



MINNESOTA COOPERATIVE FISH
AND WILDLIFE RESEARCH UNIT

Biennial Report

January 2003– December 2004

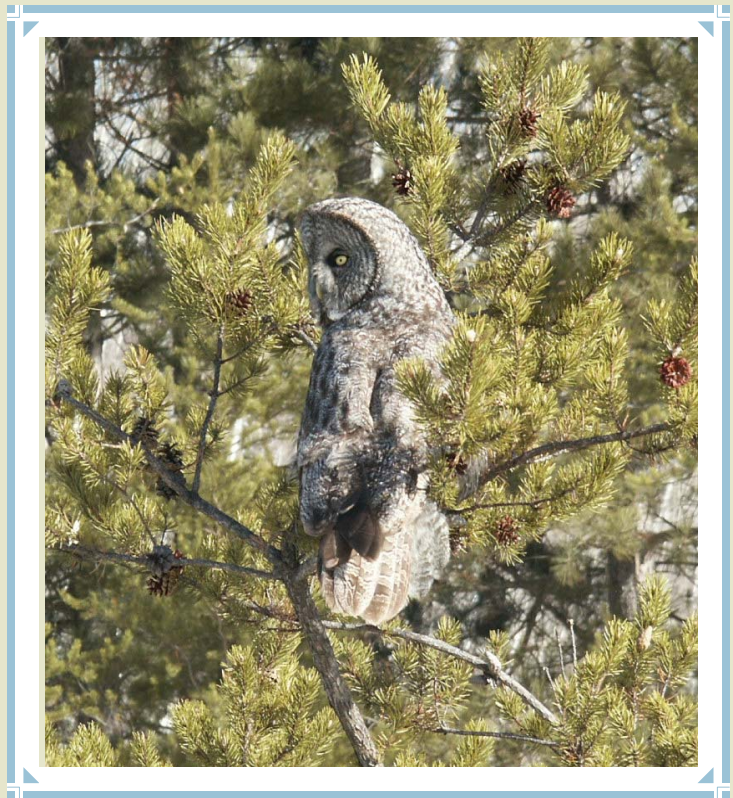
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Survey

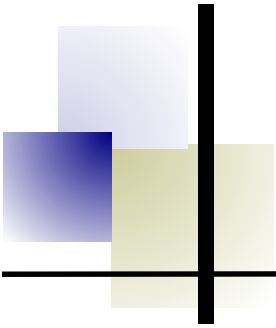
Minnesota
Department of
Natural Resources

The Wildlife
Management
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*U.S. Fish and Wildlife
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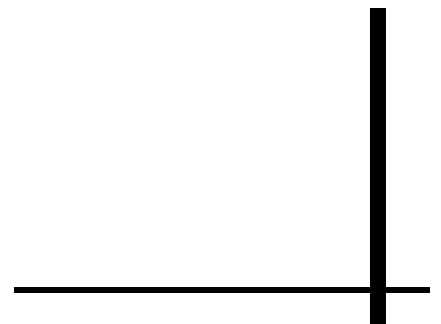
Introduction

The Cooperative Research Units Program was established over sixty years ago to facilitate cooperation among the U.S. Department of the Interior (currently through the U.S. Geological Survey), universities, state fish and wildlife agencies, and private organizations, by developing and conducting programs of research and education related to fish and wildlife resource conservation. The Minnesota Cooperative Fish and Wildlife Research Unit emphasizes research on impacts of human activities on aquatic and terrestrial ecosystems that are of state, regional, and national significance. Our research program addresses not only the biological, but also social and economic aspects of both game and nongame fisheries and wildlife management in the context of maintenance of biological diversity, and integrity and sustainability of ecosystems.

The Minnesota Cooperative Fish and Wildlife Research Unit was established in 1987, and staffed beginning in 1988. This is the eighth biennial report produced by the Minnesota Coop Unit and summarizes Unit activities during 2003 and 2004. Over the past two years, support for the Unit program in general, and for our Unit in particular, has been as strong as it has ever been. We have worked with a wide range of cooperators, outstanding graduate students, and university, federal, state and non-governmental scientists and resource managers to further our research and teaching missions, and to provide technical assistance to partners and clients. We invite you to review this summary of our Unit's accomplishments and to contact us with comments or to request additional information. Thanks to our many partners and supporters!

Sincerely,

Dr. David E. Andersen, Leader
Minnesota Cooperative Fish and Wildlife Research Unit



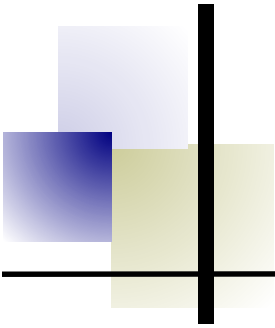
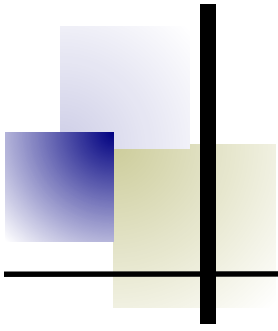


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Personnel and Cooperators

UNIT PERSONNEL

UNIT STAFF – U. S. GEOLOGICAL SURVEY – COOPERATIVE RESEARCH UNITS

Dr. David E. Andersen, Unit Leader

Dr. Bruce Vondracek, Assistant Leader – Fisheries

Dr. David C. Fulton, Assistant Leader – Wildlife

UNIT STAFF – UNIVERSITY OF MINNESOTA

Hattie Saloka, Principal Secretary

Susan Schroeder, Research Fellow

Matt Kocian, Research Specialist
(March 2004 through December 2004)

UNIT STUDENTS

Dickson Atuke, M.S. (Vondracek)
Leakhena Au, M.S. (Andersen, graduated 2003)
Kristen L. Blann, Ph.D. (Vondracek, graduated 2004)
Angela Bolton, Ph.D. (Vondracek)
Jeremy Bruskotter, Ph.D. (Fulton)
Kevin Doherty, M.S. (Andersen, graduated 2004)
John Epton, M.S. (Fulton, graduated 2004)
Julia A. Frost Nerbonne, Ph.D. (Vondracek and Nelson, graduated 2003)
Samantha Hayes, M.S. (Fulton and Anderson)
Carlene Henneman, M.S. (Andersen)
Robert Nack, M.S. (Andersen, graduated 2003)
Fiona Nagle, M.S. (Vondracek and Nelson)
Michelle Payton, M.S. (Fulton, graduated 2003)
Adam Petersen, M.S. (Vondracek)
Matthew Reiter, M.S. (Andersen)
Joanna Rosendahl, M.S. (Fulton and Anderson, graduated 2003)
Nicholas Schlessler, M.S. (Vondracek)
Susan Schroeder, Ph.D. (Fulton)
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Mary Williams, Ph.D. (Vondracek)
Julie Zimmerman, Ph.D. (Vondracek)

UNIT AFFILIATED STAFF AND STUDENTS

Brian Ash, M.S. (Wilson)	Nick McCann, M.S. (Moen, Niemi)
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Adam Barlow, M.S. (Cuthbert)	Ron Millen, Ph.D. (Kapusinski)
Chris Burdett, Ph.D. (Mech, Niemi)	Pouya Najmaie
Tessa Diedrich	Carrie Nelson
David Grandmaison, M.S. (Niemi)	Timothy Patronski, M.S. (Kapusinski)
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Jennifer Hathaway-Stucker	Mike Schwebach
Rebecca Hylton	Erick Simonsen
Vikash Kanodia	Whitney Taylor
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Mark Ledford	Linda R. Wires
Meggie Marzec	Kaia Yngve

UROP RECIPIENTS AND FACULTY SPONSORS

The Undergraduate Research Opportunity Program (UROP) is a University-wide competitive program that supports undergraduate research projects. Twice a year, students may apply by writing a proposal with the assistance of a faculty advisor.

