describe the scope, impacts, and funding levels of federal and state conservation programs and policies in North Dakota, and Figure 9.4 shows how they interact to conserve wildlife and habitat.

Through discussions with policy and wildlife practitioners in North Dakota, several of these programs and policies emerged as being the most effective in protecting habitat and environmental quality in the state. Chapter 1 contains a list of all organizations with staff interviewed for this report.

Land Retirement

CRP arose as the most far-reaching program for protecting habitat in North Dakota (see page 43 for full description). The success of CRP comes from its large scope and ability to provide monetary support for keeping land idle. When asked what determines levels of CRP enrollment, practitioners said that the decisions are predominantly economically driven; the majority of landowners choose to enroll (or re-enroll) in CRP if rental rates are competitive with commodity prices. Practitioners fear that the CRP program has been losing, and will continue to lose, its competitiveness.[467] Loss of CRP land was frequently cited as one of the major threats to habitat and wildlife populations in North Dakota.

The importance of CRP in North Dakota has been confirmed by studies showing that CRP has significantly benefited wildlife in the state. A study of grassland bird species and CRP done by the U.S. Geological Survey's Northern Prairie Wildlife Research Center found that of the 18 species that occurred commonly in CRP or cropland fields in North Dakota, 12 were more common in CRP fields than in cropland.[468] CRP land comprises only 7% of the land in North Dakota but supported more than 20% of the statewide population of many species. Many of these species are sensitive grassland bird species that have been declining in the region. According to the authors, "…CRP provides not only important breeding habitat for some grassland birds but also a possible vehicle for restoring abundant populations of these species."[469] Based on their findings, the researchers predicted if all CRP in North Dakota were converted back to cropland:

- Sedge Wrens would be reduced by about 26.[470]
- Lark Buntings would be reduced by 17%.
- Grasshopper Sparrows would be reduced by over 20%.

- Baird's Sparrows would be reduced by about 3%.
- Dickcissels would be reduced by about 17%.

Even though practitioners agreed that CRP provides numerous environmental benefits, they also emphasized that native prairie provides benefits that CRP cannot replace. For instance, native prairie is critical for many grassland birds that do not use either crop fields or CRP land for survival. These grassland bird species include the Burrowing Owl, Sprague's Pipit, and the Chestnut-collared Longspur.[471] Therefore, even though CRP has been successful in increasing the total amount of habitat for many wildlife species, gains in CRP cannot make up for losses in native prairie.

Easements

The most successful conservation program for permanently protecting grassland in North Dakota is the USFWS Grassland Easement Program (see page 54 for full description). This perpetual easement program prevents land from being converted to cropland and is desirable to many landowners because it allows them to maintain their grazing, haying, and hunting rights. Numerous practitioners we spoke with said the grassland easement program is one of best ways to perpetually protect rangeland for livestock, habitat, and hunting. However, funding for this program lags far behind demand. One official estimates that as of early 2009, about 100 landowners in North Dakota remain on the waiting list, representing about 47,000 acres of grassland. Practitioners fear that many of these landowners will be forced, for economic reasons, to sell their land for other uses before being accepted. From the perspective of conservation practitioners, lack of funding prevents this program from reaching its full potential. Additionally, state law in North Dakota prohibits Duck Stamp money—an important source of easement funding in other states—to be used on grassland easements in the state.

Technical and Cost-Share Assistance

The USFWS Partners of Fish and Wildlife has found that grazing management plans and cost-share assistance have been important tools in improving the profitability of rangeland, thus increasing the likelihood that the land will not be converted to crop production. However, while these improvements are helpful, they are often not sufficient to compete with the economic benefits of selling the land or converting it to crop production.

Other technical assistance programs reduce the impact of crop production on water and wetland quality. The Natural Resources Conservation Service (NRCS) states that some of its best tools for mitigating these impacts are residue management, reduced tillage, pest management, nutrient management, and crop rotation management. One particularly helpful activity conducted by NRCS is soil testing, which informs landowners of soil nutrient conditions and allows for better tailored inputs that reduce both financial costs and environmental impacts. Many of these practices, when implemented properly, trim costs for farmers and reduce soil erosion, nutrient loss and runoff, and pesticide use. NRCS works with landowners to find the practices that make the most economic sense for them; however, many farmers remain skeptical of the economic benefits or are averse to taking a chance on them. NRCS practitioners generally believe that landowners want to do what is best for the land but are limited by what is economically feasible.

Therefore, NRCS continues to look for ways to better illustrate and communicate to farmers the cost reductions they can achieve through these conservation practices.

The Private Land Open for Sportsmen (PLOTS) program is a cost-share program offered by the North Dakota Game and Fish Department (GFD) as part of the Private Lands Initiative. Landowners enrolled in PLOTS receive payments for opening land with habitat value to hunters. As with other state-level policies throughout the PPR, the PLOTS program depends on partnerships with federal programs, such as CRP and CREP.[472] One North Dakota official stated that the PLOTS program has played a significant role in motivating landowners to enroll or re-enroll their land in CRP. However, even the combined financial incentives of PLOTS and CRP have not been enough to compete with high commodity prices. As a result, losses of CRP land have also led to conversion of PLOTS acres to "row crops or small grains."[473]

Landowner Outreach and Education

Several respondents mentioned that educational outreach is an important way to increase participation in conservation programs. Landowner workshops were a commonly cited example. The workshops are conducted by a collaboration of organizations: USFWS, NRCS, GFD, Pheasants Forever, and Ducks Unlimited, as well as others. The workshops primarily educate participants on federal land retirement and technical assistance programs, such as CRP, WHIP, and EQIP. One of the main goals of the workshops is to explain the economic benefits these programs provide. Likewise, many farmers attend in order to learn about more sustainable forms of income, such as that provided by CRP, rather than solely relying on volatile commodity prices.

Regulations

Several practitioners described Swampbuster as a critical federal policy for protecting wetlands (see page 43 for full description). As explained by one practitioner, this policy has virtually halted wetland filling and drainage in the state. This respondent stated that if Swampbuster were lifted, the state would experience a wholesale loss of wetlands. Despite Swampbuster's effectiveness, unregulated wetland loss still occurs. For instance, this respondent noted that some farmers have been known to plow up land surrounding wetlands in such a way as to intentionally cause sedimentation that fills the wetland in over time. Some farmers have also been known to repeatedly drive vehicles near wetlands, packing down the land and creating drainage ditches. Quantifying these practices is difficult and the frequency may be marginal, but they illustrate the economic pressures landowners face and thus the importance of Swampbuster in preventing large-scale wetland loss.

Figure 9.4 System Diagram of Conservation Policies and Programs in North Dakota

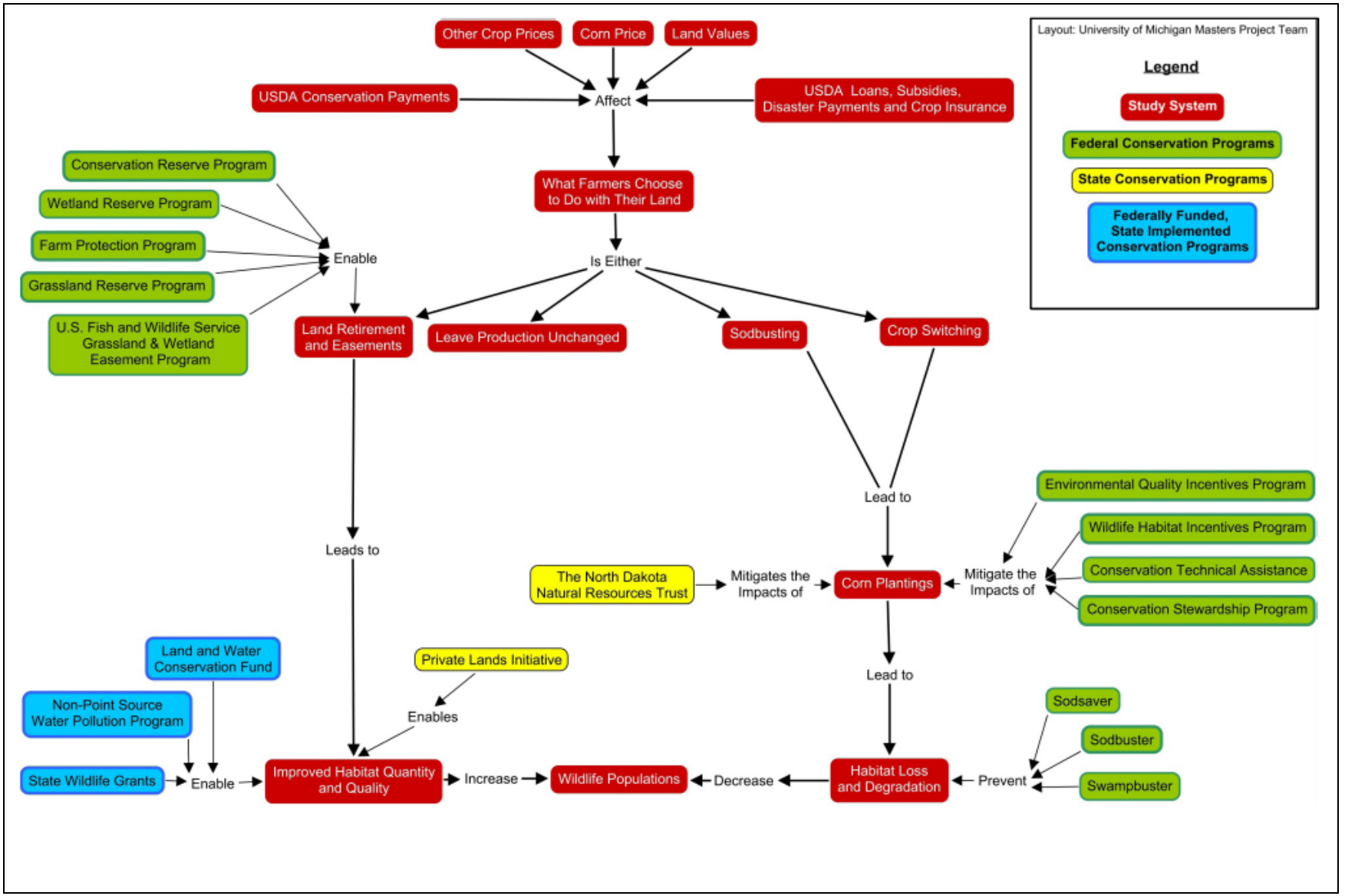


Table 9.4

Federally Funded and Implemented Programs in North Dakota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Conservation Reserve Program	FSA/NRCS	FY08	$101,019,575 in rental payments[474]	2,837,745 acres as of 10/08[475]
		FY07	$112,632,000 in rental payments[476]	3,388,474 acres as of 10/07[477]
		FY06	$111,749,000 in rental payments[478]	3,371,582 acres as of 10/06[479]
		FY05	$110,604,000 in rental payments[480]	3,341,233 acres as of 9/05[481]
Wetland Reserve Program	NRCS	FY07	$3,022,397 allocated to ND[482]	5,102 acres added[483]
		FY06	$2,999,953 allocated to ND[484]	2,039 acres added[485]
		FY05	$2,688,914 allocated to ND[486]	4,129 acres added[487]
Grassland Reserve Program	NRCS	FY07	Unknown	Unknown
		FY06	$1,399,987 obligated for contracts[488]	11,307 acres added[489]
		FY05	$1,055,524 obligated for contracts[490]	19,560 acres added[491]
Conservation Stewardship Program	NRCS	FY08	$1,913,206 approved by ND[492]	Unknown
		FY07	Unknown	Unknown
		FY06	$1,763,669 approved by ND[493]	177,431 acres added[494]
		FY05	$4,625,549 approved by ND[495]	490,627 acres added[496]
Wildlife Habitat Incentive Program	NRCS	FY08	$1,073,338 allocated to ND[497]	21,943 acres added[498]
		FY07	$461,003 allocated to ND[499]	3,638 acres added[500]
		FY06	Unknown	4,986 acres added[501]
		FY05	$460,969 allocated to ND[502]	2,504 acres added[503]
Environmental Quality Incentives Program	NRCS	FY07	$22,385,193 allocated to ND[504]	712 contracts added[505]
		FY06	Unknown	738 contracts added[506]
		FY05	$22,014,952 allocated to ND[507]	972 contracts added[508]
Technical Assistance	NRCS	FY07	$13,551,816 allocated to ND[509]	Unknown
		FY06	$13,141,954 allocated to ND[510]	Unknown
		FY05	$14,142,678 allocated to ND[511]	Unknown
Grassland & Wetland Easement Program	FWS	All	Unknown	Unknown

Table 9.5

Federally Funded and State Implemented Programs in North Dakota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Land and Water Conservation Fund	ND Parks and Recreation	FY08	$207,789 apportioned to ND[512]	1 ND Park in 2008[513]
		FY07	$251,523 apportioned to ND[514]	No ND Parks created
		FY06	$251,523 apportioned to ND[515]	No ND Parks created
Non-Point Source Pollution Program	ND Department of Health	FY03-FY06[516]	$16,796,420 distributed by ND[aa]	69 different projects from 2003 to 2006, including 22 development phase projects, 9 educational projects. 9 technical support projects, and over 25 watershed projects.[517]
State Wildlife Grants	ND Game & Fish Department	FY01-08 Annual Average	$607,052 allocated to ND[518]	On-the-ground wildlife and habitat conservation, restoration, and mitigation.
		FY08	$605,091 allocated to ND[519]	

[aa] Amount distributed by the ND NPS Program (includes TMDL development).

Table 9.6

State Funded and Implemented Programs in North Dakota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Description**
The North Dakota Natural Resources Trust	ND Game & Fish Department, ND Water Commission, Others	FY07	$13.8 million[520] (total cash assets of roughly $16 million)[bb]	The mission of the North Dakota Natural Resources Trust is to "preserve, enhance, restore, and manage wetlands and associated wildlife habitat, grasslands, and riparian areas in the ND of North Dakota."[521] Trust programs promote water storage on marshland, restoration of wetlands and grasslands, conservation of grazing system, conversion of cropland to rangeland through easements, cost-shares and technical assistance.[522] Accomplishments include 47,856 acres of wetlands and 186,627 acres of grassland and riparian habitat preserved, restored, managed, and enhanced; 180,167 acres of conservation tillage/no-till; 3,329.44 acres acquired by Trust.[523]
Private Lands Initiative	ND Game & Fish Department	FY05-07	$9.8 million[524] from Habitat Stamp sales and Game and Fish general fund[525]	The purpose of the PLI is to conserve habitat on private land by paying landowners to allow hunting and offering cost-share assistance for habitat enhancement.[526] Programs within the Initiative promote the establishment, conservation, and enhancement of wetland, grassland, and woodland habitat. Accomplishments include 1.1 million acres enrolled in the PLOTS open access program through 2007.[527]

Conclusion

While North Dakota has a significant amount of remaining native prairie, wildlife in the state is facing increasing pressure from sodbusting and CRP loss. These land-use changes are driven by agricultural expansion and are worsened by state politics. Many practitioners pointed to political, cultural, and generational forces as barriers to conservation efforts in North Dakota. State and local policies impede habitat conservation by prohibiting land trusts from operating in the state and limiting perpetual easements.

State practitioners explained that the predominant farming mentality in North Dakota is to "take control of the land." Another respondent explained that most North Dakotan farmers are of an older generation, and are resistant to using conservation practices when they are unsure of the outcome. This 'production first' mindset remains strong among the state's farming community.

[bb] $25 million authorized by State Congress.

Respondents also explained that conservation can be politically controversial in the state; the political climate favors economic growth through further agricultural expansion. When designing conservation strategies in North Dakota, these political, cultural, and generational forces must be considered in addition to the economic factors driving land-use decisions. This is more important than ever before, as corn and other crops are rapidly expanding onto the state's remaining native prairie.