Name	Year	Title of Project	Faculty Sponsor
Patricia Bobzin	Spring 2003	Benthic Invertebrates Seasonal Change in Differing Environments	Vondracek
Jesse Carlson	Spring 2003	The Relationship Between Watershed Characteristics and Macroinvertebrate Community Metrics in 30 Watersheds Located in Southeastern Minnesota	Vondracek
Ann Ollila	Spring 2003	Multi-habitat Versus Multi-plate Assessments of Muddy Bottom Streams	Vondracek

UNIT COORDINATING COMMITTEE

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(301) 834-8054

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UNIT COOPERATORS

UNIVERSITY OF MINNESOTA, DEPARTMENT OF FISHERIES, WILDLIFE, AND CONSERVATION BIOLOGY FACULTY

Ira R. Adelman	Richard Kimmel (adjunct)
Jim Almendinger (adjunct)	John Loegering
Charles Anderson (adjunct)	L. David Mech (adjunct)
Todd Arnold	Kristen Nelson
Robert Blair	Raymond M. Newman
Yosef Cohen	Karen Oberhauser
James A. Cooper (emeritus)	John Pastor (adjunct)
Francesca J. Cuthbert	Donald L. Pereira (adjunct)
Glenn DelGiudice (adjunct)	Carl Richards (adjunct)
Alan Franklin (adjunct)	Andrew M. Simons
Daniel L. Frenzel (emeritus)	Donald Siniff (emeritus)
David Garshelis (adjunct)	J. L. David Smith
Ralph J. Gutierrez	Peter W. Sorensen
Jay Hatch	George R. Spangler
Dan Hornbach (adjunct)	Anthony Starfield (emeritus)
Frederick J. Jannett (adjunct)	Ellen Strong
Douglas H. Johnson (adjunct)	Edward Swain (adjunct)
Mark R. Johnson (adjunct)	Thomas Waters (emeritus)
Peter A. Jordan (emeritus)	David Western (adjunct)
Anne R. Kapuscinski	

FACULTY AS PRINCIPAL INVESTIGATOR IN UNIT RESEARCH

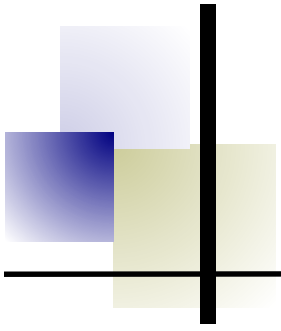
Dorothy Anderson	Kristen Nelson
Thomas E. Burk	Gerald Niemi
Francesca J. Cuthbert	James Perry
Anne R. Kapuscinski	Bruce Wilson

COOPERATING UNIVERSITY OF MINNESOTA ACADEMIC UNITS

Biosystems and Agricultural Engineering Graduate Program
College of Natural Resources
Conservation Biology Graduate Program
Consortium on Law and Values in Health, Environment, and the Life Sciences
Department of Fisheries, Wildlife, and Conservation Biology
Department of Forest Resources
Fisheries Graduate Program
Natural Resources Research Institute
Undergraduate Research Opportunities Program
Water Resources Center
Water Resources Science Graduate Program
Wildlife Conservation Graduate Program

COOPERATING ORGANIZATIONS

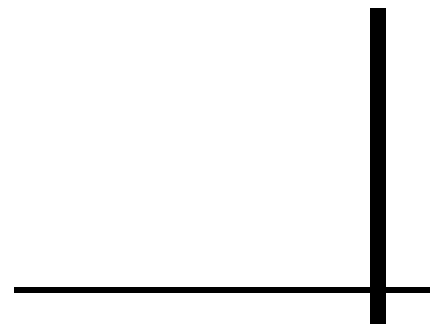
Breck High School
Cargill Fellowship
Legislative Committee for Minnesota Resources
Leech Lake Band of Chippewa
Macalester College
MacArthur Fellowship
Minnesota Forest Resources Council
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
Minnesota Falconer's Association
National Council of the Paper Industry for Air and Stream Improvements
National Park Service
 Cuyahoga Valley National Recreation Area
National Science Foundation
Potlatch Corporation
University of Minnesota
U.S. Department of Agriculture
 Forest Service
U.S. Fish and Wildlife Service
 Division of Migratory Birds
 Sherburne National Wildlife Refuge
U.S. Forest Service
 Chippewa National Forest
 Superior National Forest
U.S. Geological Survey
 Northern Prairie Wildlife Research Center
U.S. Park Service
 Voyageurs National Forest



Completed Research



Applied Ecology



Double-crested Cormorant Status Assessment and Biodiversity Impact Study

Investigator: Francesca Cuthbert (Cooperating Faculty)

Students: Dale R. Trexel, M.S. (Conservation Biology)
Staff: Linda Wires

Duration: August 2000 to March 2003

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: University of Minnesota, St. Paul

This project assessed impacts of double-crested cormorants (*Phalacrocorax auritus*) on breeding habitat and other colonial nesting waterbirds on selected islands in the U.S. Great Lakes and also determined population trends at 4 cormorant breeding areas in northern Lakes Michigan and Huron.

Study on impacts of cormorants on other species of colonial nesting waterbirds (great blue herons [*Nycticorax nycticorax*], black-crowned night-herons [*Ardea herodias*]) concluded: cormorants have caused total or partial loss of forest cover at a number of islands in the U.S. Great Lakes; soil chemistry at cormorant colony sites could affect normal plant growth and survival. However, site use data and field observations indicated cormorant presence has not caused black-crowned night-heron or great blue heron declines or abandonment except under special circumstances. Study on cormorant population



trends showed a pattern of rapid growth through the mid 1990s followed by either notably slower growth, apparent stabilization, or decline through 2001. These results suggest that population growth in number of breeding cormorants in the study area is being limited without formal human intervention.

Conservation of Great Lakes Colonial Waterbirds

Investigator: Francesca Cuthbert (Cooperating Faculty)

Student: Dale R. Trexel, M.S. (Conservation Biology)

Staff: Linda R. Wires

Duration: July 2002 to June 2003

Funding Source: U.S. Fish and Wildlife Service, Division of Migratory Birds

Project Location: Lakes Michigan, Huron and Superior in State of Michigan waters
LaCrosse, Wisconsin
University of Minnesota, St. Paul

Waterbirds in the Great Lakes of the U.S. and Canada are of ongoing conservation concern, both because of declines in populations of some species (e.g., common tern [*Sterna hirundo*]) and dramatic increases in population size of other species (e.g., double-crested cormorant [*Phalacrocorax auritus*]). Cooperative efforts to manage waterbirds in the Great Lakes include periodic nesting surveys and targeted conservation efforts for specific populations. As part of these activities, we (1) assessed status and distribution of common terns and potential breeding habitat in Michigan, and (2) facilitated development of a standardized monitoring protocol for breeding waterbirds in the Great Lakes.

In the U.S. Great Lakes, approximately 30% of the breeding common tern population is in Michigan, yet relatively little is known about common terns there. In June 2002, we surveyed 52 (95%) of 55 historical common tern breeding sites in Michigan and observed nesting at 10 sites, with a total estimate of 737 breeding pairs—approximately 60% of the number of breeding pairs estimated 5 years previous, and 47% of the number of breeding pairs estimated in 1989-1990. Our assessment of breeding site quality suggested that there are currently relatively few high quality sites in Michigan, but that existing sites can contribute significantly to the regional population.



In anticipation of a 4th Great Lakes-wide survey of breeding colonial waterbirds in 2007, we facilitated a workshop to develop a general monitoring strategy to improve population estimates and detection of population trends. Outcomes of that workshop included prioritization of 12 species for monitoring and a summary of survey challenges and best methods for monitoring individual species, including retention of the complete-count decadal survey and use of a more-frequent-than-decadal monitoring effort for all or selected species. Other considerations included minimizing disturbance to breeding birds, conducting surveys within a single year for species with low sight fidelity, and determining detectability rates for individual species.

Characterization of Existing Critical Habitat for the Great Lakes Piping Plover

Investigator: Francesca Cuthbert (Cooperating Faculty)

Student: Adam Barlow, M.S. (Conservation Biology)
Cathy Haffner, M.S. (Conservation Biology)

Duration: July 2002 to September 2003

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: University of Minnesota, St. Paul

The piping plover (*Charadrius melodus*) is a shorebird endemic to North America. Three breeding populations are recognized; Atlantic Coast, Great Lakes, and Northern Great Plains. The smallest of these, Great Lakes, was listed as endangered in the mid-1980s. As part of the recovery process, critical habitat was designated in 2002 under the Endangered Species Act. Selection of this habitat was done based on records of current and historic use by plovers; some habitat was included because it appeared to have potential for use by piping plovers. The following breeding season, USFWS obtained aerial photos for Critical Habitat units. The purpose of this project was to use a Geographic Information System to characterize Critical Habitat close to the time designation was completed. This was done as part of a larger study, conducted by a graduate student at the University of Minnesota, that examined habitat characteristics at currently used, historical, and potential plover nesting habitat in the Great Lakes.



Aerial photos were used to delineate legal boundaries, measure Primary Constituent Elements and identify major landmarks for most of the 35 Critical Habitat Units in the U.S. Great Lakes. This information was organized into a spatial database and we developed the database structure for entering data on historic and current nest location, breeding pair natural history, and historical plover use of critical habitat.

Eastern Prairie Population Canada Goose Breeding Ecology

Investigator: David E. Andersen

Students: John E. Sammler, M.S. (Wildlife Conservation)
Robert R. Nack, M.S. (Wildlife Conservation)

Duration: August 1999 to December 2003

Funding Sources: U.S. Geological Survey – Biological Resources Division,
Cooperative Research Units
Mississippi Flyway Council, EPP Canada Goose Technical
Committee (through the Wildlife Management Institute)
Manitoba Department of Natural Resources
Minnesota Department of Natural Resources
U.S. Fish and Wildlife Service
Iowa Department of Natural Resources
Missouri Department of Conservation
Arkansas Game and Fish Commission
Canadian Wildlife Service

Project Location: Cape Churchill, Manitoba
Minnesota Cooperative Fish and Wildlife Research Unit

Eastern Prairie Population (EPP) Canada geese (*Branta canadensis*) breed in the Hudson Bay Lowlands in northeastern Manitoba. This population of Canada geese migrates through southern Manitoba and western Minnesota, and historically wintered in Missouri and Arkansas. Because they nest in the sub-Arctic, EPP Canada geese exhibit wide variation in productivity and recruitment, and annual information regarding breeding ecology and population status is required to effectively manage harvest.

Research on breeding ecology of this population of sub-arctic-nesting geese has continued since the 1960s, and information from these studies has been used to inform management and harvest strategies. Long-term monitoring of breeding density, nesting success, gosling production, and other breeding population parameters has resulted in information useful in modeling this population. These monitoring efforts occur in close proximity to the La Pérouse Bay snow goose (*Chen caerulescens caerulescens*) colony,

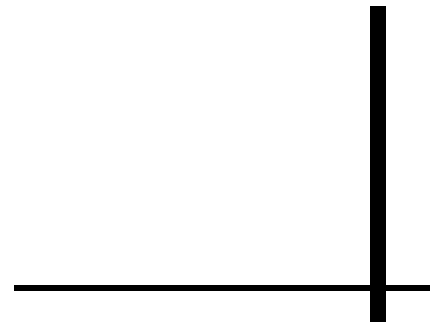


and over the past 20 years, snow goose use of the study area has increased dramatically. During the same period, breeding densities of Canada geese have dropped dramatically, and snow geese now dominate numerically in historical Canada goose brood-rearing areas. Beginning in 1999, we undertook several projects designed to better understand the relationship between Canada and snow geese on their breeding grounds. Adult



female Canada geese were radio-marked prior to hatch, and subsequently monitored from the ground and air to document habitat use and interactions with snow geese during the brood-rearing period. In 2001 and 2002, we also repeated extensive aerial brood surveys and compared our results to those from surveys conducted in the late 1970s, prior to use of this area by snow goose broods. In addition, surveys for nesting songbirds and shorebirds were conducted in 1998, 1999, and 2000, and these data were compared to survey data collected in 1984, prior to significant use of the study area by snow geese. Field activities also included annually monitoring Canada goose breeding density, nesting success, and other breeding population parameters at the Cape Churchill study area.

Radio-telemetry monitoring indicated that Canada geese currently use freshwater sedge meadow habitats and freshwater lakes for brood rearing. Compared to the 1970s, salt marsh habitats are used only sparingly. Aerial brood surveys suggested that snow geese now dominate in most traditional Canada goose brood-rearing areas, and that Canada goose brood abundance is highest farthest from snow goose nesting aggregations. Observed decreases in nesting density may be related to shifts in brood-rearing behavior by Canada geese in response to increased snow goose abundance and impacts of goose foraging on vegetation. Similarly, significant changes in breeding bird communities have occurred since the early 1980s. At the scale of our study area, several breeding bird species have disappeared and several have experienced dramatic population declines; however, most persist at levels comparable to those indicated from surveys in the early 1980s. At spatial scales smaller than our study area, breeding shorebirds are largely absent from salt marsh habitats, and in freshwater sedge meadow habitats, many bird species occur at reduced abundance in patches highly impacted by goose foraging. As the extent of area impacted by goose foraging increases, impacts of bird communities at larger scales are likely to be evident.



Ecology of Oak Savanna Birds at Sherburne National Wildlife Refuge

Investigator: David E. Andersen

Student: Leakhena Au, M.S. (Wildlife Conservation)

Duration: September 2000 to September 2003

Funding Sources: U.S. Fish and Wildlife Service
Sherburne National Wildlife Refuge
National Science Foundation

Project Location: Sherburne National Wildlife Refuge

Oak savanna habitats are one of the most endangered habitats in the Upper Midwest and relatively little is known regarding the ecology of birds that occupy these habitats. Habitat management activities at the Sherburne National Wildlife Refuge in east-central Minnesota emphasize maintaining, restoring, and enhancing oak savanna, yet few data exist regarding occurrence of breeding birds at this site and their response to management activities. Effects of habitat changes on breeding birds in landscapes dominated by oak savanna are likely to be different than in landscapes dominated by forest or grassland habitats, where fragmentation is generally thought to have negative consequences. In contrast, oak savanna habitats are naturally heterogeneous, and birds that breed and persist in these habitats may not be affected in the same manner by habitat fragmentation as birds in other landscapes. Aspects of this project included summarizing and reviewing existing data on oak savanna birds, conducting surveys for these birds at Sherburne National Wildlife Refuge, and evaluating habitat relations and effects of habitat management.

In 2001 and 2002, breeding bird surveys were conducted across a gradient of oak woodland,



restored oak savanna, remnant oak savanna, and prairie habitats. Canopy cover and burn frequency were most strongly related to observed patterns in bird communities. Most savanna points had bird communities that were distinct from those found at oak woodland or burned woodland points. Savanna points similar to oak woodland points were in areas managed by periodic cutting rather than burning. Remnant savanna bird communities were more strongly associated with prescribed burning than those in other habitat types, but it is unclear whether ≥ 20 years of prescribed burning in woodlands has resulted in bird communities comparable to those in remnant savannas.