Chapter 10: South Dakota State Profile

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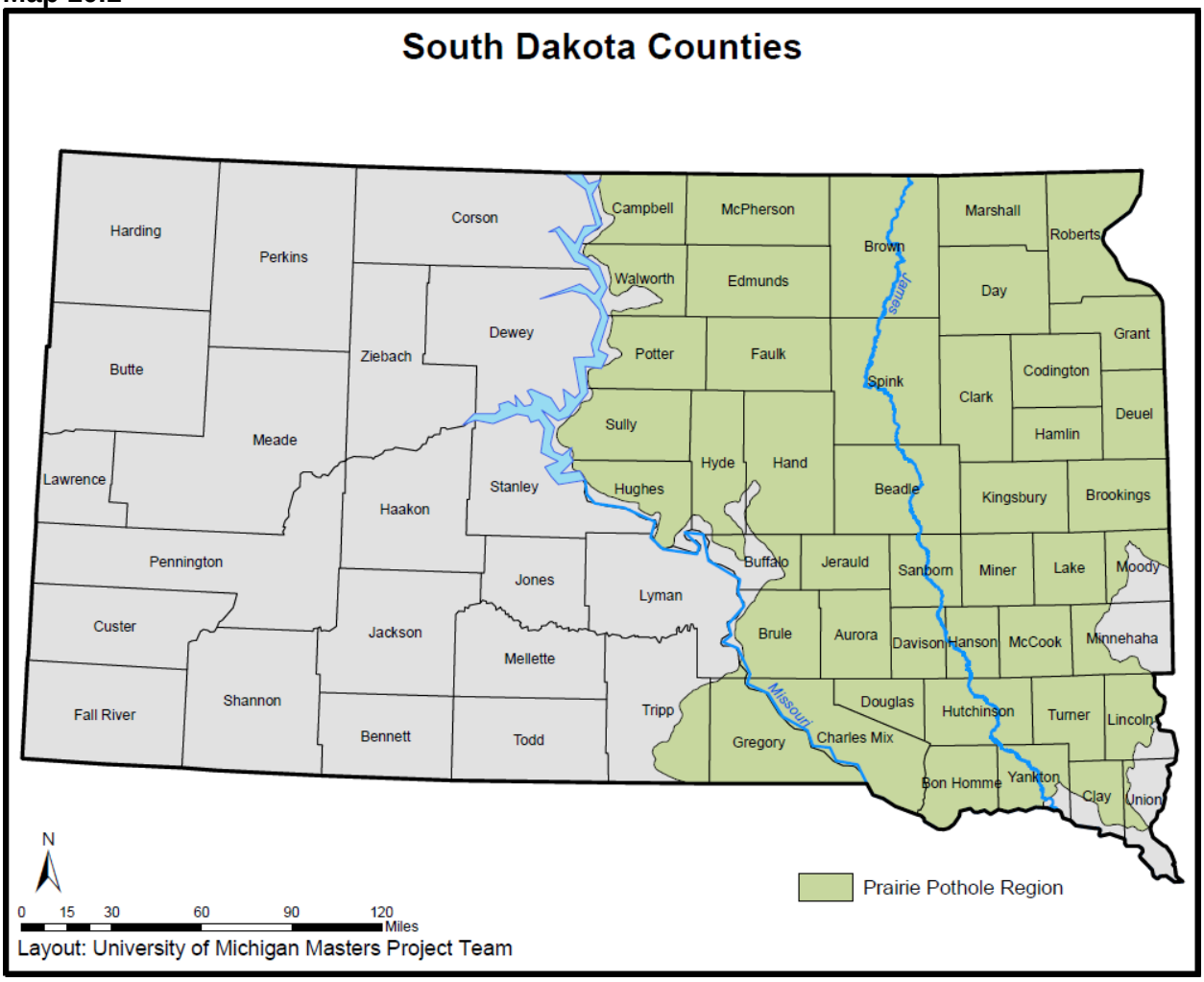
Wetland Reserve Program Land in South Dakota
Photo: NRCS

Map 10.1


South Dakota Counties
Harding
Perkins
Corson
Campbell
McPherson
Marshall
Roberts
Brown
Walworth
Edmunds
Day
James
Dewey
Ziebach
Potter
Faulk
Grant
Butte
Spink
Codington
Clark
Deuel
Meade
Sully
Hamlin
Lawrence
Hyde
Hand
Stanley
Hughes
Beadle
Kingsbury
Brookings
Haakon
Pennington
Buffalo
Jerauld
Sanborn
Miner
Lake
Moody
Jones
Lyman
Custer
Jackson
Brule
Aurora
Davison
Hanson
McCook
Minnehaha
Mellette
Fall River
Shannon
Tripp
Douglas
Hutchinson
Turner
Lincoln
Missouri
Bennett
Todd
Gregory
Charles Mix
Bon Homme
Yankton
Clay
Union
N
0 15 30 60 90 120
Miles
Prairie Pothole Region
Layout: University of Michigan Masters Project Team

Chapter 10

South Dakota State Profile

South Dakota's state government has implemented robust incentive programs to bring ethanol production to the state. These programs have been widely successful, with ethanol production in the state increasing over 450% between 2002 and 2009. Along with the state's growing ethanol production capacity, the number of corn acres planted across South Dakota has also been increasing, with the state's average annual corn acreage up over 20% in this decade compared to the 1990s average. Additionally, almost 50% of South Dakota's corn crop is used for ethanol production—more than any other state.[528]

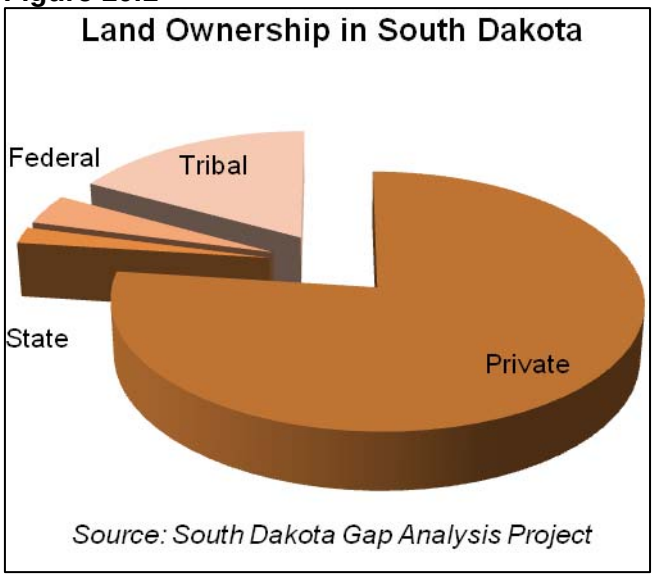
The strong demand for in-state corn has put even more pressure on South Dakota's agricultural land. Record high corn prices have further incentivized the conversion of land into corn production. Conservation practitioners in the state cited the fact that rising commodity prices made re-enrolling land in the Conservation Reserve Program (CRP) unattractive to many of the state's farmers as a major cause of land conversion. The loss of this conserved land, as well as the conversion of current grazing land into cropland, has reduced habitat throughout the state. Despite these pressures, there is significant opportunity for habitat preservation in the state; about 25% of the state's Prairie Pothole Region (PPR) is still composed of native prairie or grazing land. Adequate funding and effective implementation of both state and federal land conservation programs is necessary to keep this remaining habitat from being lost.

The following chapter discusses South Dakota's land use, ethanol industry and incentives, the status of habitat and wildlife issues, the threats posed by ethanol expansion, and the conservation successes and challenges described by South Dakota practitioners.

Land Ownership and Usage

Approximately 77% of South Dakota's 49.4 million acres (77,116 square miles) are held by private landowners. Another 17% of the state's area consists of tribal lands. Of the remaining land, 2.1% is state land and 3.9% is federal (Figure 10.1). [529]

Figure 10.1



The U.S. Fish and Wildlife Service (USFWS) manages six National Wildlife Refuges and six Wetland Management Districts in South Dakota, totaling over 223,000 acres. Among these is the Sand Lake National Wildlife Refuge, which is consistently cited as one of the most important wetlands in the world by various bird and wetland groups.[530] In addition to these refuges, the USFWS oversees

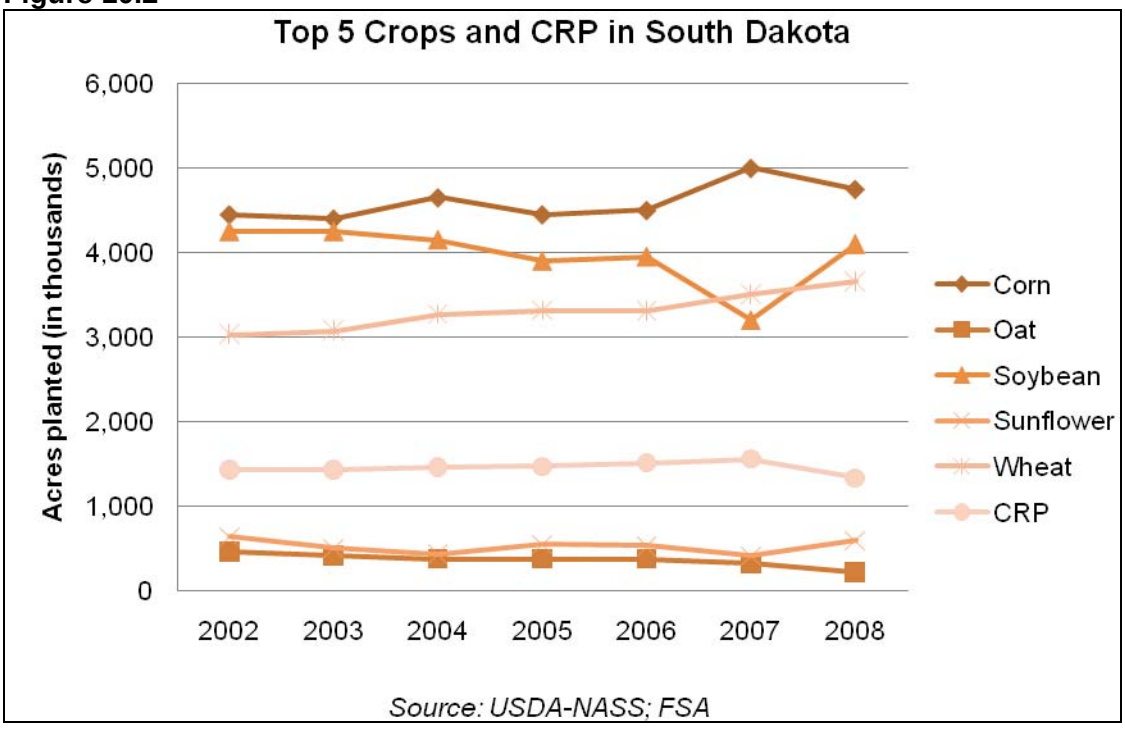
2,820,000 acres of wetland easements on private lands throughout the state. These easements cover 5.85% of the state's total area and make the USFWS South Dakota's largest public land manager.

The U.S. Forest Service manages the state's four National Grasslands, which total 867,000 acres. The National Park Service manages another 179,000 acres within the state. This land is divided into seven areas, many of which contain ecologically important mixed-grass prairie.[531] The Army Corps of Engineers and the Bureau of Land Management manage the state's remaining federal land.

About 65% of South Dakota's state owned land is managed by the School and Public Lands Commission for various state institutions, as well as grazing and mineral and energy development. The South Dakota Department of Game, Fish and Parks (GFP), manages the remaining 289,000 acres of state land. Of this land, 103,000 acres are part of the state park system, with the vast majority (70,781 acres) comprising the area of Custer State Park.[532] The rest of the GFP land is held in Game Production Areas.[533]

Two land trusts operate in South Dakota: the Northern Prairies Land Trust, which also works in Nebraska;[534] and the Lewis and Clark/Spirit Mound Trust, which focuses on preserving Spirit Mound, a part of the Lewis and Clark Trail that lies along the Missouri River.[535] The Nature Conservancy also owns about 9,000 acres in the state.[536]

Figure 10.2



Like most states in the Northern Great Plains, the vast majority of South Dakota's land is in farms. Almost 90%—43.4 million acres—of South Dakota's private land is in farms. Of this land 52.7%, or 22.9 million acres, is pasture. Another 43.7%, 19.0 million acres, is cropland. The

remaining 2.5 million acres are farmland under other uses.[537] The five field crops with the most planted acreage in South Dakota are corn, soybeans, wheat, sunflowers, and oats. In 2007, these crops made up 21.8%, 15.3%, 14.0%, 1.8% and 1.4%, respectively, of South Dakota's total cropland (Figure 10.2).[538]

South Dakota had a small but consistent increase in total number of acres enrolled in CRP each year between 2000 and 2007. Total CRP enrollment in South Dakota increased from 1.33 million acres in 2000 to 1.56 million acres in 2007. This trend reversed in 2008, with enrollment falling to 1.34 million acres for FY 2008. By January of 2009, South Dakota's CRP enrollment had fallen even further, reaching an eight-year low of 1.23 million acres.[539]

Corn Ethanol Industry

South Dakota's first ethanol refinery was built in the town of Scotland in 1988, but the state's ethanol industry did not begin significant growth until the late 1990s.[540] By 2002 the state was producing 165 million gallons of ethanol a year, and strong state incentive programs have brought that number up to 786 million gallons per year as of early 2009. At the end of 2008, South Dakota was fifth in the nation for ethanol production, responsible for 8.5% of the country's ethanol refining capacity.[541] There are presently 13 operating refineries in the state and 2 non-operating refineries, which are owned by the recently bankrupt VeraSun Energy Corporation (Table 10.1).

Ethanol production dominates the use of the state's corn crop. For the last several years, South Dakota has led the nation in the percentage of the state's corn crop used to produce ethanol. In 2008, almost 50% of the state's corn crop was converted to ethanol.[542] This is a large increase from 2007, when 25% of a record-high corn crop was used to produce 6.49 billion gallons of ethanol.[543]

As in other states, ethanol consumption is growing in South Dakota. In 2005, approximately 27 million gallons of ethanol were consumed in the state, placing South Dakota 23rd in the nation for ethanol consumption.[544] In 2007, consumers were able to find E85 at 58 fueling stations in the state. In 2008, a state incentive of $5,000 for fueling stations that installed a blending pump was distributed, but as of 2007 South Dakota ranked 7th in the nation in terms of numbers of E85 fueling stations.[545,546]

Table 10.1

South Dakota Biorefinery Locations and Capacities							
Company	**Locally Owned**	**Location**	**Nameplate Capacity (mgy)[cc]**	**Operating Production (mgy)**	**Estimated Corn Used (million bu/year)[dd]**	**Estimated Co-Products (thousand tons/year)**	**Expansion Capacity (mgy)**
Advanced Bioenergy, LLC	N	Aberdeen	50	50	18.5	151.2	0
Advanced Bioenergy, LLC	N	Huron	32	32	11.9	96.7	33
Dakota Ethanol, LLC	Y	Wentworth	50	50	18.5	151.2	0
Glacial Lakes Energy, LLC	Y	Watertown	100	100	37.0	302.3	0
Glacial Lakes Energy, LLC	N	Mina	107	107	39.6	323.5	0
North Country Ethanol, LLC	N	Rosholt	20	20	7.4	60.5	0
POET Biorefining	N	Big Stone City	79	79	29.3	238.9	0
POET Biorefining	N	Chancellor	110	110	40.7	332.6	0
POET Biorefining	N	Hudson	56	56	20.7	169.3	0
POET Biorefining	N	Mitchell	68	68	25.2	205.6	0
POET Biorefining	N	Scotland	11	11	4.1	33.3	0
POET Biorefining	N	Groton	53	53	19.6	160.2	0
Redfield Energy, LLC	Y	Redfield	50	50	18.5	151.2	0
VeraSun Energy Corp.	N	Marion	Unknown	Not Operating	N/A	N/A	0
VeraSun Energy Corp.	N	Aurora	Unknown	Not Operating	N/A	N/A	0
Total			**786.0**	**786.0**	**291.1**	**2,376.4**	**33.0**

Source: Renewable Fuels Association, February 2009

The South Dakota ethanol industry benefits from a variety of federal and state incentives and regulations. Figure 10.3 shows the combination of state and federal programs that drive demand for corn ethanol in South Dakota. In addition, Table 10.2 describes the state-level programs and their funding levels.

[cc] mgy denotes million gallons per year of ethanol produced.
[dd] Estimates are based on 1 bushels of corn yielding approximately 2.7 gallons of ethanol and 18 lbs of DDGS.

Figure 10.3 System Diagram of Corn Ethanol Laws, Incentives, and Programs in South Dakota

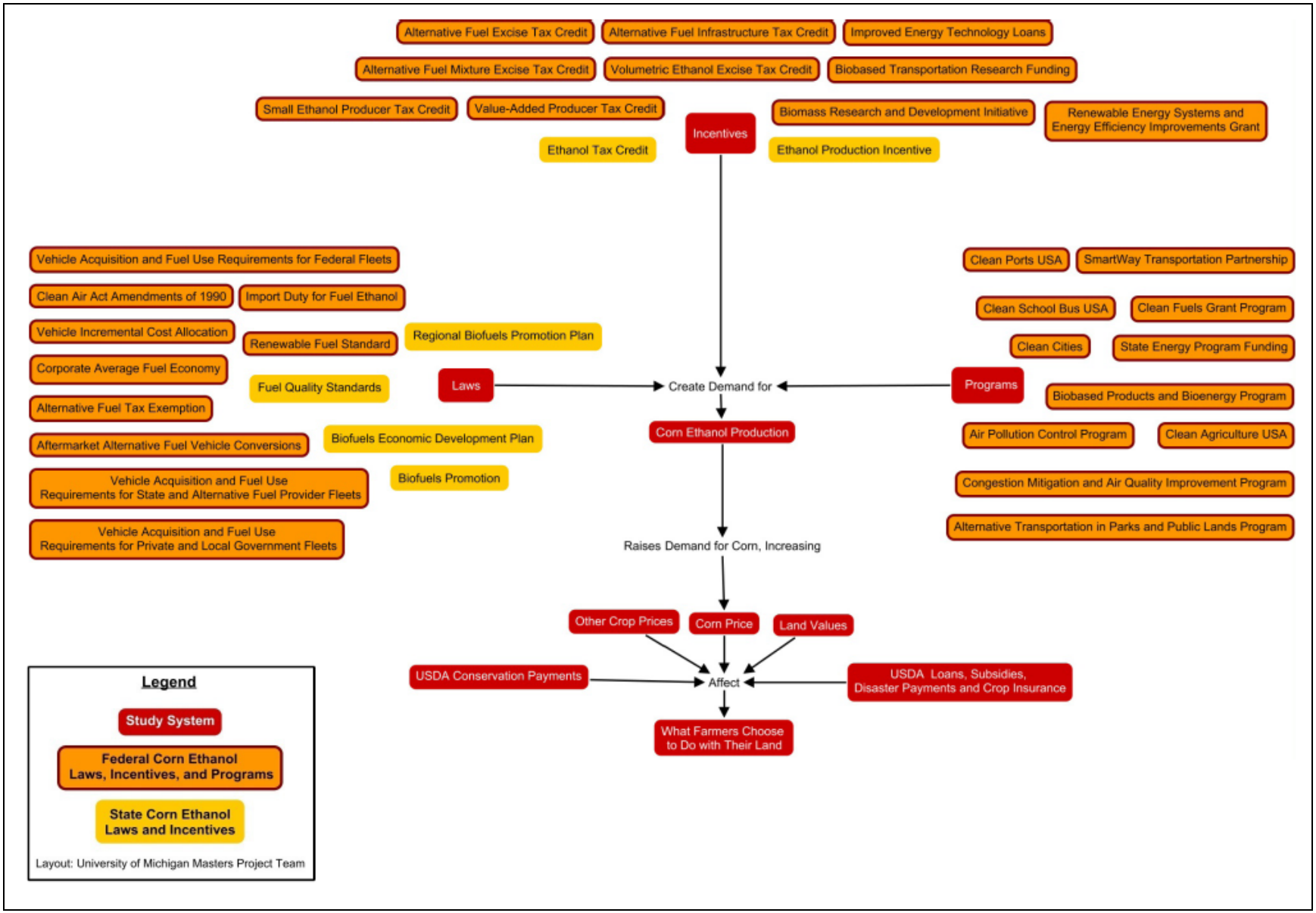


Table 10.2

South Dakota Ethanol Incentives, Laws, and Regulations		
Name	**Description**	**Funding**
Ethanol Tax Credit (South Dakota Statutes 10-47B-4 and 10-47B-136)	"Licensed fuel blenders may be eligible for a tax credit for gasoline blended with ethanol to create E85. The tax credit is a $0.02 per gallon tax break for the 10% blend and a $0.12 per gallon tax break for E85."[547] Ethanol is taxed at a rate of $0.08 per gallon at the wholesale level.[548]	Since the credit's inception in 1979, $75 million in taxes were not collected from gasoline users.[549]
Ethanol Production Incentive (South Dakota Statutes 10-47B-162)	"A $0.20 per gallon production incentive is available to ethanol producers for ethanol that is fully distilled and produced in South Dakota. To be eligible for this incentive, the ethanol must be denatured and blended with gasoline to create an ethanol blend. Cumulative annual production incentives paid out may not exceed $7 million."[550]	The cumulative annual production incentive payments made under this section may not exceed: FY 2003: $4 Million FY 2004: $5 Million FY 2006: $6 Million FY 2007 onward: $7 Million per year[551]
Biofuels Promotion **"25 x 25" Goal** (House Concurrent Resolution 1010, 2007)	"The South Dakota Legislature supports a "25 x 25" vision in which agricultural products will provide 25% of the total energy consumed in the United States by the year 2025. Biodiesel and ethanol will be used to meet this goal."[552] This goal has resulted in a variety of agency-level programs.	$6 million in rail-line work and in loans for improvements for ethanol plants in the eastern part of the state.[553]
Regional Biofuels Promotion Plan "The Energy Security and Climate Stewardship Platform Plan"	South Dakota, along with IN, IA, KS, MI, MN, OH, and WI has adopted the Energy Security and Climate Stewardship Platform Plan, with the following goals: "1. Produce commercially available cellulosic ethanol and other low-carbon fuels in the region by 2012; 2. Increase E85 availability at retail fueling stations in the region to 15% of stations by 2015, 20% by 2020, and 33% of all fueling stations in the region by 2025; 3. Reduce the amount of fossil fuel that is used in the production of biofuels by 50% by 2025; 4. By 2025, at least 50% of all transportation fuels consumed by the Midwest will be from regionally produced biofuels and other low-carbon transportation fuels. The Platform also establishes a regional biofuels corridor program…(which) directs state transportation, agriculture, and regulatory officials to develop a system of coordinated signage across the Midwest for biofuels and advanced transportation fuels."[554]	Biofuels Corridor Funding: The U.S. Department of Energy gave $1.3 million in grant money to the Indiana Office of Energy and Defense Development, which is coordinating the project through the Clean Cities Program.[555]

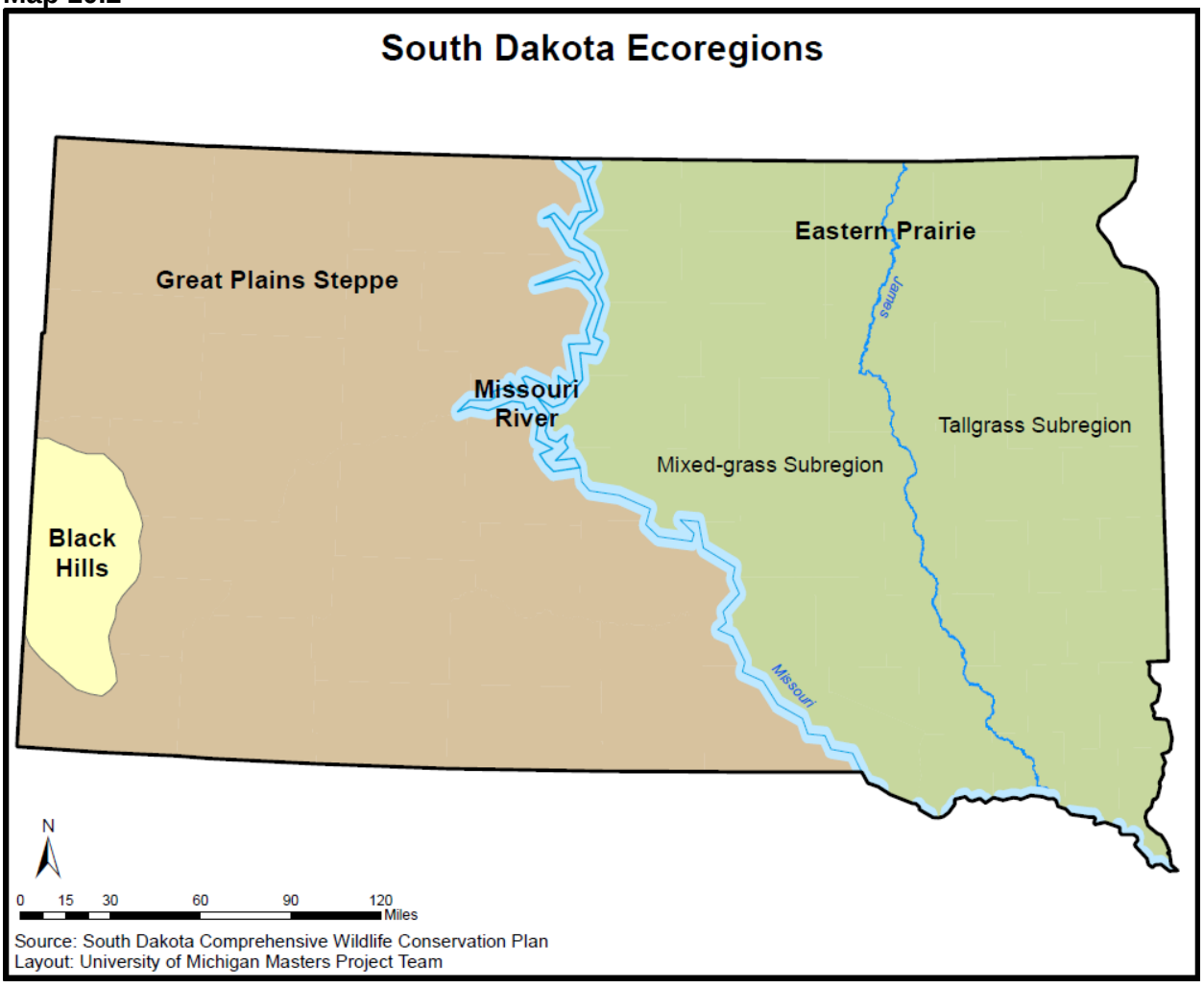
Name	Description	Funding
Biofuels Economic Development Plan (Senate Concurrent Resolution 8, 2007)	" South Dakota Legislature has resolved to develop a biofuels economy in the state by investing in the development of perennial biomass crops, including switchgrass and other native grasses by supporting long-term research and development of crops and cropping systems; and providing opportunities to purchase biofuels by promoting the development of vehicles that operate on biofuels, expanding the government purchase of biofuels, and offering incentives for fueling stations offering blends of biofuels such as E85 and B20."[556]	In 2008 a $5,000 cash grant was awarded for the installation of new blender pump technology. Free marketing support was also provided. FFV's were about 82% of the state's order of new vehicles in 2006, bringing the FFV total in the state fleet to 562 units or about 17%. The governor has set a goal of FFVs accounting for 57% of the South Dakota fleet by 2010. State employees are required to purchase E85 fuel from convenience stores and other private sector pumps when fueling state vehicles. [557]

Ecological Background

In the 1800s, South Dakota's natural habitat consisted of grassland prairies teaming with abundant wildlife populations such as bison, elk, pronghorn, and bighorn sheep. Over-hunting, agricultural expansion, and loss of disturbance regimes have led to the decimation of many of these populations. A little less than half of South Dakota—east of the Missouri River—lies within the PPR. The State Wildlife Action Plan, known as the South Dakota Comprehensive Wildlife Conservation Plan (CWCP), denotes this region as the Eastern Prairie Ecoregion, which is made up of a Mixed-grass Subregion adjacent to the Missouri River and a Tallgrass Subregion on the easternmost side of the state (Map 10.2).

The Mixed-grass Subregion is characterized by glacial till plains interspersed with potholes and ridges of low, rolling hills known as moraines. Land use in this area is dominated by farming and ranching, with 70% of the land in agricultural cultivation and 25% composed of native prairie or pastureland for ranching. The Tallgrass Subregion is characterized by rolling glacial till plains. This is the wettest region of South Dakota, and potholes are estimated to comprise around 10% of this landscape.

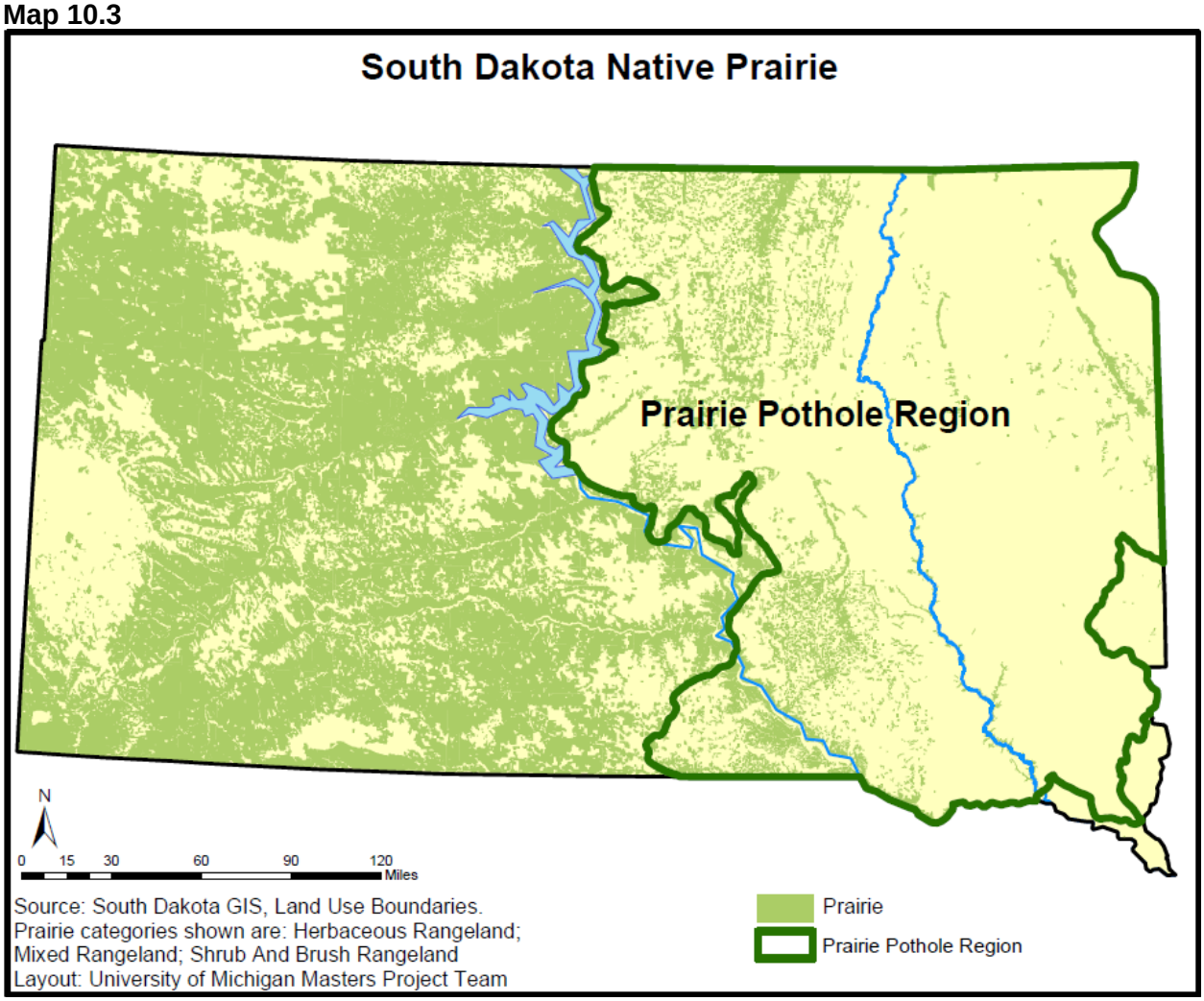
Map 10.2



Remaining Native Prairie

Map 10.3 shows an estimate of remaining native prairie (based on rangeland data) in South Dakota. A 2009 report by the Nature Conservancy estimates that only 2% of the remaining native prairie in South Dakota is legally protected.[558] Much of South Dakota's grassland lies west of the Missouri River, but the PPR also has a considerable amount of remaining prairie, particularly in the mixed-grass subregion. The grassland in this region is most at risk for conversion to cropland. At the same time, this grassland is critically important for wildlife, particularly waterfowl species that breed in upland grassland around wetlands. New technology, including genetically modified crops, is increasingly allowing the native prairie in the state to be converted into corn acres. Further corn expansion will continue to threaten the remaining prairie in the region, potentially fragmenting some of the large remaining swaths and threatening grassland species.