Home Range and Habitat Use of Breeding Northern Goshawks in North-central Minnesota

Investigators: David E. Andersen, Clint Boal, and Patricia L. Kennedy (Colorado State University)

Student: Aimee Roberson, M.S. (Conservation Biology)
Brett Smithers, M.S. (Wildlife – Texas Tech University)

Duration: January 1998 to December 2003

Funding Sources: U.S. Forest Service
Chippewa National Forest
Superior National Forest
Voyageurs National Park
National Council of the Paper Industry for Air and Stream Improvements
Potlatch Corporation
Leech Lake Band of Chippewa
Minnesota Department of Natural Resources
Minnesota Falconer's Association
U.S. Fish and Wildlife Service

Project Location: Chippewa and Superior National Forests and surrounding northcentral and northeastern Minnesota

In the western Great Lakes region, the population status of northern goshawks (*Accipiter gentilis*) is largely unknown. Existing information on goshawk population ecology in this portion of their range is limited to long-term monitoring of nest sites and scattered information on food habits and movements from studies of individual nests or birds. Only recently have efforts been undertaken to quantitatively describe nest sites and assess breeding population status beyond single study sites. The objective of this cooperative study was to begin to address this information gap by collecting data on habitat use, home range, and diet of goshawks in Minnesota, with potential for direct application toward conservation and management of goshawks throughout the Laurentian Mixed Forest Province. From 1998 through 2000, we captured and radio-equipped 33 breeding northern goshawks in northern Minnesota, and monitored their movements from the ground and air (1998) or exclusively from the air (1999 and 2000) through the fledgling-dependency period (mid-August). In addition, we measured structural habitat characteristics at

a subset of locations for each male goshawk, and in 2000, 2001, and 2002 placed video cameras and recording equipment at nests to document diet. In 1999 and 2000, we also established fixed stations at active nest sites, and evaluated call broadcasts for potential use as a survey technique in the western Great Lakes region. Mean home range size for male goshawks during the breeding season averaged 2,676 ha (minimum convex polygon) and male goshawks exhibited a strong preference for old early-





successional upland hardwood, mature late-successional upland conifer, and mature upland early-successional conifer habitats. Stands used for foraging had high stem densities of large canopy trees, with distinct subcanopy and shrub layers. Call broadcast surveys were most

effective during the courtship and nestling breeding phases, and we developed an approach to use these surveys to estimate breeding density. Finally, during the breeding season, goshawk diet was comprised of mammals (61.3% of biomass delivered) and birds (38.7%), with red squirrels (*Tamiasciurus hudsonicus*) and eastern chipmunks (*Tamias striatus*) comprising 66% of identified prey and $\geq 46\%$ of all prey deliveries. Prey delivery rates to nestlings varied with brood size, suggesting that prey availability may limit goshawk productivity, at least in some years. Study results have been presented as final reports, theses, and manuscripts submitted for peer-reviewed publication, and are currently being used in goshawk habitat management and population monitoring in the western Great Lakes region.



Recovery Information Needed to Prevent Extinction of the Federally Endangered Winged Mapleleaf Mussel

Investigators: Mark C. Hove and Anne R. Kapuscinski (Cooperating Faculty)

Students: Undergraduate
Tessa Diedrich Mike Schwebach
Whitney Taylor Erick Simonsen
Carrie Nelson Vikash Kanodia
Marissa McGill Kaia Yngve

High school
Mark Ledford Meggie Marzec

Duration: June 2001 to August 2004

Funding Sources: U.S. Fish and Wildlife Service
Undergraduate Research Opportunities Program, University of Minnesota
Macalester College
Breck High School

Project Locations: St. Croix River, Minnesota and Wisconsin
University of Minnesota

Life history information frequently improves resource managers' ability to conserve rare species. Early life history information is needed for several rare upper Mississippi River mussel species. We conducted the following studies to improve understanding of early life history requirements of select upper Mississippi River mussel species: (1) determine suitable hosts of 2 federally listed species, and 5 rare and common mussel species, (2) identify St. Croix River fishes naturally infested with winged glochidia, and (3) determine the importance of various factors (e.g., water temperature, host fish size, host fish source) on juvenile mussel production. We followed standard protocol to identify suitable host fish species for winged mapleleaf (*Quadrula fragosa*), Higgins eye (*Lampsilis higginsii*), snuffbox (*Epioblasma triquetra*), pistolgrip (*Tritogonia verrucosa*), round pigtoe (*Pleurobema sintoxia*), mapleleaf (*Quadrula quadrula*), and pink heelsplitter (*Potamilus alatus*). Winged mapleleaf glochidia metamorphosed on blue (*Arius graeffei*) and channel catfish (*Ictalurus punctatus*), and



Higgins eye glochidia transformed on black crappie (*Pomoxis nigromaculatus*), smallmouth bass (*Micropterus dolomieu*), and sauger (*Sander canadensis*). Logperch (*Percina caprodes*) facilitated metamorphosis of snuffbox glochidia, and pistolgrip glochidia transformed on flathead catfish (*Pilodictus olivarius*). Round pigtoe glochidia transformed on common (*Luxilus cornutus*), golden (*Notemigonus crysoleucas*), and spotfin shiners (*Cyprinella*



spiloptera), and creek (*Semotilus atromaculatus*) and hornyhead chubs (*Nocomis biguttatus*). We showed that mapleleaf glochidia metamorphose on channel catfish, and pink heelsplitter glochidia transform on freshwater drum (*Aplodinotus grunniens*). These trials confirm known suitable host species and identify several previously unknown suitable host species.

We collected several fishes from the St. Croix River naturally infested with glochidia. Over 300 fish (34 species) were collected above winged mapleleaf beds during fall 2002 and spring 2003. Winged mapleleaf were not found among the 269 juvenile mussels recovered from naturally infested fishes. As expected, fishes were most heavily infested with glochidia in the spring. Infestation rates of fishes in the St. Croix River were similar to those shown in other studies. During the first 18 months of the study, we only collected 1 ictalurid (yellow bullhead [*Ameiurus*

natalis]) using boom shocking and seines. During fall 2003 we switched to angling equipment and collected 8 channel catfish. Future efforts to collect fishes naturally infested with winged mapleleaf glochidia should be focused on techniques designed specifically for collecting ictalurids.

Juvenile mussel propagation studies show water temperature influences juvenile mussel transformation rate and possibly success. No significant differences were observed in Higgins eye glochidia transformation success or juvenile production between season or water temperature treatments. Cooler water temperature extended Higgins eye transformation time. Water temperature appeared to influence juvenile winged mapleleaf production. A group of channel catfish from the Mississippi River held near 11 °C produced 743 juvenile winged mapleleaf, compared to no juveniles produced by a group of Mississippi River channel catfish held at 19 °C. Similarly, blue catfish held near 11 °C produced 2,182 juvenile winged mapleleaf compared to 813 produced by blue catfish held near 19 °C. Host fish size and host fish source did not consistently influence juvenile winged mapleleaf production. As with Higgins eye glochidia transformation rates, winged mapleleaf metamorphosed more slowly at cooler water temperature. Additional work is needed to more fully explore the influence of water temperature on winged mapleleaf transformation success.



Review of Research Pertinent to an Amphibian and Three Small Perch of the Great Lakes and Midwestern States

Investigators: Gerald Niemi, Joseph Mayasich (Cooperating Faculty)

Student: David Grandmaison, M.S. (Biology)

Duration: August 2002 to March 2004

Funding Source: U. S. Fish and Wildlife Service

Project Location: University of Minnesota, Duluth; Natural Resources Research Institute

The eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) is just 1 of several hundred amphibian species that is declining worldwide. There are indications that populations of the eastern hellbender are declining and exhibit low reproductive and recruitment rates. A general status assessment for eastern hellbender populations in Region 3 of the U.S. Fish and Wildlife Service was conducted in 2001, but a range-wide status assessment has not been conducted.

The eastern sand (*Ammocrypta pellucida*), spotted (*Etheostoma maculatum*), and crystal darters (*Crystallaria asprella*) have declined throughout much of their ranges. These declines are primarily ascribed to habitat degradation. These darters are becoming isolated to those streams or stream segments where clean sand and/or gravel substrates still exist. Extensive areas of clean sand/gravel are becoming ever less common as heavy silt loads and non-point pollutants move into streams that were formerly suited for these darters.