Map 10.3



Species of Conservation Concern

The South Dakota CWCP identifies 30 species that are listed as threatened or endangered and designates 90 species as species of conservation concern. These 90 species include: 28 birds, 20 fish, 10 mammals, 10 reptiles, 9 insects, 7 mussels, 4 snails, and 2 amphibians. Of these 90 species, 47 have breeding or migratory habitat in one of the two subregions within the PPR. Table 10.3 shows these species, their habitats (by PPR geographic region), and major relevant threats they face, as identified in the CWCP. Many of these species of conservation priority in the PPR are threatened by loss of native prairie habitat, loss of wetlands, and pesticide use. Some are so threatened by cultivation and conversion of native grassland that their populations have suffered major declines. According to the CWCP, one such species, the Long-Billed Curlew, has been extirpated from the region because of these threats.

Table 10.3

South Dakota Species of Conservation Concern in the PPR							
	Habitat Subregion			Major Threats[ee]			
	Mixed-Grass	Tallgrass	Prairie Loss	Wetland Loss	Wetland Degradation	Pesticides	Other Relevant Threats
Birds							
American White Pelican	●	●		●		●	
Bald Eagle	●	●					
Ferruginous Hawk	●	●	●				
Peregrine Falcon	●	●	●			●	
Greater Prairie Chicken	●	●	●			●	Fragmentation of native prairie
Whooping Crane	●	●		●	●		
Willet	●	●		●			
Long-Billed Curlew	●		●			●	Agricultural practices disturb nest sites
Marbled Godwit	●	●		●			Habitat fragmentation
Wilson's Phalarope	●	●		●			
Black Tern	●	●		●	●	●	
Burrowing Owl	●	●	●				
Sprague's Pipit	●		●				Habitat fragmentation
Lark Bunting	●	●	●			●	
Baird's Sparrow	●	●	●				Draining of wet meadows
Le Conte's Sparrow	●	●		●			
Chestnut-Collared Longspur	●	●	●			●	

[ee] Only threats associated with increased corn plantings, new breakings, and CRP losses are included.

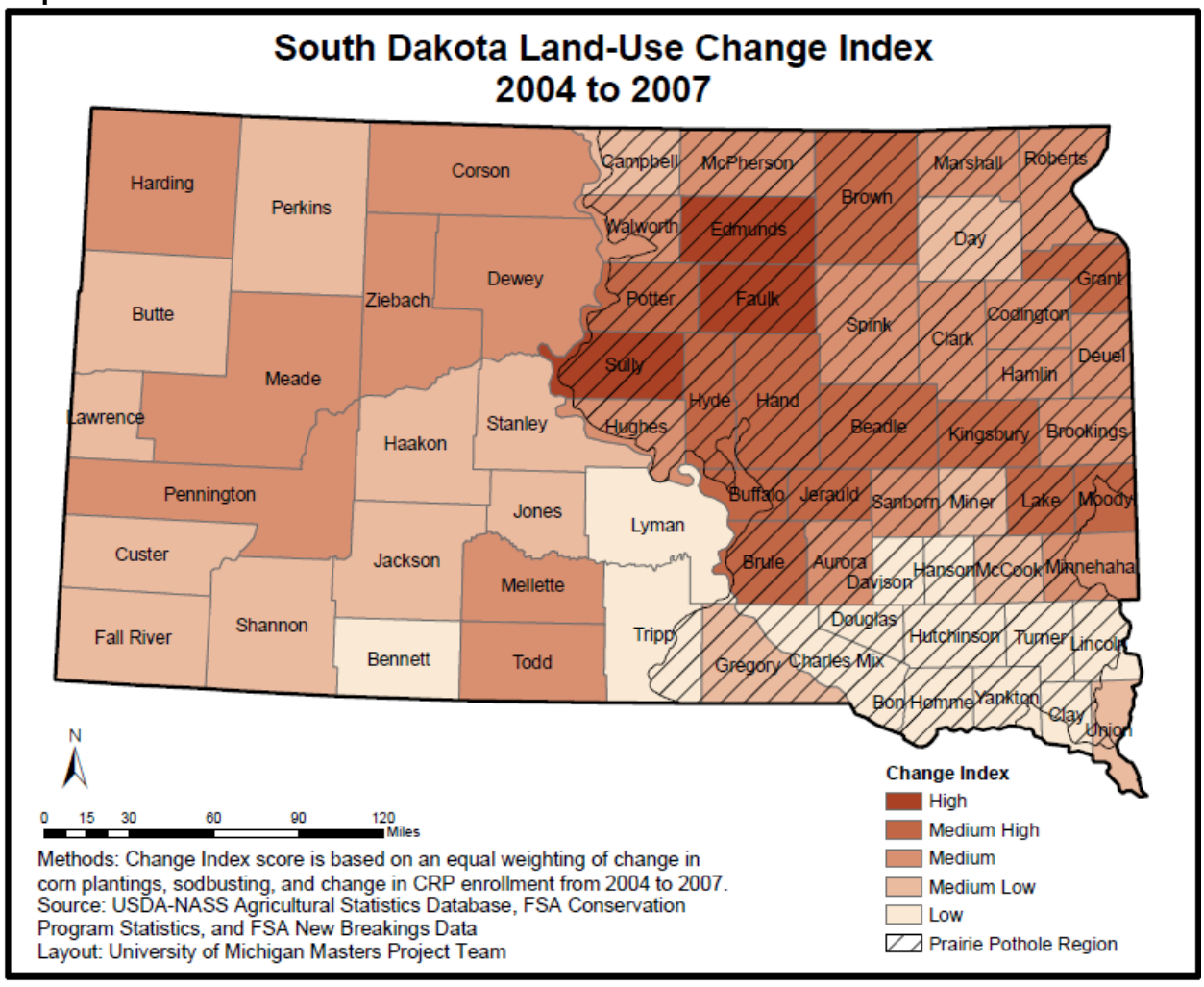
Table 10.3

South Dakota Species of Conservation Concern in the PPR							
	Habitat Subregion			Major Threats[ee]			
	Mixed-Grass	Tallgrass	Prairie Loss	Wetland Loss	Wetland Degradation	Pesticides	Other Relevant Threats
Mammals							
Franklin's Ground Squirrel	●	●	●				Fragmentation
Richardson's Ground Squirrel	●	●		●			
Northern River Otter	●	●					Water pollution
Freshwater Mussels							
Elktoe		●				●	
Rock Pocketbook	●	●				●	
Creek Heelsplitter		●				●	
Hickorynut		●				●	
Mapleleaf	●	●				●	
Insects							
Powesheik Skipperling		●	●			●	
Ottoe Skipper	●	●	●			●	
Dakota Skipper		●	●			●	
Iowa Skipper	●	●	●			●	
Regal Fritillary	●	●	●			●	
Fishes							
Banded Killifish		●		●	●	●	
Blacknose Shiner		●				●	
Central Mudminnow		●		●	●		
Northern Redbelly Dace		●					Water pollution
Topeka Shiner	●	●					Water pollution
Trout Perch		●					Water pollution
Southern Redbelly Dace		●					Water pollution
Hornyhead Chub		●					Water pollution
Rosyface Channel		●					Water pollution
Logperch		●					Water pollution
Blackside Darter		●					Water pollution
Reptiles/Amphibians							
Blanding's Turtle		●		●	●	●	
Lined Snake		●		●			
Eastern Hognose Snake	●	●	●			●	
Cope's Gray Treefrog		●		●		●	
Smooth Softshell		●				●	
Northern Cricket Frog	●	●				●	

Land-Use Change Hotspots

Habitat loss and degradation is one of the greatest challenges facing wildlife in South Dakota. In order to determine which areas have experienced the most agricultural land-use change, and therefore where habitat might be affected most, we undertook a GIS analysis of land-use changes in the state (Map 10.4). Chapter 1 explains our methodology for calculating South Dakota's Land-Use Change Index.

Map 10.4



Our change analysis for South Dakota reveals a hotspot of land-use change east of the Missouri River, particularly in the high-quality, mixed-grass prairie region of the state. The counties with the highest change index scores are Edmunds, Faulk, and Sully counties. Beadle, Grant, Hand, Jerauld, and Kingsbury counties also ranked very highly. All of these counties experienced increases in corn plantings, with Edmunds, Faulk, Kingsbury, and Sully counties experiencing particularly dramatic increases. In these counties, as much as 3–7% of county land was brought into corn production between 2004 and 2007. The high scores for Edmunds, Faulk, Hand, Jerauld, and Sully counties are also due to the high percentage of county area converted from native grassland to cropland between 2004 and 2007 (between 1–1.4% of county area). CRP loss

between 2004 and 2007 was not substantial, as most counties actually increased in CRP enrollment during this time. However, Beadle, Faulk, and Sully counties experienced a net loss of CRP land in this time period, and their change index values were higher as a result of this.

Discussions with state conservation and wildlife practitioners confirmed that land-use change in the high-ranking counties present serious threats to wildlife populations, particularly because these counties contain some of the highest quality prairie and wetland habitat that remains in the PPR. Although most land-use trends illustrated in the map were confirmed, some agency officials questioned the amount of new breakings in Edmunds County; they did not agree that it ranks as highly as the new breakings data collected by the Farm Service Agency (FSA) suggest. This disagreement over the accuracy of new breakings data underscores the need for complete and consistent recording of grassland loss across the Northern Great Plains.

Effective Conservation Programs and Policies

Federal conservation programs are critical to the preservation of wildlife habitat in South Dakota. Several state-level programs complement these federal programs, often working as cost-shares or adding additional incentives to existing federal conservation incentives. Tables 10.4, 10.5, and 10.6 describe the scope, impacts, and funding levels of federal and state conservation programs and policies in South Dakota, and Figure 10.4 shows how they interact to conserve wildlife and habitat.

Through discussions with policy and wildlife practitioners in South Dakota, several of these programs and policies emerged as being the most effective in protecting habitat and environmental quality in the state. Chapter 1 contains a list of all organizations with staff interviewed for this report. All programs described help to mitigate habitat loss or degradation and will play a critical role as agricultural land-use changes continue to occur.

Land Retirement

As in other states, CRP is a far-reaching and popular program among landowners in South Dakota. According to published written communication from a South Dakota GFP official, of all the conservation provisions in the Farm Bill, "…CRP provides hands-down the single most significant wildlife habitat benefits by providing a landscape level of undisturbed cover for numerous wildlife species."[559] CRP has contributed to an increase in pheasant populations to a level that has not been seen in the state in over 35 years.[560] Because pheasant hunting is so important to the rural economies of South Dakota, CRP has been a boost not only for wildlife populations but also for the state's economy.

However, enrollment statistics show that participation in CRP in South Dakota has substantially declined between 2007 and 2009. One official noted that the state was below the national average in terms of extensions and re-enrollment. Practitioners stated that one reason for this decline was that the program was not financially attractive to landowners at a time when commodity prices were high. During the extension and reenrollment period in 2006, the rental rates offered to farmers were ten years old. Asking landowners to add two to five years to their CRP contracts with a ten-year-old rental rate was "unreasonable," stated one official.

One South Dakota official said that FSA is now seeing a lot of interest in CRP, mainly because crop prices are decreasing and the rental rates in many counties have increased as a result of a recent rate review. Despite this interest, practitioners note that they do not anticipate conducting a general sign-up for some time, given that the last Farm Bill reduced the national enrollment cap from 39.2 to 32 million acres. Therefore, many interested landowners will be unable to enroll in the program unless their land qualifies for targeted conservation practices through continuous sign-up.

While CRP enrollment has not occurred through general sign-up in the past five years, continuous sign-up has been successful in bringing acres into the program. In contrast to general sign-up, continuous sign-up is conducted all the time, but landowners must enroll for specific practices, such as riparian buffers, filter strips, restoration practices, and marginal pasture and wetland buffer practices. The practices offered under continuous enrollment are decided at the county level. One official explained that the most popular practices in the state's continuous sign-up program are those related to wetlands in eastern South Dakota.

The Farmable Wetlands Program (FWP) was described in several interviews as being one of the most used programs under continuous CRP sign-up. FWP is a voluntary program that restores farmable wetlands and associated buffers by providing annual rental payments, incentive payments, and cost-share for installing necessary practices. FWP contracts last from 10 to 15 years. Up to 100,000 acres can be enrolled in any one state, and as of February 2009, there were 45,902 acres enrolled in FWP in South Dakota. One restriction of FWP is that enrolled wetlands must be 10 acres or smaller, and only the first 5 acres receive payment. To encourage enrollment of wetlands larger than 5 acres, SDGFP provides a one-time incentive payment for any wetland acres enrolled in FWP between the 5 and 10 acre limit.[561]

Another successful program under continuous CRP sign-up is the State Acres For wildlife Enhancement (SAFE) program. This program is designed to protect high-value wildlife species specific to each participating state or region.[562] In South Dakota, SAFE targets Ring-Necked Pheasants, prairie chickens, upland nesting ducks, Sage Grouse, and other sagebrush obligate birds.[563] According to one official, SAFE acres in South Dakota "sold out in two weeks."

Other farm bill conservation programs are active in South Dakota but with smaller successes than CRP. State practitioners stated that the Grassland Reserve Program has functioned in some areas but has not been well funded, so the overall impact on the landscape has been minimal. Similarly, the Wetland Reserve Program focuses mainly on wetlands and its scope is much smaller than CRP.

Easements

As in North Dakota, one of the most popular conservation tools for protecting grassland in South Dakota is USFWS's Grassland Easement Program (see page 54 for full description). As one South Dakota official explained, hundreds of landowners are interested in this type of easement because it allows them to continue grazing, haying, and hunting on the land. Funding for this program lags far behind demand. The official explained that hundreds of landowners are waiting

to enroll, but the agency can only fund about 50 easements a year. Similarly, another official estimated that there is a backlog of approximately 700 South Dakota landowners, representing about 210,000 acres of grassland. Practitioners expressed concerns that many of these landowners will decide to lease or sell their land for other uses before the easement can be purchased. From the perspective of conservation practitioners, lack of funding prevents the USFWS Grassland Easement Program from reaching its full potential.

Technical and Cost-Share Assistance

According to interviews, the two most effective state cost-share programs are the Wildlife Habitat Incentives Program (WHIP) and the Environmental Quality Incentives Program (EQIP) (see pages 51 and 49 for full descriptions). EQIP was described as the main cost-share program supporting conservation practices. While this program does not directly target wildlife conservation, the end results are improved grassland management and improved water quality. EQIP was described as having "the biggest bang for the buck" in helping landowners create grazing management systems. However, one problem of the EQIP program is that the application process for the program is time-consuming and therefore may discourage participation.

The USFWS also works with landowners to design grazing management plans. One USFWS official explained that these plans help make ranching more profitable by allowing more cattle to be supported and reducing operation costs. Making ranching more profitable increases the likelihood that the land remains as rangeland or pastureland and is not converted to crop production.

Landowner Outreach and Education

Educational outreach arose as an effective way to increase participation in conservation programs.[564] Landowner workshops are conducted in the state through a collaboration of several organizations, including the USFWS, Natural Resources Conservation Service, Pheasants Forever, and Ducks Unlimited. The workshops educate participants on federal land retirement and technical assistance programs, such as CRP, WHIP, and EQIP. One of the main goals of the workshops is to explain the economic benefits these programs provide.

Partnerships

Several interviewees pointed to the importance of inter-agency and agency-NGO partnerships in achieving conservation goals. For example, South Dakota GFP implements a number of programs that complement or piggyback on federal programs. When there is a potential for large blocks of land to come out of CRP, the state agency works with USFWS to put up fences to keep the land in grass for livestock production. An FSA official also mentioned that non-federal efforts to increase participation in CRP are very helpful. Pheasants Forever, for instance, actively promotes CRP to producers. Other private land programs complement conservation with additional incentives for public hunting and grazing management systems.

Figure 10.4 System Diagram of Conservation Policies and Programs in South Dakota

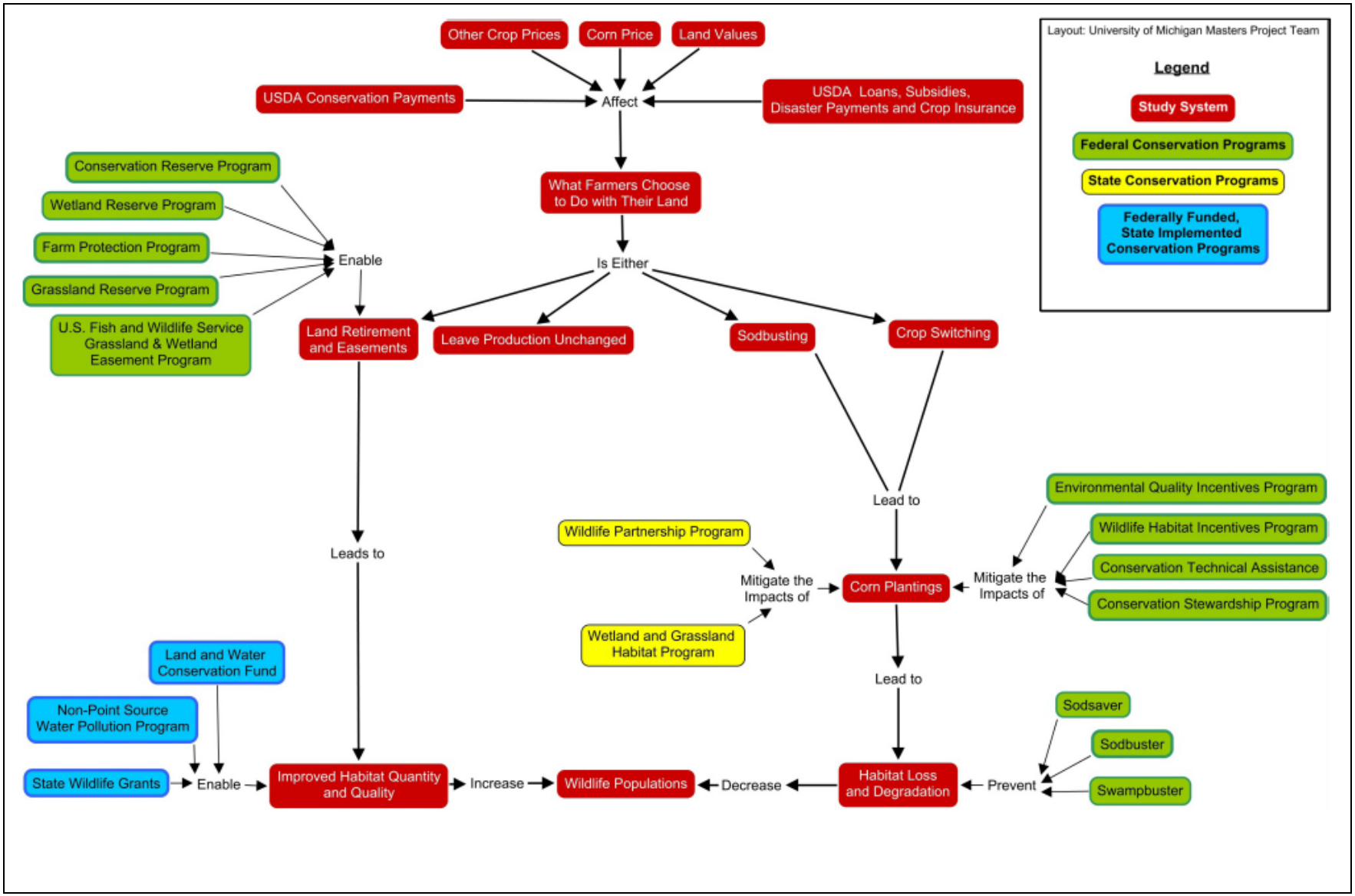


Table 10.4

Federally Funded and Implemented Programs in South Dakota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Conservation Reserve Program	FSA/NRCS	FY08	$58,581,720 in rental payments[565]	1,310,708 acres as of 9/08[566]
		FY07	$65,872,000 in rental payments[567]	1,559,343 acres as of 10/07[568]
		FY06	$63,250,000 in rental payments [569]	1,515,227 acres as of 10/06[570]
		FY05	$60,647,000 in rental payments [571]	1,473,199 acres as of 9/05[572]
Wetland Reserve Program	NRCS	FY07	$3,302,805 allocated to SD[573]	1,088 acres added[574]
		FY06	$2,556,893 allocated to SD[575]	1,355 acres added[576]
		FY05	$2,736,650 allocated to SD[577]	2,414 acres added[578]
Grassland Reserve Program	NRCS	FY07	Unknown	Unknown
		FY06	$2,057,985 obligated for contracts[579]	18,044 acres added[580]
		FY05	$2,378,486 obligated for contracts[581]	11,214 acres added[582]
Conservation Stewardship Program	NRCS	FY08	$1,561,523 payments approved by SD[583]	Unknown
		FY07	Unknown	Unknown
		FY06	$1,317,996 payments approved by SD[584]	148,944 acres added[585]
		FY05	$663,208 payments approved by SD[586]	64,817 acres added[587]
Wildlife Habitat Incentive Program	NRCS	FY08	$950,644 allocated to SD[588]	11,610 acres added[589]
		FY07	$462,108 allocated to SD[590]	4,774 acres added[591]
		FY06	Unknown	6,373 acres added[592]
		FY05	$626,068 allocated to SD[593]	24,973 acres added[594]
Environmental Quality Incentives Program	NRCS	FY07	$20,887,628 allocated to SD[595]	369 contracts added[596]
		FY06	$17,746,447 allocated to SD[597]	442 contracts added[598]
		FY05	$17,855,093 allocated to SD[599]	412 contracts added[600]

Name	Implementing Agency	Fiscal Year	Funding	Outcome
Technical Assistance	NRCS	FY07	$12,210,712 allocated to SD[601]	Unknown
		FY06	$11,455,301 allocated to SD[602]	Unknown
		FY05	$11,488,885 allocated to SD[603]	Unknown
Grassland Easement Program	FWS	All	Unknown	Unknown

Table 10.5

Federally Funded and State Implemented Programs in South Dakota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Outcome**
Land and Water Conservation Fund	SD Parks and Recreation	FY08	$211,498	4 State Parks created[605]
		FY07	$256,018	3 State Parks created[607]
		FY06	$256,018	No State Parks created[609]
Non-Point Source Pollution Program	SD NPS Task Force; SD Dept. of Environment and Natural Resources	FY08	$3,160,100 allocated to SD[610]	TMDL Assessment; Watershed Planning & Assistance; 3 watershed projects[611]
		FY07	$3,150,700 allocated to SD[612]	TMDL Assessment; Grassland Management; watershed projects; 6 TMDLs were approved by EPA[613]
		FY06	$3,263,000 allocated to SD[614]	Watershed Assessment; watershed and water quality projects; 8 TMDLs were approved by EPA[615]
		FY05	$3,282,600 allocated to SD[616]	Watershed Assessment; watershed and water quality projects; 8 TMDLs were approved by EPA[617]
State Wildlife Grants	SD Game & Fish Department	FY08	$ 605,091 allocated to SD[618]	On-the-ground wildlife and habitat conservation, restoration, and mitigation.
		FY01-FY08 Annual Average	$607,052 allocated to SD[619]	

Table 10.6

State Funded and Implemented Programs in South Dakota				
Name	**Implementing Agency**	**Fiscal Year**	**Funding**	**Description**
Wildlife Partnership Program (WPP)	South Dakota Department of Game, Fish & Parks, Division of Wildlife	Annual	The Department has an annual budget of roughly $500,000 for private lands projects.[620]	As in other PPR states, the WPP is designed to complement federal Farm Bill conservation programs. It is a cost-share program to help landowners develop pheasant habitat.[621] GFP provides up to 100% of the cost to establish Dense Nesting Cover on plots ranging from 10 to 160 acres in size. These are 10-year contracts.[622] GFP also cost-shares up to 100% of the cost to plant native warm season grass,[623] reimburses landowners up to 75% of the cost to plant woody habitat,[624] and provides $20-$40 per acre to establish wildlife food plots.[625]
Wetland and Grassland Habitat Program (WGHP)	South Dakota Department of Game, Fish & Parks, Division of Wildlife			The WGHP is also designed to complement Farm Bill programs. It helps landowners develop waterfowl habitat by offering technical assistance and cost-sharing for both wetland and upland restoration, enhancement and creation.[626] GFP provides up to 100% of the cost to restore wetland hydrology,[627] and up to 100% of the cost of seed needed to convert cropland to grass.[628]

Conclusion

Land-use change in South Dakota is fueled by conversion of rangeland and pastureland into cropland, as well as the state's low rate of CRP re-enrollment. As evidenced by our Land-Use Change Hotspot analysis, South Dakota's land-use change has been concentrated in the state's Eastern Prairie Ecoregion. A part of the PPR, this region is critically important habitat for ducks and other migratory birds. Continued loss of habitat in this area has the potential to further imperil many of the state's species of conservation concern. Also at risk are the population gains in game bird populations that have been occurring throughout the state since the inception of CRP.

In conversations, South Dakota practitioners pointed out that the number of landowners operating their own land is declining. For example, one practitioner noted that the American farmer is aging, which has increased absentee ownership and the number of landowners who are retiring and renting out acres. This results in "broken ties" to the land, which compromises the stewardship ethic. While interviews also revealed a strong conservation ethic among South Dakotans and a motivation to do what is best for the environment and wildlife, these "broken ties" should be considered when addressing ways to strengthen and incentivize conservation in the state.

Chapter 11: Four-State Comparison

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Sign Inside North Dakota Game and Fish Department
Photo: Aviva Glaser

Chapter 11
Four-State Comparison

Our interviews with policy and conservation practitioners in Iowa, Minnesota, North Dakota, and South Dakota were focused on land-use trends, the conservation challenges created by these trends, and conservation tools within each state. These interviews revealed both common themes and meaningful differences with regard to corn ethanol's impacts and the programs and policies that can serve to mitigate such impacts. Understanding these similarities and differences helps to define necessary improvements and to inform whether policy responses should be national or state-specific.

Predominant Themes across Iowa, Minnesota, North Dakota, and South Dakota

The following four themes were addressed by nearly all conservation practitioners with whom we spoke. Therefore we highlight them as major themes across the four states.

The Threat of Ethanol and High Corn Prices

When asked to describe whether corn ethanol production poses threats to habitat and wildlife in their state, many respondents pointed to corn prices as a central driver of corn expansion. As one respondent explained, ethanol "is a threat in so far as it keeps corn prices high" because high corn prices incentivize either converting native prairie to cropland or removing land from conservation programs. The weight placed on ethanol as a threat to habitat and wildlife varied among respondents. Corn ethanol was described both as "one of many pressures" and as "a real threat." The resounding theme, however, was that habitat and associated wildlife in the Prairie Pothole Region (PPR) are fragile and face numerous challenges—even without the new pressures from corn ethanol. These additional pressures made conservation practitioners throughout the four states feel less equipped to protect habitat and wildlife.

The Role of Economic Factors in Decision-Making

Respondents in all states stressed that landowners largely make land-use decisions based on economic factors. Most respondents qualified this statement by saying that many landowners are also environmentally conscious, and they see the value of preventing soil erosion, protecting water quality, and in most cases, preserving native prairie. The recent economic recession has lessened the already small profit margins most farmers and ranchers earn. When conservation practices, such as retiring land from production or implementing more sustainable grazing practices, make economic sense, then landowners will choose to participate. But respondents explained that economic incentives for conservation must keep pace with the changing profitability of planting crops. This has been a problem in recent years as commodity prices have risen. Practitioners in all states said that many landowners who did not re-enroll Conservation Reserve Program (CRP) land when given the option in 2006 made that decision because their rental rates were not competitive with commodity prices. They stated that rental rates in general were not updated often enough to be able to compete on an economic basis. Technological factors are also changing the economics of breaking native prairie; new genetic varieties of crops

have made formerly unsuitable land more profitable for crop production, so many producers are breaking new land for this purpose. For these reasons, respondents in all states explained that, in order for conservation to be successful, conservation options must compete economically with crop production.

The Value of the Conservation Reserve Program

Another resounding theme that emerged was the importance of CRP for providing habitat and other environmental benefits. Concerns about CRP loss are widespread, and almost all practitioners pointed to uncompetitive rental rates and lack of general CRP sign-up since 2006 as the reason behind dramatic declines in enrollment. Without a general sign-up, multiple practitioners explained the value of continuous CRP enrollment in bringing practice-specific acres into the program. Several practitioners also mentioned that the reduced acreage cap specified by the 2008 Farm Bill will make the recent CRP losses even more difficult to recoup. Respondents from North and South Dakota emphasized that even though CRP land is critically important, CRP does not replace the ecological value of the swaths of native prairie that still exist in the Dakotas.

The Importance of Ranching

Respondents from all states mentioned that rangeland is important habitat and that the profitability of ranching is necessary to prevent the conversion of native prairie to crop production. Respondents pointed to a disparity between the high subsidy payments given to crop producers and the limited support available for ranchers. Even though representatives in all study states mentioned this "uneven playing field," it was a particularly strong theme in North and South Dakota, where much more rangeland is present than in Iowa and Minnesota. In Iowa, practitioners expressed a similar concern about pastureland. Even though pastureland is seeded for the purpose of feeding livestock, and therefore does not necessarily represent native plant communities in the way that rangeland does, it provides better habitat for wildlife than row crops.

The Benefits of Working Lands Programs

Another theme across the region was the importance of working lands programs that promote best-management practices on farms and ranches. Because agriculture dominates much of the states' landscapes, these programs help protect soil, water, and habitat in ways that land retirement and easement programs cannot. Practitioners in all states explained that working lands programs such as the Wildlife Incentives Habitat Program (WHIP) and the Environmental Quality Incentives Program (EQIP) are very popular among landowners, but unfortunately staff, time, and funding limitations make it impossible to accommodate many of those interested in participating. Practitioners in all states explained that the Natural Resources Conservation Service (NRCS) does not have enough representatives to work directly with landowners to determine their eligibility and diagnose which practices should be implemented. To overcome this challenge, several states rely on partnerships between NRCS, state agencies, and conservation organizations that allow more specialists to be in the field working directly with private landowners.

Different Landscapes, Different Concerns about Ethanol Threats

When asked whether corn ethanol production threatens habitat and wildlife in their states, almost all practitioners prefaced their concerns with a description of the current status of habitat abundance and quality. They described how corn plantings for ethanol exacerbate on-going trends of habitat loss and degradation. Concerns about corn ethanol's impact on habitat and wildlife differed from state to state based on the quantity and quality of native habitat that remains. Respondents' descriptions of their states' unique habitat concerns and conservation priorities are summarized below. Interviewees were asked specifically about prairie and wetland habitat, which are most under threat by agriculture expansion, and therefore forest ecosystems were not addressed.

Iowa

Iowa has the least amount of native habitat remaining among the four study states, and conservation practitioners in the state described the natural habitat as extremely limited and highly degraded. One respondent said that Iowa has converted 97% of its wetlands and more than 99% of its prairie. Furthermore, nutrient loading and erosion from intensive agriculture have severely degraded the state's wetlands and streams. Nearly all respondents mentioned that poor water quality is a primary concern among conservationists and landowners in the state. Because so much of Iowa was in agricultural production prior to the boom in corn ethanol, increased corn prices have resulted in more corn-corn rotations, with a visible impact on water quality in some areas. Practitioners also are concerned about losing pasture to row crops, as the former vegetation provides at least some suitable habitat for wildlife. CRP loss has posed additional threats to wildlife in Iowa. One respondent noted that as corn prices rose in 2007, many landowners participating in CRP actually reneged on their contracts in order to move land into corn. To address these various threats, conservation priorities in Iowa include restoring wetlands and riparian areas and preserving remaining fragments of native habitat through acquisitions and conservation easements. Water quality is, and will continue to be, the primary environmental concern that motivates conservation in the state.