Given the indications of declining populations of the eastern hellbender and these 3 darters, and the likely continuation of anthropogenic pressures, a thorough range-wide status assessment of these taxa was warranted. This

project summarized and reviewed information relevant to a status assessment.

The information compiled and evaluated regarding the eastern hellbender strongly indicated that populations are declining throughout the United States. The primary threats to the eastern hellbender appear to be the loss and/or degradation of habitat and illegal/unauthorized harvesting or collection. Some management programs are currently addressing habitat loss and degradation. Illegal/unauthorized taking of eastern hellbenders has not been addressed.

The information compiled and evaluated for these darters also revealed loss and/or degradation of habitat to be the primary threat to their populations. However, inadequate sampling efforts and inappropriate sampling techniques appear to be confounding the monitoring of crystal darter and eastern sand darter populations. Both of these darters inhabit lotic systems possessing sandy substrates, which enable them to burrow into the sediment. Commonly used sampling equipment and techniques can result in highly variable data on the abundance and density of the eastern sand and crystal darters.

Survival of Elk Calves in Yellowstone National Park

Investigator: James Perry (Cooperating Faculty)

Student: Shannon Barber, Ph.D. (Wildlife Conservation)

Duration: August 2003 to May 2004

Funding Source: U. S. Geological Survey; Northern Prairie Wildlife Research Center

Project Location: Yellowstone National Park

Twenty-nine wolves (*Canis lupus*) were reintroduced to Yellowstone National Park (YNP) in 1995 and 1996. YNP wolves numbered about 174 in 2003. Elk (*Cervus elaphus*) are the primary prey of YNP wolves, many of which migrate out of the park and are subject to hunting. Many hunters and outfitters have criticized wolf reintroduction citing decreased elk numbers.

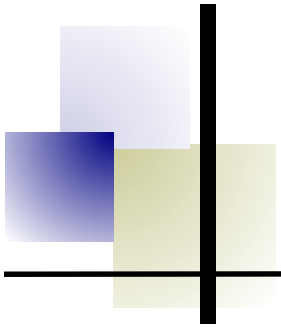
Examining wolf predation on elk calves is critical because wolves could be killing calves at a rate that reduces herd size (additive mortality), wolf predation could be merely substituting for other mortality sources like starvation (compensatory mortality), or an intermediate could be occurring (partial compensation).

During May 2003, the Yellowstone Center for Resources, U.S. Geological Survey, and the University of Minnesota initiated a 3-year study of mortality in northern Yellowstone elk calves. The primary objectives of the study were to: (1) estimate the relative causes and timing of calf deaths; (2) estimate calf survival rates; and (3) evaluate factors that may predispose calves to death.

During May/June 2003, 51 calves ≤ 6 days old were captured, fit with ear-tag transmitters, and monitored daily. During May through September 2003, 34 instrumented calves died (31 predation, 3 other causes) and 1 transmitter



malfunctioned. Preliminary determinations of causes of death for instrumented calves were 19 killed by grizzly (*Ursus arctos*) and black bears (*Ursus americanus*), 5 killed by wolves, 3 killed by coyotes (*Canis latrans*), 2 killed by either wolves or bears, 1 killed by a mountain lion (*Puma concolor*), 1 killed by a wolverine (*Gulo gulo*), and 3 non-predation deaths due to unknown causes. Increased predation relative to previous data and decreased winter starvation indicate probable compensatory mortality is occurring. Other studies provide explanations as to why increased predation is occurring including increased Greater Yellowstone Ecosystem grizzly bear minimum population estimates, increasing cougar population estimates since 1990, and increasing wolf numbers since 1995. Monitoring of surviving radioed calves will continue through winter 2004, and new captures are scheduled for May/June 2004 and 2005.



Completed Research



Human Activities,
Management, and
Conservation



Assessment of Use and Benefits of Waterfowl Production Areas in Minnesota

Investigators: David C. Fulton and Dorothy Anderson

Student: Jonathan Vlaming, M.S. (Forest Resources)

Duration: September 1999 to June 2003

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: Wetland Management Districts, Minnesota
U.S. Fish and Wildlife Service
University of Minnesota

Although information concerning public visitation and the factors affecting public support of Waterfowl Production Area (WPA) management are essential to effective WPA management strategies, at the present time little is known about the level of public use on WPAs or the value and benefits of WPAs to users. The purpose of this study was to develop a sampling methodology for accurately estimating the level of public use on small, dispersed recreation areas such as WPAs and to identify the types of benefits provided by WPAs and the non-economic value and importance of those benefits to the public. Specific study objectives were to: (1) develop a valid and reliable methodology for estimating visitation rates at WPAs within each of the 5 Wetland Management Districts

(WMDs) within Minnesota (estimates at the WMD level); (2) identify the level of use for different activities at WPAs; (3) develop and assess a social psychological framework for identifying and measuring the non-economic benefits that WPA users receive from WPAs; and (4) determine the influence of non-economic benefits on user support for federal ownership and management of WPAs.

Two reports were completed and are available from the Minnesota Cooperative Fish and Wildlife Research Unit. One report summarizes visitor activities and benefits associated with WPAs and the second details protocols for estimating visitation levels at WPAs in Minnesota.

Breeding Biology and Management of the Great Lakes Piping Plover Population: Shoreline Habitat and Species Protection Program

Investigator: Francesca Cuthbert (Cooperating Faculty)

Staff: Jennifer Hathaway-Stucker

Students: Vanessa Pompeii, M.S. (Conservation Biology)
Elizabeth Weaver Price, M.S. (Conservation Biology)
Olivia LeDee, Ph.D. (Conservation Biology)

Duration: April 2000 to February 2003

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: Upper Peninsula Michigan
University of Minnesota, St. Paul

The Great Lakes population of the piping plover (*Charadrius melodus*) was given federal endangered status in 1986. At that time, the only remaining breeding areas in the Great Lakes region were located within the state of Michigan. The islands of northern Lake Michigan (Charlevoix County) and shoreline of Emmet, Leelanau, and Cheboygan Counties are historically important breeding sites for piping plovers in Michigan's Lower Peninsula. Since the mid-1980s, nesting sites have been located and monitored in the Lower Peninsula of Michigan in Benzie, Charelvoix, Emmet, Leelanau, and Cheboygan Counties. In the Upper Peninsula, nests have been located in Mackinac, Chippewa, Luce and Alger Counties. During 1998, a pair of plovers hatched at different Michigan sites dispersed to Long Island (Ashland County, Wisconsin), successfully fledged young, and expanded the recent breeding range of the Great Lakes population. Objectives of this study were to continue to locate and monitor breeding plovers in the Great Lakes population, coordinate nest protection efforts, and estimate population parameters important for conservation.

From 2000-2002, we surveyed the Michigan shoreline, targeting areas where recent or



historical breeding and nesting attempts are known to have occurred. The U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources surveyed portions of the Wisconsin shoreline. Existing nests were protected with predator enclosures monitored throughout the season. As much as possible, both adults and chicks were banded for future identification, and Global Positioning System coordinates recorded for each capture or nesting site. By 2002, the population totaled 51 pairs of nesting plovers in the Great Lakes region; 79.4% and 19.6% of these nested on public and private land, respectively. The 2002 breeding season resulted in 61 chicks successfully fledged, based on nests monitored, and 19 captive-reared birds released.