Minnesota

While slightly more prairie exists in Minnesota than Iowa, most of the state's prairie landscape has been lost to agriculture, with less than 1% of the original 18 million acres of prairie remaining.[629] Minnesota conservation practitioners described the state's prairie and wetland habitat as sparse, fragmented, and under continued pressure from agriculture. Even though prairie and wetland restoration have been major priorities and have been successfully incentivized through state programs, one practitioner stated that land-use change is the biggest threat to wildlife in the state and discussed the draining of the state's many wet areas for agricultural production. Furthermore, prairie on private land that is not protected is still at risk of conversion to agriculture if commodity prices are high enough. Several practitioners described the ethanol boom as creating new pressures on wildlife habitat in the state through increased corn plantings.

North Dakota

North Dakota has some of the highest quality native prairie that remains in the four-state area. Practitioners described the prairie and wetland complex in the eastern portion of the state as critically important to supporting nationally and internationally important waterfowl. In fact, waterfowl conservationists in Iowa and Minnesota explained that what happens in the Dakotas directly impacts the migrating waterfowl that travel through their states. North Dakota practitioners are extremely concerned about loss of native prairie to crop production, fueled not just by corn ethanol demand but also by crop insurance and disaster payments that incentivize plowing of prairie land. New forms of drought-tolerant crops also contribute to the expansion of row crops onto native prairie. Practitioners expressed concern about large losses in CRP, and like interviewees in Iowa, they observed that landowners reneged on CRP contracts when corn prices were high. Practitioners explained that some of the most significant hurdles to conservation in North Dakota are state laws that outlaw permanent easements and require the governor's approval for non-profit land acquisition.

South Dakota

South Dakota contains the largest quantity of high quality native prairie in our four state focal area. The concerns in South Dakota are very similar to those in North Dakota: prairie is fragmented and wetlands are being lost and degraded. The Dakotas are similar in that they both support the most productive area of what Ducks Unlimited describes as the "duck factory." Threats to native prairie in South Dakota are nearly identical to those described in North Dakota. The profitability of ranching is declining, while crop insurance, disaster payments, and high commodity prices incentivize conversion to crop production. In addition to these threats, South Dakota supports a much larger corn ethanol industry than North Dakota, and thus demand for corn for ethanol is higher in this state. Nonetheless, in contrast to North Dakota, the state benefits from a booming pheasant hunting industry that incentivizes land conservation.

Implications for Wildlife across the Four States

Because our interviews with practitioners focused primarily on threats to habitat rather than impacts on wildlife, we referred to each state's respective State Wildlife Action Plan (SWAP) to better understand what interviewees' comments meant for wildlife populations. This also allowed us to compare the different wildlife concerns across states. A review of each state's SWAP reveals that the land-use changes practitioners described are likely to threaten and cause declines in many species of conservation concern. Furthermore, the land-use changes associated with increased ethanol production—loss and degradation of prairie, wetlands, and CRP—are all mentioned as threats to many species. This indicates that corn ethanol production is exacerbating already existing threats rather than creating a new set of challenges for wildlife.

Of the four states, Iowa's SWAP sends the most urgent message for wildlife conservation, reflecting Iowa's status as having the most degraded and least amount of habitat left. The SWAP explains that nearly one third of the identified 1,000 species in the state need conservation to prevent them from declining further into threatened or endangered status. The threats to Iowa's

wildlife echo the concerns expressed during interviews: habitat loss due to conversion to row crops and draining of wetlands; habitat fragmentation and loss of connectivity; and habitat degradation through pesticide and fertilizer runoff—all of which are associated with increased corn plantings. The SWAP reveals that grassland species such as prairie chickens, Sharp-tailed Grouse, Short-eared Owls, and Bobolinks have very little remaining habitat in the state. In some areas in the state, the only grassland found is in roadside ditches, which is not suitable for sensitive obligate species.[630]

Minnesota's SWAP explains that the major threats to the state's wildlife are habitat loss and habitat degradation. Therefore, practitioners' comments that grassland conversion and wetland draining are occurring in the state suggest that wildlife populations will suffer as a result. The SWAP lists 292 species as "species in greatest conservation need" in the state,[631] and of these species, 224 are found in Minnesota's prairie regions—a disproportionately high percentage given that the state hosts a variety of habitat types other than prairie. There are 20 unique species that are found only within these PPR regions and not in any other part of the state.

The North Dakota SWAP identifies loss of native prairie habitat as the largest threat to the state's wildlife. Many species are also sensitive to loss and degradation of wetland habitat and CRP land. North Dakota conservation practitioners stated that these land-use trends are occurring at alarming rates and are exacerbated by increased corn ethanol demand and high corn prices. This spells disaster for the state's wildlife populations that rely on prairie and wetland habitat. The North Dakota SWAP identifies 100 species of conservation priority, 31 of which are associated with the PPR.

As in the other states, many of South Dakota's species of conservation priority are threatened by loss of native prairie habitat, loss of wetlands, and pesticide use. State practitioners explained that these habitat changes will continue as row crops replace rangeland. The South Dakota SWAP designates 90 species as species of conservation concern, with a third of them listed as threatened or endangered. Of these 90 species, 47 rely heavily on the PPR. Some are so threatened by conversion of native grassland to cropland that their populations have suffered major declines.

A Closer Look at Conservation Successes and Challenges across the Four States

The following section summarizes comments from practitioners regarding the successes and challenges of implementing conservation efforts in their respective states. While we discuss some similarities, we pay particular attention to unique approaches, successes, and challenges. As we describe these differences across states, we recognize that our interviews did not allow for a comprehensive review of how every program is operating in each state; therefore, we do not assume that just because a program went unmentioned in a particular state that it is therefore less effective. We draw comparisons when there is ample information to do so.

Sometimes the differences described are clearly attributable to different availabilities of resources and funding. Other times, the differences correspond to variations in the political climate and level of public support for conservation. When possible, these factors are explained

to help reveal how resource and funding allocation could improve the situation, as well as to indicate what types of conservation solutions are more or less feasible in certain states given the political and public support for these efforts.

Farm Bill Land Retirement Programs

CRP was described by practitioners in all states as the most far-reaching conservation program because of the sheer number of acres enrolled, but practitioners in Iowa and South Dakota also pointed specifically to the federal State Acres For wildlife Enhancement (SAFE) program within CRP as helping to increase habitat for certain wildlife species. As of 2008, total enrollment was 27,700 acres in Iowa and 20,700 acres in South Dakota. Practitioners from both Iowa and South Dakota also mentioned that demand for SAFE remains strong; at current funding levels, these states cannot accommodate all interested landowners. Although practitioners in Minnesota and North Dakota did not specifically mention SAFE acres, this does not necessarily indicate it is less important in protecting habitat in those states. Minnesota and North Dakota have comparable SAFE enrollment to the other states: 23,100 acres and 27,000 acres, respectively.[632]

After CRP, the second most commonly mentioned land retirement program was the Wetland Reserve Program (WRP). WRP has been particularly successful in Minnesota and Iowa, which have 87,151 acres and 80,083 acres enrolled in the program, respectively, as of 2008.[633] Iowa respondents stated that both WRP and the Emergency Wetland Reserve Program are extremely important for wetland restoration and protection in the state, but they are underfunded relative to landowner interest. One Iowa practitioner explained that local Farm Service Agency (FSA) offices have stopped marketing WRP because there is not adequate funding to respond to those who are interested. This practitioner believes that the demand would be even more apparent if the program were not downplayed in this way. North and South Dakota have received significantly smaller allocations of WRP funding,[634] and therefore this program has not had the opportunity to protect as many wetlands in these states. As of 2008, each state's cumulative enrollment in WRP was 37,872 acres and 36,941 acres, respectively. Funding for WRP was reauthorized by the Farm Bill in 2008 and is allocated to states on a first-come-first-serve basis.[635]

Grassland Easements

A number of the practitioners identified the Grassland Easement Program, administered by the U.S. Fish and Wildlife Service (USFWS), as the most important federal perpetual easement program in North and South Dakota. Practitioners described this program as very successful at protecting grassland, but it is severely underfunded relative to landowner interest. Current acreage information is not publicly available, but a 2004 report indicated that 136,000 acres in North Dakota and 429,000 acres in South Dakota have been protected under USFWS grassland easements.[636] One official provided estimates of the backlog of interested landowners, revealing the disparity between funding and demand. He estimated that approximately 100 North Dakota landowners, representing about 47,000 acres of grassland, are on the waiting list. In South Dakota, approximately 700 landowners, representing about 210,000 acres of land, are on the waiting list. Because Iowa and Minnesota are in a different USFWS region than the Dakotas, the

Grassland Easement Program is implemented differently in these states, and comparable enrollment and backlog data are not available.

Minnesota is the only state with a state-level easement program designed specifically to protect native prairie. The Minnesota Department of Natural Resources (DNR) runs a program called the Native Prairie Bank, whereby the agency purchases native prairie easements from private landowners, with perpetual easements receiving priority. Although important to protecting native prairie in the state, the program is relatively small and minimally funded in comparison to federal programs.

State-Federal Partnerships

Practitioners described several important state-federal partnerships that help leverage conservation funds and resources. For instance, Iowa DNR runs a Private Lands Program specifically designed to connect private landowners with a spectrum of state and federal conservation programs. The Private Lands Program works closely with the NRCS to contact and advise landowners about which conservation practices are the best fit for their land. Activities include restoring wetlands, developing winter food plots for wildlife, and planting native grass and trees.[637] DNR biologists are housed in local NRCS offices and thus have a close working relationship with the NRCS.

Another successful partnership revealed through interviews is the Reinvest in Minnesota (RIM)-WRP Wetland Restoration Partnership, described as "the premier wetland restoration program on private lands in the nation."[638] Minnesota is the only state in the study region to combine WRP easements with state funding to achieve long-term protection of restored wetlands, made possible with funds generated from lottery tickets and the state sales tax.

Practitioners in South Dakota also described the importance of partnerships. FSA officials in the state explained that they work closely with Pheasants Forever biologists, South Dakota Department of Game, Fish, and Parks (GFP), and USFWS. In particular, South Dakota GFP partners with Pheasants Forever and NRCS to place biologists in NRCS offices to provide scientific expertise and aid in program administration. As described by one official, NRCS runs numerous programs but does not have the "warm bodies" needed to get the work done.

North Dakota practitioners also mentioned the Private Lands Open to Sportsmen (PLOTS) program, managed by North Dakota Department of Game and Fish. This program works in conjunction with a variety of federal programs and conservation organizations to provide payments to landowners who open their land, including CRP, for hunting. One practitioner described this program as very important in incentivizing conservation on private land.

State Tax Incentives

In Iowa, several practitioners mentioned that a recently passed tax credit for donating land for conservation purposes was a big step towards encouraging conservation in the state. They believe this tax credit will increase the amount of land donated to conservation NGOs. The new tax credit is in addition to the itemized deduction that landowners can claim for conservation-

related donations, which reduces their taxable income. No other state in the study region provides both an itemized deduction and a tax credit for land donations. Although this tax incentive helps perpetually protect prairie through donations, one Iowa respondent explained that there are not many programs that reward landowners who have preserved native prairie on private property. The Conservation Security Program has helped, but has had limited success because only larger parcels qualify. As a result, Iowa's small parcels of prairie have been neglected. In contrast, Minnesota rewards landowners who keep native prairie on their land by providing a tax exemption called the Native Prairie Tax Exemption Program. Landowners enrolled in the program do not have to pay property taxes on the native prairie on their property.

Conservation through Public Support and NGO Efforts

In contrast to the other states, respondents mentioned that there is generally more public support for funding land conservation in Minnesota. This is evidenced by the tax increase that voters approved in 2008, making Minnesota one of only two states in the nation that has successfully created a dedicated funding source for its state wildlife diversity program. Thirty-three percent of the recent sales tax increase is dedicated to restoring, protecting, and enhancing wetlands, prairies, forests, and habitat for fish, game, and wildlife. This sales tax generates approximately $90 million a year for wildlife habitat conservation.

Although Minnesota benefits from broader public support for land conservation, all states have dedicated conservation organizations that have played a critical role in protecting natural landscapes and wildlife. Iowa NGOs, particularly The Nature Conservancy and Iowa Natural Heritage Foundation, have been very active in acquiring land and conservation easements. Throughout the four states, Pheasants Forever has been extremely successful in facilitating habitat restoration on private lands, particularly in South Dakota where there is widespread public support for the state's profitable pheasant hunting industry. Additionally, Ducks Unlimited works in all four states to restore and protect grassland and wetland habitat for waterfowl.

Ducks Unlimited and other conservation NGOs in North Dakota face unique, and in some ways insurmountable, challenges to permanently conserving natural areas even though the state has a strong outdoor recreation culture. Impeding conservation efforts are state policies that disallow permanent conservation easements and restrict land acquisition. Organizations interested in purchasing land must go before the local county commission and the state's Natural Areas Acquisition Advisory Committee, both of which advise the governor on whether to approve the sale. Respondents in North Dakota spoke with frustration about time-consuming attempts to purchase land from willing sellers, only to have state politics and policies negate their efforts.

Conclusion

Interviews revealed both similarities and differences among the four states in our study region. Several recurring themes emerged across all states, including the role of economic factors in decision-making, the importance of CRP and ranching in protecting wildlife habitat, and the benefits that working lands programs provide on farms. While the four states' SWAPs list

similar threats to wildlife and habitat across the region, the differences in existing landscapes, state programs, resources, and political attitudes result in different outcomes on the ground. Unique state-federal partnerships, state funding mechanisms, and tax incentives for conservation, and attitudes toward wildlife and habitat protection were also apparent.

Chapter 12: Conclusions and Recommendations

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Corn Field Along Highway in North Dakota
Photo: Aviva Glaser

Chapter 12
Conclusions and Recommendations

This study displays the link between increased corn plantings for corn ethanol, losses of habitat, and declining wildlife populations. First, through a review of current legislation and market data, we found that government incentives have driven recent increases in corn ethanol production. New demand for corn for ethanol has led to increased corn plantings. These new corn acres have come from land previously planted with other crops such as soy and wheat, from conservation program—primarily Conservation Reserve Program (CRP)—land, and from native prairie. Using GIS software, we determined that these land-use changes in Iowa, Minnesota, North Dakota, and South Dakota are concentrated in areas with unique ecological value. Furthermore, a statistical analysis of grassland-breeding birds shows that populations in high-change areas are declining significantly.

Interviews with over 30 conservation practitioners in the four-state area revealed that wildlife and habitat in these states are facing many pressures. While federal and state conservation programs have successfully addressed many of the challenges that existed prior to the expansion of corn ethanol, agencies often lack the funding, time, staff, and general capacity to respond to new challenges. This is particularly concerning given that federal mandates and incentives for corn ethanol production are scheduled to increase steadily over the next six years. As long as such government support for corn ethanol persists, conservation programs will likely be unable to mitigate the full impacts associated with corn ethanol production.

Key Findings

Table 12.1

Key Findings
1. Government support for corn ethanol is driving industry growth.
2. Increasing corn plantings are reducing habitat quantity and quality.
3. Permanent conservation programs are small, and long-term protection of retired agricultural land is being de-emphasized by Congress.
4. Hotspots of land-use change are concentrated in areas with unique ecological value.
5. Key wildlife populations are declining in hotspots of corn increase and land-use change.
6. Despite successes, federal and state conservation programs are limited in their ability to mitigate the increasing pressure of corn ethanol production on wildlife and habitat.
7. Unless federal laws and incentives are changed, corn ethanol production will increase in the future, causing wildlife populations to decline further.

1. Government support for corn ethanol is driving industry growth.

A large quantity and variety of federal and state laws, incentives, and programs drive growth in the corn ethanol industry. Chief among these is the Renewable Fuel Standard (RFS), which sets requirements on the levels of corn ethanol that oil companies and fuel retailers are required to blend with gasoline each year. This law essentially sets a floor for corn ethanol demand. Annual increases in these blending requirements ensure that industry capacity will continue to grow in the future. A second important incentive, the Volumetric Ethanol Excise Tax Credit (VEETC)

pays blenders 45 cents for every gallon of ethanol they blend with gasoline. This tax credit pays oil companies for complying with the RFS, and it may drive additional demand for ethanol above the RFS if gas prices are high. Furthermore, the Import Duty for Fuel Ethanol protects the domestic corn ethanol industry from cheaper foreign competition through high tariffs on imports. Other federal support subsidizes not only the production and blending of corn ethanol but also E85 fueling infrastructure, the sale of E10 and E85, and flex-fuel vehicle use. States also support corn ethanol through various channels, ranging from state-specific blending requirements which are higher than those required by the federal RFS, to incentives for the retail sale of E10 and/or E85 and incentives for ethanol refiners. This high level of support for corn ethanol production has resulted in guaranteed demand and easy financing, which are driving growth in the industry.

2. Increasing corn plantings are reducing habitat quantity and quality.

The increase in corn plantings to meet ethanol demand has been dramatic. Between 2006 and 2007, total U.S. corn plantings increased 19%, from 78.3 million acres to 93.5 million acres, displacing other crops as well as contributing to the conversion of idle land and grassland habitat. The total increase in corn plantings since 2006 coincided with documented losses in CRP from 2007 to 2009 and anecdotal evidence of increased sodbusting. Since peaking in 2007, total corn acreage has fallen to a projected 85.0 million acres in 2009.[639] However, the United States still has more acreage in corn than at any time in the past 50 years.[640] Even if some of the land being converted to corn production is returned to CRP or other land-retirement programs, it will not immediately provide the environmental services it once did, including habitat, carbon sequestration, and water quality benefits. This is particularly true of native prairie, which is lost forever once it has been put into production for agriculture.

In addition to habitat loss through the conversion of CRP acres and native prairie into corn acres, increased corn plantings contribute to increased erosion, sedimentation, and pesticide and fertilizer pollution—all of which degrade remaining habitat. Runoff of pesticides and fertilizers into waterways poses a significant threat to aquatic ecosystems, particularly for the numerous wetlands throughout the Prairie Pothole Region (PPR) and the many species that rely on them. The production and combustion of ethanol and its feedstock can also lead to increased greenhouse gas emissions and increased air pollution from emissions of carbon monoxide, VOCs, sulfur oxides, nitrogen oxides, and PM10 (particulate matter less than 10 microns in diameter).

3. Permanent conservation programs are small, and long-term protection of retired agricultural land is being de-emphasized by Congress.

Few federal programs exist to permanently protect wildlife habitat. The Wetland Reserve Program (WRP) and Grassland Reserve Program (GRP) are the only two Farm Bill programs to offer permanent easements, and these programs remain small. In fact, annual enrollments in WRP permanent easements have been declining on an annual basis since 2002, despite reports of high demand for the program. The Grassland Easement Program, run by the U.S. Fish and Wildlife Service (USFWS), also offers permanent easements. Interviews with practitioners revealed that, like GRP, demand for such easements far outstrips available funds. In addition, Congress has downsized conservation offered by land retirement programs. The 2008 Farm Bill reduced enrollment caps and funding for CRP and increased support for the Environmental

Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP), both working land programs. Such programs play a critical role in mitigating the environmental impacts of agricultural production; however, they focus less on preserving untouched habitat.

4. *Hotspots of land-use change are concentrated in areas with unique ecological value.*

A GIS analysis of land-use trends revealed that increased corn plantings are concentrated in the Midwestern United States. Within our focal area of Iowa, Minnesota, North Dakota, and South Dakota, these increases are largely concentrated in the PPR. For the two states for which sodbusting data is available, loss of native grassland habitat was also found to be concentrated in the PPR. Our Change Index analysis revealed that, even when CRP increases between 2004 and 2007 are taken into account, habitat loss and degradation associated with corn expansion are concentrated within the PPR. This is particularly alarming given the region's unique ecological value.

5. *Key wildlife populations are declining in hotspots of corn increase and land-use change.*

As demonstrated by our statistical analysis of breeding bird populations in the PPR, obligate grassland species have already experienced significant decreases in areas of high corn increase and high habitat change. Areas of high corn increase have shown significant declines in both the number of grassland species and the number of individual grassland birds. Populations of sensitive grassland birds were shown to have dropped by almost 30% between 2005 and 2008 in areas of high corn increase. Grassland birds are among the fastest and most consistently declining birds in North America. These findings demonstrate that the expansion of corn plantings may be speeding up this decline, particularly in those areas with highest corn increases and greatest losses in CRP. Birds are somewhat protected from local land-use changes because they are mobile and can shift habitats. Thus, the observed changes in bird populations may indicate more dramatic local changes for less mobile species, such as mammals, amphibians, and plants.

All but one of the five species we analyzed in our wildlife analysis are species of conservation concern in Iowa, Minnesota, North Dakota, and/or South Dakota. State wildlife action plans for the four states list dozens of species that are threatened by loss and degradation of wetlands and native prairie. The loss and degradation of grassland habitat in the region driven by increased corn plantings is further imperiling these already threatened species. Beyond the effects of increased corn plantings on specific grassland bird populations, loss of habitat in the PPR has the potential to impact North American waterfowl from across the continent, 70% of which breed in this ecologically unique region.

6. *Despite successes, federal and state conservation programs are limited in their ability to mitigate the increasing pressure of corn ethanol production on wildlife and habitat.*

Interviews with conservation practitioners in Iowa, Minnesota, North Dakota, and South Dakota revealed that a suite of federal and state programs help to conserve habitat and environmental quality in landscapes dominated by agriculture. Federal conservation programs protect millions of acres and provide measurable benefits to wildlife populations. There is a high demand for

such programs and many small state-level programs have been designed to complement and build on federal programs. Despite these successes, practitioners listed many challenges, chief among which was lack of funding, staff, and time to address new challenges to wildlife. They pointed to a variety of factors contributing to habitat losses: there is no federal disincentive for cropping on native prairie, CRP rental rates are uncompetitive, landowners are unable to enroll new land in CRP, and there is very limited funding for perpetual easements in particular. Without dramatic changes from Congress and federal agencies, conservation programs will remain limited in their ability to mitigate the impacts of corn ethanol on habitat and wildlife. Because state programs are much smaller in nature and designed to complement these federal programs, it is unlikely that increased state efforts would be able to make up the difference.

7. *Unless federal laws and incentives are changed, corn ethanol production will increase in the future, causing wildlife populations to decline further.*

Despite the promise of cellulosic ethanol, mandates for corn ethanol will continue. The RFS requires corn ethanol production to increase from 10.57 billion gallons in 2009 to 15 billion gallons in 2015. This 4.47 billion gallon increase in corn ethanol production will create demand for an additional 10.69 million acres of corn plantings a year. Such increases in corn production have serious implications for wildlife and habitat. If corn ethanol demand continues to support high corn prices, and CRP rental rates remain too low to incentivize farmers to keep their acres enrolled, CRP land will continue to be converted into cropland. Given that the deadline has passed for the governors of PPR states to sign on to the Sodsaver provision of the 2008 Farm Bill, there is currently no state or federal legislation that penalizes further conversion of native prairie into cropland. Thus, without changes to ethanol incentives, CRP, and prairie protection policy, there is little doubt that the loss of habitat in the PPR will continue, further threatening sensitive grassland species already facing population declines.

Recommendations

The impact of corn ethanol on wildlife and habitat can be mitigated in many ways. Here, we make recommendations on legislative changes, improved program implementation, NGO participation in conservation, data needs, and future research.

Table 12.2

Recommendations
Legislation
1. Reduce federal and state incentives for corn ethanol production. 2. Decrease federal blending requirements for corn ethanol. 3. Reduce disparity between government support of row-crop farming and other agriculture, such as ranching. 4. Disqualify landowners who convert native prairie to cropland from receiving federal financial support on that land. 5. Increase the capacity of federal programs to conserve prairie and wetland habitats in perpetuity. 6. Increase the CRP acreage cap and provide additional funding aimed at bringing marginal farmland into the program.
Policy Implementation
7. Hold a general sign-up for CRP in order to conserve large, contiguous blocks of land and thereby mitigate the effects of fragmentation. 8. Improve the flexibility and responsiveness of CRP rental rates in order to offer more competitive payments and conserve more acres for the same amount of money. 9. Increase Natural Resource Conservation Service's capacity to deliver technical assistance through better staffing and longer, more realistic timelines for obligating funds. 10. Standardize and simplify the application process for Farm Bill conservation programs.
NGO Participation
11. Lead state-level funding initiatives to create dedicated, long-term funding for wildlife conservation and related recreation and education. 12. Educate communities and decision-makers on the importance of revenue generated from hunting, recreation, and nature tourism associated with conservation.
Data Needs
13. Make National Agricultural Statistic Service crop data available at the county level, not just the U.S. Department of Agriculture district level, for all crops and states. 14. Collect and make available data measuring conversion of grassland to cropland. 15. Make CRP contract data more easily accessible, within reason of privacy laws. Specifically, track and make available online county-level information on broken contracts, Maximum Allowable Rental Rates, Environmental Benefits Index, and Conservation Reserve Enhancement Program. 16. Instigate a U.S. General Accountability Office investigation of the full cost of government incentives for corn ethanol. 17. Implement special monitoring programs for rare species of conservation concern.
Future Research
18. Quantify projected land-use changes and habitat loss due to the introduction of genetically modified crops and new farming technologies. 19. Examine the connection between ethanol and corn prices by studying how the opening of an ethanol refinery affects local corn prices. 20. Improve conservation, restoration, and research that help wildlife adapt to climate change, particularly within the increasingly fragmented Prairie Pothole Region. 21. Research the impacts of corn expansion on wildlife populations in the Prairie Pothole Region. 22. Quantify the effect of the recent major decline in CRP acreage on wildlife.

Legislation

1. Reduce federal and state incentives for corn ethanol production.

A large number of federal laws, incentives, and programs drive market demand for corn ethanol. Given the habitat and wildlife impacts associated with the production of corn ethanol, the sheer quantity and size of such federal and state incentives should be re-assessed. In addition, some of these programs share the same goal and may be unnecessarily costly to tax payers. One example of this is the Renewable Fuel Standard (RFS), which sets blending requirements, and the Volumetric Ethanol Excise Tax (VEETC), which pays blenders to meet the RFS. If the RFS is truly mandatory, than the VEETC is redundant in trying to incentivize blending through payments and in addition is quite costly to the federal government. This type of redundant incentive should be eliminated and the general quantity of support for corn ethanol reduced.

2. Decrease federal blending requirements for corn ethanol.

The RFS sets the floor for corn ethanol demand through blending requirements, which increase annually. These requirements are the single largest reason for recent increases in corn ethanol production. To the extent that the RFS drives demand for corn ethanol, it is clearly responsible for increasing demand for corn, resulting in changing land-use and habitat and wildlife impacts. As of early 2009, many industry groups are calling for an increase in the ethanol-gasoline blend requirement from the present cap of 10.2% to 15% in response to the recent downturn in the ethanol industry. U.S. Department of Agriculture (USDA) Secretary Tom Vilsack has stated his support for this, suggesting an increase to 12% or 13% in the short term and 15%-20% over the next two years.[641] On March 6, 2009, Growth Energy, an ethanol trade group, submitted an official request to the Environmental Protection Agency (EPA) to increase the blend rate up to 15%. The EPA has 270 days to review the request, collect public comment, and make a decision.

Increasing the blend requirement to 15% would increase demand for ethanol to about 15 billion gallons-per-year.[642,643] Such an increase would essentially pre-empt the blending requirements set by the RFS, under which 15 billion gallons of blending is not mandated until 2015. As discussed throughout this report, there are many serious wildlife and habitat impacts associated with corn ethanol production. Even the present blending increases required by the RFS will have serious impacts on wildlife and habitat (see Chapter 3). Therefore, the EPA should consider immediate reductions in the RFS rather than increases.

3. Reduce disparity between government support of row-crop farming and other agriculture, such as ranching.

Much of the native prairie remaining in the Northern Great Plains and PPR is owned by ranchers and used for livestock grazing. In addition to supporting ranchers' livelihoods, this rangeland also provides essential habitat for numerous grassland birds, upland breeding waterfowl, and other prairie species. In states like Minnesota and Iowa, where only small fragments of native prairie remain, pastureland planted with forage vegetation provides critically important habitat. Prairie and wetland wildlife depend on rangeland and pastureland. Therefore, protecting these wildlife populations necessitates protecting the viability of ranching operations.

Numerous practitioners we interviewed explained that rangeland and pasture are being converted to cropland because of the "uneven playing field" between ranchers and crop producers. Crop producers benefit from a host of federal subsidies—price supports, crop insurance, and disaster payments—while ranchers receive a small fraction of this support. Therefore, people who own grassland can earn better profits by selling or leasing their land to crop producers or converting it to cropland themselves, than by using it for livestock grazing. Unfortunately, many ranchers who want to protect their grassland for ranching operations are not able to benefit from grassland easement programs that would provide critical financial incentives to do so. In order to level this "uneven playing field," funding for the federally administered GRP and Grassland Easement Program must increase to support the number of interested landowners and reduce the incentive to convert ranchland into cropland.

4. *Disqualify landowners who convert native prairie to cropland from receiving federal financial support on that land.*

Much of the remaining native prairie in the PPR has not yet been converted to cropland because poor soil quality, steep terrain, or infrequent rainfall cause it to be less suitable for agricultural production. However, the Farm Bill provides subsidies and risk protection that virtually eliminate the economic consequences of cultivating unproductive or disaster-prone land. In effect, these government crop insurance subsidies incentivize farmers to cultivate land regardless of agricultural quality. Several practitioners we interviewed explained that farmers have chosen to plow extremely marginal land knowing that federal support payments will make the venture profitable, regardless of the yield. Similarly, a 2007 General Accountability Office report found that farm program payments are an important factor influencing the conversion of grassland to cropland.[644] Marginal land for crops is often high-quality habitat for wildlife, especially for grassland species.

Numerous conservation practitioners we interviewed pointed to the Sodsaver provision in the 2008 Farm Bill as a missed opportunity to truly address this problem. Conservation organizations supported a provision that would have disqualified land with no previous cropping history from receiving federal subsidy support of any kind.[645] However, the final Sodsaver provision in the 2008 Farm Bill was weakened by geographically limiting it to the PPR and requiring state governors to sign on to the policy. No governors chose to opt-in, as they refused to implement a policy that would place some producers in their states at an economic disadvantage.

To avoid this problem, Sodsaver should be re-written as a national policy that applies to all producers, and state governors should not be given the opportunity to opt-out. Several practitioners we interviewed argued that a strong Sodsaver provision is the best way to limit native grassland loss and will also benefit taxpayers by reducing payments. Even though landowners would still have the freedom to break native prairie, they would do so without the financial safety net provided by federal programs.

5. *Increase the capacity of federal programs to conserve prairie and wetland habitats in perpetuity.*

A number of the practitioners that we interviewed noted that landowner demand for permanent conservation easements through the Grassland Easement Program and WRP far exceeds the supply of contracts. Funding for these programs should be increased to allow agencies to meet demand and more effectively protect wildlife habitat into the future.

Another prominent federal program that offers permanent protection is GRP, which is used to conserve ranchland but has many conservation benefits as well, since ranchland often doubles as wildlife habitat. The program has been effective in conserving working grasslands (e.g. grazing operations), and its goal could be extended include the permanent protection of un-grazed prairie. GRP rules presently exclude producers who want to enroll fewer than 40 contiguous acres of grassland.[646] This limits the conservation effectiveness of the program and the USDA should broaden program eligibility by reducing this minimum requirement. In addition, Congress should explore ways to increase funding for grassland conservation in general at both the federal and state level.