Constraints and Opportunities for Quality Trout Angling Experiences in Southeastern Minnesota

Investigators: David C. Fulton and Bruce Vondracek

Students: Kristen Blann, Ph.D. (Conservation Biology)
Jonathan Vlaming, Ph.D. (Natural Resource Science and Management)

Duration: August 2000 to December 2003

Funding Source: Minnesota Department of Natural Resources

Project Location: Southeast Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

Management of quality trout fishing opportunities in the state of Minnesota has been a contentious issue for several years. Much of the conflict focuses on the competing demands of anglers who have different beliefs about the size and quantity of fish that can be produced by various streams in the region. Managers are challenged with identifying the demands of the trout-angling public as well as developing regulations that attend to these various demands while adhering to the available scientific knowledge of resource conditions and capabilities. This project developed an outcomes-based management system designed to improve the quality of the trout-fishing experience in southeastern Minnesota. This goal was accomplished through: (1) identifying differences in the biological productivity (e.g., species and size class abundance, growth rates, and growth potentials) of diverse trout streams in

southeast Minnesota; (2) determining the factors affecting stream productivity such as physical habitat measures and habitat suitability, habitat improvement activities, land use practices, food availability, fishing pressure, and supplemental fish stocking (brown [*Salmo trutta trutta*] and indigenous brook trout [*Salvelinus fontinalis*]), (3) assessing trout angler knowledge of factors affecting trout populations and stream quality, and (4) defining public preferences for angling experiences, activities, settings and benefits associated with these trout waters.

Three reports are available. One summarizes the biophysical results, a second summarizes attitudinal information and recreational, and the third summarizes landowner attitudes toward recreational fishing and conservation management on their property.

Trends on Fisheries Issues in Minnesota

Investigator: David C. Fulton

Students: Joanna Rosendahl, M.S. (Natural Resource Science and Management)
Michelle Payton, M.S. (Natural Resource Science and Management)

Duration: January 2000 to June 2003

Funding Source: Minnesota Department of Natural Resources

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

The purpose of this study was to develop a better understanding of anglers' perceptions of fisheries management issues and to initiate a long-term research program that will assist the Minnesota Department of Natural Resources with tracking trends in public perception of fisheries management issues. The objectives of this study were to: (1) determine anglers' attitudes toward and support for various fishing regulations in the state including regulations pertaining to the size and number of fish that can be retained; (2) assess anglers' perception of the effect of fishing regulations on the fishing

experience; (3) develop a battery of items based on research studies in Minnesota and other states that will be used to track trends in anglers' preferences and attitudes on key issues and perceptions including satisfaction with the general fishing experience, satisfaction with the number and size of fish caught, perceptions of crowding, and other key indicators of the quality of fishing experiences.

Two project reports summarizing the results of this study are available from the Unit.

Understanding Visitor Uses, Motives, and Benefits at Sherburne National Wildlife Refuge

Investigators: David C. Fulton and Dorothy Anderson (cooperating faculty)

Student: Michelle Payton, M.S. (Forest Resources)

Duration: September 2000 to December 2003

Funding Sources: U.S. Fish and Wildlife Service
U.S. Geological Survey

Project Location: Sherburne National Wildlife Refuge
Minnesota Cooperative Fish and Wildlife Research Unit

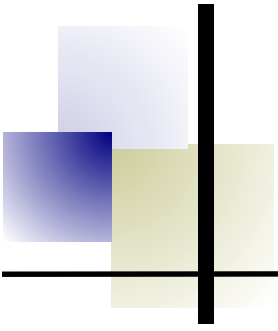
This project focused on developing information concerning refuge visitors' motivations for visiting Sherburne National Wildlife Refuge (NWR) and their perceptions of management issues at the refuge including issues involving visitor-visitor interactions, visitor-resource interactions and impacts, and visitor-management structure interactions. The research was directed by current ideas and theory concerning outcomes-based management (experience and benefits-based) of natural resource use. This approach to managing recreational use of natural resources is a relatively new area of research focus. One key aspect of this approach is the development of a system of indicators and standards for specifying management objectives that will facilitate the integration of biophysical and social information in the Comprehensive Conservation Planning (CCP) process, as well as serve as a basis for quantitative evaluation of planning decisions and actions. Specific study objectives were to:

1. Identify visitor motivations for visiting Sherburne NWR,
2. Identify the desired experiences and benefits



3. Identify objectives preferred by various visitor segments interested in the management of Sherburne NWR,
4. Develop a system of biophysical and social indicators to facilitate long-term monitoring of whether or not desired management objectives are being achieved for Sherburne NWR.

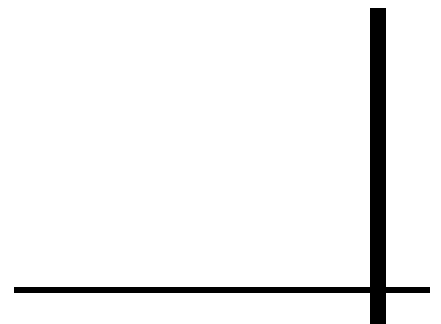
A visitor study report has been completed and is available from the Minnesota Cooperative Fish and Wildlife Research Unit. This information was used in developing the Sherburne CCP.



Ongoing Research



Applied Ecology



An Assessment of Terrestrial Snail Biology and Ecology with Threats Analysis

Investigators: Gerald Niemi, Joseph Mayasich (Cooperating Faculty)

Students: Anna Peterson, M.S. (Biology, University of Minnesota—Duluth)

Duration: September 2004 to December 2005

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: University of Minnesota, Duluth; Natural Resources Research Institute

There is little information available on the biology and ecology of various species of terrestrial snails that inhabit the midwestern United States. Although some survey work was completed in the early 1990s, there has since been no follow-up effort on terrestrial snails regarding species-specific population trends and distributional patterns, or research on potential threats to their existence. Terrestrial snails have very unique and specific habitat requirements, with a preference for cool and moist microclimates associated with areas of limestone and dolomite that were unaffected by historical glacial drift. Because terrestrial snails are habitat specialists, their populations tend to be relatively isolated. Their patchy distribution makes them vulnerable to stresses imposed by land use changes, especially development for commercial and/or residential use. Given the high potential for anthropogenic activities to significantly impact unique habitats and thereby threaten the relatively isolated populations of any species associated with them, a thorough range-wide status assessment of terrestrial snails is warranted.

The objective of the proposed research is to determine the status and distribution of select terrestrial snail species and to determine data

gaps in biological information available on these species. This will be accomplished through a review, interpretation, and summary of published and unpublished literature, reports, plans, and data. In addition, extensive personal communications with terrestrial snail experts will be used to update essential information and/or close data gaps. The deliverable product will be a status assessment that will include a detailed and thorough analysis of all potential threats to terrestrial snails, discern trends in their populations, and present geographic distributional patterns. The status assessment will focus on the following species of terrestrial snails:

Vertigo brierensis

Vertigo hubrichti hubrichti

Vertigo hubrichti variabilis

Vertigo iowaensis

Vertigo meramecensis

Catinella gelida

Novasuccinea n. sp. minnesota a

Novasuccinea n. sp. minnesota b

Ecology of Canada Lynx in Minnesota

Investigators: Gerald Niemi, Ronald Moen (Cooperating Faculty)

Students: Chris Burdett, Ph.D. (Conservation Biology)
Nick McCann, M.S. (Biology)

Duration: April 2003 to December 2006

Funding Sources: U.S. Department of Agriculture - Forest Service
U.S. Fish and Wildlife Service
U.S. Geological Survey - Biological Resource Division
Minnesota Department of Natural Resources

Project Location: University of Minnesota, Duluth; Natural Resources Research Institute

Minnesota historically supported the largest lynx population in the United States Great Lakes region. It was thought that Canada lynx (*Lynx canadensis*) had been extirpated from Minnesota in the early 1990s, but videos, sightings, and DNA evidence documented the presence of Canada lynx in Minnesota while lynx were being listed as a Threatened Species under the Endangered Species Act in 2000. This project was undertaken to increase understanding of the (1) location, (2) distribution, (3) persistence, and (4) habitat use of Canada lynx in and near the Superior National Forest (SNF) in northeastern Minnesota. We have captured and deployed radiotelemetry collars on 15 Canada lynx and 2 bobcats (*Lynx rufus*). Each animal is relocated approximately weekly after being collared. Radio telemetry provides information on the distribution of Canada lynx in Minnesota, supported by observations that are reported to the Canada lynx hotline (800-234-0054 or lynx@nrri.umn.edu). Genetic analysis of scat, hair, and tissue identifies individual Canada lynx, and also provides a baseline for mark-recapture estimates of abundance and persistence in future years. One major question being addressed in this project is whether Canada lynx persist in Minnesota through a lynx-hare (*Lepus americanus*) cycle. Monitoring radio-collared individuals over the next decade, observations, and genetic analysis



will all provide supporting data on the question of persistence. Habitat use is being evaluated primarily with Global Positioning System (GPS) collars that collect up to 4 locations per day. About half of the collars that have been deployed have been GPS collars. GPS collar data are supplemented with snow-tracking in the winter months. The status of the major prey species of Canada lynx, snowshoe hare and red squirrel (*Tamiasciurus hudsonicus*) is monitored with permanent plots established throughout the SNF. Plots were distributed based on stratified random, systematic, and selective site selection strategies. These methods collectively make it



possible to greatly increase understanding of the location, distribution, persistence, and habitat use of Canada lynx in Minnesota.

The radiotelemetry program progressed from 2 Canada lynx captured in the first winter to 13 Canada lynx and 2 bobcats captured in the first full year of the project. All animals have been located approximately weekly via telemetry from either the ground or air unless they have moved out of search range. Through September 2004, 15 adult or subadult Canada lynx have been captured, radiocollared, and released. Eight of the Canada lynx have worn or are wearing GPS collars, and we have downloaded or recovered collars for about 2,600 GPS location attempts. Success of GPS location attempts has ranged from 50% in summer with leaves on to about 70% in winter.

For the first time ever, this project documented reproduction of Canada lynx in Minnesota. It is likely that Canada lynx reproduced in Minnesota in the past, but this was the first time that dens

were found. Den sites of 3 of the female Canada lynx radiocollared in the project were visited in June 2004. There were ≥ 10 kittens in these den sites, 8 of which were ear-tagged after samples were collected for genetic analysis.

This project has also documented movement of individual Canada lynx between Ontario and Minnesota. GPS collar data are especially useful because movement rates can be determined from periodic locations when the animals are out of telemetry range. At least 3 males have spent extended periods of time in Ontario, from 10 to 60 km north of the U.S. border. Other males have made short trips into Ontario, while still others have remained resident in Minnesota. Females have generally been more sedentary, except for 1 individual that moved west of Ely and died during this movement.

Other field work includes visiting permanent pellet plots each spring to monitor the snowshoe hare population, snow-tracking of Canada lynx in winter, evaluating cameras and scent stations to attract Canada lynx and other carnivores for identification and population estimates, genetic analysis of Canada lynx samples, and continuing the trapping program at a reduced scale in the summer, beginning again in Fall 2004.

Further details on the Canada lynx project are available on the Lynx Project website at www.nrri.umn.edu/lynx. The website provides a history of the project, lists project goals and accomplishments, and includes links to press coverage.



Effects of Biotic and Physical Heterogeneity on Trophic Interactions in Headwater Streams

Investigator: Bruce Vondracek

Student: Julie Zimmerman, Ph.D. (Fisheries)

Duration: September 2001 to May 2005

Funding Source: Cargill Fellowship

Project Location: Valley Creek, Washington County, Minnesota

We examined interactions between slimy sculpin and a native (brook [*Salvelinus fontinalis*]) versus a nonnative (brown [*Salmo trutta trutta*]) trout, to test whether introductions of a nonnative salmonid has an effect on growth and diet of sculpin where a native trout was present. Enclosures (1 m²) were stocked with fish (5 treatments: juvenile brown trout with sculpin, juvenile brook trout with sculpin, and single species controls) at 3 densities. We examined growth and prey selection of each species in combined-species versus single-species treatments with 9 replicates over 6 38-day experiments, conducted over 3 years (2002-2004). Presence of sculpin did not affect growth of either brook or brown trout juveniles. In contrast, sculpin grew significantly greater (measured both by change in length and change in mass) in treatments with brook trout than in treatments with brown trout. Growth of sculpin in single-species controls was not significantly different than sculpin growth in brook trout treatments (measured by change in length and



change in mass), but was significantly higher than sculpin growth in brown trout treatments (measured by change in mass only). This suggests that the differences in morphology and foraging modes between the 2 native species allow them to coexist without competition, whereas nonnative brown trout compete with sculpin. We are also examining dietary overlap among these 3 species to investigate this hypothesis, but this analysis is not complete.

Fall Movements, Habitat Use, and Survival of the American Woodcock in the Western Great Lakes Region

Investigator: David E. Andersen

Student: Kevin Doherty, M.S. (Wildlife Conservation)

Staff: Becky Hylton (Project Field Supervisor, 2004)

Duration: September 2000 to June 2005

Funding Sources: U.S. Fish and Wildlife Service
Minnesota Department of Natural Resources
U.S. Geological Survey – Biological Resources Division

Project Location: Mille Lacs and Four Brooks Wildlife Management Areas
Minnesota Cooperative Fish and Wildlife Research Unit

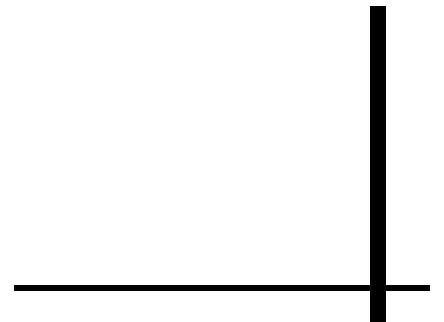
Little is known regarding fall movements, habitat use, and survival of American woodcock (*Scolopax minor*), particularly in the Central Management Unit. As part of a regional study to investigate these aspects of woodcock ecology, and to understand the impact of harvest on fall woodcock survival, in 2000 we initiated a 4-year study of fall woodcock ecology in the western Great Lakes region. Field work began in Minnesota in 2000, with parallel studies initiated in Wisconsin and Michigan in 2001. In Minnesota, Wisconsin, and Michigan, we identified a pair of study sites in close geographic proximity where woodcock habitat and population sizes were similar. One of these areas was open to woodcock hunting, and the other was closed to woodcock hunting or experienced very low hunting pressure. On each study site, we annually captured and equipped 30-90 woodcock with radio transmitters in late summer and early fall, prior to the initiation of the woodcock hunting season. Subsequent to capture and release, we monitored survival and habitat use of radio-marked woodcock through the hunting season or until surviving woodcock migrated from study sites. From 2001-2004 across all 3 states we captured and radio-equipped 1,169 woodcock; 594 on hunted areas and 575 on non-hunted or lightly-hunted areas. Preliminary survival estimates during the hunting season ranged from 0.639 ± 0.150



(hunted area in Wisconsin in 2003) to 0.900 ± 0.228 (hunted area in Minnesota in 2001) and were generally higher in non-hunted than in hunted areas. However, survival estimates between study sites in the same state during the same year were not statistically different from one another, except in 2 instances. Survival was variable among years and sites, but highest in non-hunted areas, suggesting that hunting mortality may vary more than other causes of mortality. A sub-sample of after-hatch-year (AHY) female woodcock was monitored intensively in each state and analyses of movement and habitat use data from these birds suggest that woodcock make primarily small-scale movements (47.7% <50 m between



subsequent locations and 5.82 ha average 95% fixed kernel home range size) prior to migration. Primary cover types used were aspen (*Populus* spp.) seedling/sapling, aspen pole, alder (*Alnus* spp.), conifer, and willow (*Salix* spp.). Preliminary analyses also suggest that woodcock used edges within individual covers, but that use of edge habitats is variable among habitat types and years. Field work has been completed and data analyses and project report, thesis, and manuscript preparation are ongoing.