6. *Increase the CRP acreage cap and provide additional funding aimed at bringing marginal farmland into the program.*

The 2008 Farm Bill lowers the CRP cap to 32 million acres (effective October 1, 2009) from enrollment of 34.7 million acres in August 2008. The loss of 2.7 million acres of conservation land will have both ecological and economic repercussions and came up as a major concern in our interviews with conservation practitioners. CRP land improves water quality, reduces soil erosion, and provides important wildlife habitat for many species of conservation concern. CRP also provides critical nesting habitat for grassland birds, many of which are declining. Many of these birds, such as pheasants, grouse, and prairie chickens, are game birds which bring valuable recreation dollars to local economies. Though not a central goal of the program, CRP land is also an important carbon sink. Because of these important functions of CRP land, and the new pressures being placed on conservation land by increased corn plantings, the CRP cap should be raised and funding levels increased in order to maximize the potential of this program to respond to new threats.

Policy Implementation

7. *Hold a general sign-up for CRP in order to conserve large, contiguous blocks of land and thereby mitigate the effects of fragmentation.*

The USDA last held a general sign-up for the CRP in April of 2006. Since then, at least 3.85 million program acres have expired.[647] In place of a general sign-up, the agency enrolls land through "continuous sign-up," which is aimed at promoting specific conservation practices. Though enrollment through continuous signup has remained strong, its reach is limited. Non-practice-specific general enrollment is uniquely important because of its role in conserving large contiguous blocks of land, thereby mitigating the effects of habitat fragmentation. The USDA has noted that while continuous, practice specific enrollment is important, "many environmental

benefits, such as nesting habitat, are highly correlated with total acreage."[648] More than 30.7 million CRP acres are set to expire over the next ten years.[649] It is clear that if the USDA does not hold general sign-ups, CRP enrollment will fall far below the program's statutory cap.

8. *Improve the flexibility and responsiveness of CRP rental rates in order to offer more competitive payments and conserve more acres for the same amount of money.*

In conversations with practitioners in our four study states, we repeatedly heard that CRP rental rates were not updated on a frequent enough basis to keep up with crop price volatility and to remain competitive in attracting farmers. In reference to wetland conservation rates, one South Dakota USDA official noted, "you are always behind." In other words, producers have less incentive to enroll in CRP if they can make more money by farming their land. The 2008 Farm Bill directs the National Agricultural Statistics Service (NASS) to collect and report county-level cash rent data from producers annually. Rental rates should be regularly reviewed and adjusted to be competitive with current land values and crop prices.

9. *Increase NRCS's capacity to deliver technical assistance through better staffing and longer, more realistic timelines for obligating funds.*

Technical assistance run through the Natural Resources Conservation Service (NRCS) is a vital conservation tool, putting landowners in direct contact with conservation experts to help address the specific needs on their land. However, state offices are understaffed and assistance is in high demand. NRCS officials in general expressed that the high demand for technical assistance led to a haphazard approach to conservation; rather than looking at an entire farm operation to address the root cause of environmental impacts, funding often goes to fix the most obvious symptoms. One practitioner stated that it would be ideal to work with the whole farm and address all conservation needs at once, but that the agency does not have the staff and time to do so. NRCS programs need to change to address not just single practices but whole farm systems.

Officials also talked with frustration about the timeline they are given for obligating funds. Often federal budgets are not set until late February and all funds are required to be allocated by mid-March. This leads to a chaotic approach of funding whatever projects are at the top of the pile. One NRCS official stated, "It's about how quickly we spend the money. If we don't spend it quickly enough, it gets taken away."

10. *Standardize and simplify the application process for Farm Bill conservation programs.*

Many practitioners we interviewed explained that landowners find the application for conservation programs confusing, complicated, and time consuming, largely because paperwork and procedures differ across programs. Furthermore, many landowners have difficulty determining exactly which programs their land qualifies for. This not only creates frustration and deters participation, but it may also create inefficiencies for agencies as they process multiple applications from the same landowner. To engage landowners and increase processing efficiency, applications should be transparent and easy to understand, and landowners should have access to the technical expertise necessary to determine their eligibility.

In addition to expanding expert assistance, technology can also simplify the application process. The 2007 Agriculture Census reported that nearly 57% of farms have internet access, and this percentage is likely to increase.[650] An interactive online interface with survey questions to clarify eligibility and to calculate approximate payments could provide critical information to landowners as they consider which programs to pursue. The interface could also allow landowners to securely store their application information online and apply to multiple programs in a simplified manner. Participants could also choose to receive email updates on relevant program changes.

NGO Participation

11. Lead state-level funding initiatives to create dedicated, long-term funding for wildlife conservation and related recreation and education.

Adequate funding for conservation programs is a major challenge for successful conservation of wildlife and natural areas. Most state-level programs are designed to complement federal programs, stretching limited dollars to be more effective in conservation efforts. However, practitioners in most state fish and wildlife agencies stated that limited funding was a barrier to preventing habitat loss and degradation. A practitioner in Iowa said specifically that, without a dedicated state funding source, conservation is "opportunistic" and it is very difficult to build upon Conservation Reserve Enhancement Program (CREP) and other federal efforts. Minnesota is one of two states in the nation that has successfully created a dedicated funding source for its state wildlife diversity program. Thirty-three percent of revenue derived from a recent sales tax hike is dedicated to restoring, protecting, and enhancing wetlands, prairies, forests, and habitat for fish, game, and wildlife. This sales tax generates approximately $90 million a year for wildlife habitat programs. NGOs have a critical role to play in leading such funding initiatives in other states.

12. Educate communities and decision makers on the importance of revenue generated from hunting, recreation, and nature tourism associated with conservation.

Ethanol production is often described as a boon to rural economies, but this overlooks the economic implications of destroying wetland and prairie habitat. The hunting, recreation, and tourism dollars afforded by natural areas help to diversify the economies of otherwise agriculture-dependent states. In our study states, pheasant hunting, along with other game bird hunting, is a major source of income. Converting natural areas to cropland will reduce tourism dollars as well as the viability of hunting outfitters in the states. These messages must reach decision-makers who prioritize agricultural expansion over conservation for economic reasons.

Data Needs

13. Make NASS crop data available at the county level, not just the USDA district level, for all crops and states.

Quantifying crop plantings at fine spatial scales over time is important for determining how land use and agricultural practices are changing. We faced major challenges when quantifying

changes in corn plantings and other crops at the county level, largely because county-level plantings data were not available for all crop types through the NASS website. Plantings data for counties are often grouped into district categories. This is more common when county production of a particular crop is very low, and thus the information is less critical; but there are other instances when major crops, such as soybeans and wheat, are also grouped into district categories. We were therefore limited in our ability to determine where and to what extent corn plantings in a county were displacing other crops. This data is extremely useful in studying the effects of agricultural expansion on wildlife populations. The NASS Quick Stats website is a valuable resource that is easy to use and well maintained; however, it lacks important county-level plantings data that should be publicly available.

14. Collect and make available data measuring conversion of grassland to cropland.

According to a September 2007 Government Accountability Office (GAO) report, "no comprehensive and current source of information exists on the conversion of grassland to cropland or on the resulting farm program payments for newly converted land."[651] The USDA has collected informal data in North Dakota, South Dakota, and Montana. These data are clearly insufficient for understanding grassland conversion across the country. Furthermore, the Farm Service Agency (FSA) has pointed out that county offices may not have used consistent methods to determine the extent of conversion in their counties. In interviews, FSA officials in both South and North Dakota voiced concern that county officials may have included cropped acres adjacent to prairie in their acreage reports.

Without consistent, comprehensive, spatially-allocated data available on sodbusting of native prairie, researchers will not be able to quantify the effects of conversion of grassland to cropland on wildlife populations. With grassland bird populations already showing declines related to increased corn production, it is especially important that this data be available. The USDA should develop and implement uniform county-level data collection practices. The results of this monitoring should be publicly available in order to improve transparency and facilitate research into the impacts of these land-use changes on wildlife populations.

15. Make CRP contract data more easily accessible, within reason of privacy laws. Specifically, track and make available online county-level information on broken contracts, Maximum Allowable Rental Rates (MARR), Environmental Benefit Index (EBI), and CREP.

Very little CRP contract data is made publicly available on the Internet. As a research group, we had to file a Freedom of Information Act (FOIA) request to obtain historical, county-level data on CRP contract components, such as MARRs and EBI county averages. It is unclear as to whether this data is available at all, as the FOIA, which was submitted over ten months ago, has yet to be fulfilled. The USDA should explore options for collecting and distributing these county-level data. Doing so will only improve the transparency and aid in the improvement of these programs.

16. Instigate a U.S. General Accountability Office investigation of the full cost of government incentives for corn ethanol.

Given the quantity and variety of federal and state incentives for corn ethanol, it is difficult to determine where federal and state support for corn ethanol may be overlapping in unintended ways or to assign a total dollar value to the amount of government funds going to support this industry. Program-specific funding information is not readily available on government websites, and often difficult to obtain even through direct requests to government offices, particularly on the state level. We recommend a comprehensive study on the funding that is being allocated by both federal and state governments to be undertaken by the GAO. As the investigative arm of Congress, the GAO has the authority to request such information.

17. Implement special monitoring programs for rare species of conservation concern.

Our wildlife analysis used publicly available Breeding Bird Survey (BBS) data to analyze trends in wildlife populations. While the BBS is an excellent source of data on population trends for many species, it does not capture comprehensive data for all bird species. Many species are too rare to be picked up by the BBS and other annual population surveys. Others, such as the prairie chicken and other grouse species, are not commonly identified in point counts. If these species are counted in these surveys, the data is typically sparse and not ideal for long-term monitoring of trends. However, because these species are fairly rare, they are especially threatened by loss and degradation of habitat. Increases in corn expansion and native prairie loss may be affecting them in the same way that the 'indicator" species in the wildlife analysis are being affected.

Therefore, it is imperative that monitoring programs be employed for these rarer and harder-to-track species. State Wildlife Action Plans (SWAPs) have already identified species of conservation concern, along with the threats particular to each species. The SWAPs are state-level plans for wildlife conservation, created by state fish and wildlife agencies and conservation organizations in each state. Many species have been identified as threatened by loss and degradation of native prairie habitat. Four of the five indicator species that we analyzed are species of conservation concern. The population declines that we found in these species demonstrate that the threats to species of conservation concern are both real and immediate. Thus, the species of conservation concern lists, as identified in SWAPs, are an ideal place to begin when constructing monitoring programs for rare species.

Future Research

18. Quantify projected land-use changes and habitat loss due to the introduction of genetically modified crops and new farming technologies.

Conservation practitioners we interviewed explained that the advancement of genetically modified (GM) crops and new farming technologies have been major drivers of land conversion. GM crops produce higher yields in areas with less precipitation and lower soil quality than conventional crops, and new farming technologies allow farmers to cultivate rockier, hillier land.[652] Combined, these advancements have opened up large areas that were formerly unsuitable for cultivation. In fact, the reason much of the native prairie in the PPR still exists is that it was

formerly not profitable for crop production. Conservation practitioners we interviewed explained that these genetic and technological advancements are allowing for the conversion and fragmentation of the last remaining contiguous areas of PPR grassland in the Dakotas. To better understand the threat these technologies pose to native habitat, the amount of land now at risk of being converted to crop production should be quantified. Furthermore, spatial models predicting the likely extent and location of these technology-driven land-use changes should guide conservation efforts by highlighting which areas are most at risk and which wildlife populations are most likely to be affected.

19. Examine the connection between ethanol and corn prices by studying how the opening of an ethanol refinery affects local corn prices.

Few studies have analyzed the direct link between ethanol refineries and local corn prices. One way to establish this connection would be to study corn prices at granaries within a 20 mile radius of a plant and see if there is a significant change in corn prices after the opening of the refinery. Data on biorefinery opening dates are generally available on state Department of Agriculture websites. Such a study would clarify the relationship between ethanol refinery siting and corn price, which in turn determines a landowner's decision on how to use their land and affects subsequent changes in acres of corn planted.

20. Improve conservation, restoration, and research that help wildlife adapt to climate change, particularly within the increasingly fragmented Prairie Pothole Region.

While land conversion and habitat degradation pose the most immediate threats to wildlife within the PPR, climate change will present serious, yet unknown, threats in coming years. Increased agricultural production that results in grassland and wetland loss will further fragment PPR habitat and limit the ability of wildlife populations to adapt to changes in temperature and precipitation levels. Under most climate scenarios, the PPR is likely to experience increased drought, higher temperatures, and longer growing seasons. As a result of these changes, model simulations suggest that the wetlands supporting much of the PPR's "duck factory" will become substantially drier in most years, diminishing critical waterfowl breeding habitat and altering wetland vegetation and biodiversity. Furthermore, the simulations predict that more suitable conditions for waterfowl may shift east to areas where most wetlands have been drained.[653] Climate change may also drive additional land-use conversion as the growing season becomes longer. One interview respondent at USFWS explained that as the growing season lengthens, new areas in the PPR will become more suitable for a wider range of crops, including corn. If this trend continues, more prairie land that was once undesirable as cropland will be brought into cultivation. Projected impacts of climate change on both habitat and crop suitability must be investigated further and used to guide conservation and restoration efforts to help wildlife adapt to a changing climate.

21. Research the impacts of corn expansion on wildlife populations in the Prairie Pothole Region.

As demonstrated by our analysis of breeding birds in our four states, grassland-breeding species have already experienced statistically significant decreases in areas of high corn increase and

high habitat change. Populations of sensitive grassland birds have dropped by almost 30% between 2005 and 2008 in areas of high corn increase. Grassland birds are among the fastest and most consistently declining birds in North America; our findings demonstrate that the expansion of corn plantings may be speeding up this decline, particularly in those areas with highest corn increases and greatest losses in CRP. This study only looked at five indicator bird species; however, there are many other grassland bird species that may be adversely affected by increased corn plantings and habitat loss and degradation.

Other wildlife populations in addition to grassland birds are likely experiencing the effects of habitat loss and degradation. For example, upland-breeding waterfowl, which also depend on native prairie habitat, would logically be experiencing impacts as well. Non-bird species, such as reptiles, small mammals, and insects are also particularly sensitive to local land-use changes. More research on the effects of increased corn expansion and losses of native prairie is needed.

22. Quantify the effect of the recent major decline in CRP acreage on wildlife.

Our wildlife analysis used 2005 and 2008 BBS data to quantify changes in wildlife populations. However, 2008 was the first year that dramatic losses in CRP occurred in our focal states, and these losses have increased into 2009. The 2008 BBS data reflected habitat losses in 2007, but losses that began in 2008 were generally not reflected in the BBS data. This is because bird populations do not respond to changes in habitat immediately; rather, habitat losses may affect breeding and reproductive success. Thus, habitat losses in one year affect the population in the subsequent year. As such, our analysis did not reflect changes in bird populations due to the losses of CRP land that began in 2008. The effects of these losses are only beginning to be felt in grassland bird populations. Therefore, the actual declines may be even greater than our findings suggest.

While many studies have quantified the beneficial effects of CRP on bird populations, it is still unknown how losses in CRP may affect these populations. Studies predict that there may be dramatic declines in grassland bird populations as CRP land is put back into production. New research must be undertaken to understand how these recent, dramatic losses in CRP acreage have affected and will continue to affect grassland bird populations.

Final Thoughts

While lower profits, excess capacity, and the present economic downturn have slowed corn ethanol growth in the short term, they have by no means stopped it. The many federal and state incentives for ethanol production will continue to drive demand for corn ethanol and increase corn plantings into the future. Unless such incentives are decreased or eliminated, the environmental impacts of corn ethanol will continue to grow, and wildlife populations will continue to decline in the ecologically sensitive Prairie Pothole Region.

There is a common misconception that cellulosic ethanol will replace corn ethanol in the near future. If fact, mandated production levels for both fuels rise in parallel until 2015, when the mandate for corn ethanol production levels off but does not decline. Government incentives drive

the growth of corn ethanol. Thus, the government must take responsibility for mitigating the impacts of corn ethanol on wildlife by strengthening existing conservation programs and policies. Corn ethanol is not a phenomenon of the past. It is very much a problem of the present and future. If action is not taken by Congress and implementing agencies, habitat will continue to be lost and wildlife populations will continue to decline, threatening the ecological stability of the Prairie Pothole Region.

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