Genetic Methods of Biological Control of Non-native Fish in the Gila River System

Investigator: Anne Kapuscinski (Cooperating Faculty)

Students: Timothy Patronski, M.S. (Humphrey Institute)
Ron Millen, Ph.D. (Conservation Biology)
Pouya Najmaie, Undergraduate (College of Natural Resources)

Duration: August 2003 to August 2004

Funding Source: U.S. Fish and Wildlife Service, Region 2

Project Location: Gila River System
University of Minnesota

We are conducting a feasibility study of using various genetic approaches to control non-native fish in the Gila River System in the U.S. Desert Southwest. As part of our overall feasibility assessment, we are reviewing: available genetic methods (including sterility via traditional methods for ploidy manipulation, and recombinant DNA techniques to produce transgenic fish with novel characteristics); ecological risk considerations; community awareness and involvement considerations; and legal, policy and regulatory considerations. We are also developing an overall roadmap, including a timeline and general categories of costs necessary to develop a transgenic fish for biological control in the Gila River Basin.

In May 2004 we visited with scientists from Centre for Research on Introduced Marine Pests at the Commonwealth Scientific Industrial Research Organization (CSIRO) Marine Labs in Hobart, Tasmania, Australia. The CSIRO group is leading the world in exploring creative transgenic approaches to controlling non-native species. Our visit was essential in informing all aspects of our feasibility research. In late June 2004, we visited the Gila River Basin in Arizona



to meet with state and federal agency staff, and local university researchers to learn more about Gila River specific considerations for our feasibility study. We also presented an update of our research at a Transgenic Fish Briefing held in Phoenix, Arizona to inform federal and state agency staff. Information gained from these 2 trips has been extremely valuable for the final phase of our study. As of September 2004, we are working to finalize our research and writing. Our draft final report will be finished by September 2005.

The Great Lakes Piping Plover: Population Research and Recovery

Investigator: Francesca Cuthbert (Cooperating Faculty)

Student: Cathy Haffner, M.S. (Conservation Biology)

Duration: May 2003 to March 2006

Funding Sources: U.S. Fish and Wildlife Service, Region 3

Project Location: United States Great Lakes
University of Minnesota

This project will initiate several new studies of the federally endangered Great Lakes piping plover (*Charadrius melodus*) and continue a long-term research program. We will determine population status, breeding pair distribution and productivity, factors affecting reproduction, and spatial use of plover nesting habitat. We will also implement and evaluate effectiveness of protection and recovery efforts.

Objectives are as follows:

- Estimate total number of nesting piping plover pairs, eggs laid, eggs hatched and chicks fledged
- Document breeding distribution
- Determine, when possible, cause of mortality of eggs, chicks and/or adults

- Determine spatial use of plover breeding habitat
- Implement and evaluate protection/recovery strategies (e.g., nest exclosures; beach closure; salvage, rear, and release abandoned eggs)
- Make recommendations to improve nesting success, long-term plover population persistence, and ultimately, population recovery

One year of field work has been completed. Spatial use analyses of piping plover breeding habitat is underway.

Survival of Elk Calves in Yellowstone National Park

Investigator: James Perry (Cooperating Faculty)

Student: Shannon Barber, Ph.D. (Wildlife Conservation)

Duration: September 2004 to October 2005

Funding Source: U. S. Geological Survey; Northern Prairie Wildlife Research Center

Project Location: Yellowstone National Park

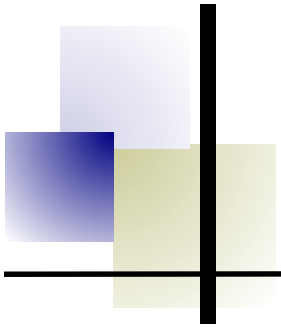
Twenty-nine wolves (*Canis lupus*) were reintroduced to Yellowstone National Park (YNP) in 1995 and 1996. YNP wolves numbered about 174 in 2003. Elk (*Cervus elaphus*) are the primary prey of YNP wolves, many of which migrate out of the park and are subject to hunting. Many hunters and outfitters have criticized wolf reintroduction citing decreased elk numbers.

Examining wolf predation on elk calves is critical because wolves could be killing calves at a rate that reduces the herd (additive mortality), wolf predation could be merely substituting for other mortality sources like starvation (compensatory mortality), or an intermediate could be occurring (partial compensation).

The Yellowstone Center for Resources, U.S. Geological Survey, and the University of Minnesota are continuing a 3-year study of mortality in northern Yellowstone elk calves. The primary objectives of the study are to: (1) estimate the relative causes and timing of calf deaths; (2) estimate calf survival rates; and (3) evaluate factors that may predispose calves to death.



During May/June 2004, 44 calves ≤ 6 days old were captured, fit with ear-tag transmitters, and monitored daily. To date, 31 of these calves have died (29 predation, 2 other causes). Preliminary determinations of causes of death for instrumented calves were 18 killed by grizzly (*Ursus arctos*) and black bears (*Ursus americanus*), 3 by wolves, 4 by coyotes (*Canis latrans*), 1 by a golden eagle (*Aquila chrysaetos*), 1 by either wolves or bears, 2 by unknown predators, and 2 non-predation deaths due to unknown causes. Monitoring of surviving radioed calves will continue through winter 2005, and the next capture is scheduled for May/June 2005.



Ongoing Research



Human Activities,
Management, and
Conservation



Biodiversity Conflict Management: Land-use Policies in Island Landscapes, a State-level Comparison

Investigators: Bruce Vondracek and Kristen Nelson

Student: Fiona Nagle, M.S. (Conservation Biology)

Duration: December 2001 to December 2005

Funding Sources: Consortium on Law and Values in Health, Environment, and the Life Sciences, University of Minnesota
MacArthur Fellowship

Project Location: Hawaii, Southern California, Tasmania

State and regional policies that designate land for biodiversity reserves are found worldwide. However, with escalating globalization, development, and biodiversity crises, policy goals have faced increasingly intense competition from human-oriented land uses. Island landscapes, both oceanic and terrestrial (i. e., geographically isolated areas), foster particularly contentious disputes between government officials and land users due to the

juxtaposition of local species crises and the finiteness of land and economic alternatives. Using policy case studies, disputes, which disrupt policy implementation, will be explored to determine whether conflict management effectively promotes biodiversity and human welfare. All case studies are complete and analysis is underway. Recommendations will address improved future conservation land-use policies.

Effects of Riparian Forest Harvest on Instream Habitat and Fish and Invertebrate Communities

Investigators: Bruce Vondracek and Raymond M. Newman (Cooperating Faculty)

Students: Dickson Atuke, M.S. (Conservation Biology)
Nicholas Schlessler, M.S. (Conservation Biology)

Duration: July 2003 to December 2007

Funding Sources: Minnesota Department of Natural Resources
Legislative Committee for Minnesota Resources, Water Resources Center
Minnesota Forest Resources Council

Project Location: Northern Minnesota

The Minnesota Forest Resources Council was charged under the Sustainable Forest Resources Act with coordinating the development of voluntary site-level timber harvesting and forest management guidelines. Finalized in 1998, these guidelines recommend practices to address riparian, wildlife habitat, soil, water quality, wetlands, visual quality, and historic and cultural resources. This project will evaluate how effective the guidelines protect forested riparian areas at a site-level. Specifically, we examine the effects of different levels of riparian (stream side) forest harvest on water quality, fish, invertebrates, and stream morphology at eight sites in northern Minnesota. We have selected sites on small (1 to 5 m wide) perennial streams that have as similar morphologies and communities as possible and that will permit similar harvest treatments (e.g., similar stand type, harvest method, etc.). We assess the effects of 3 riparian harvest treatments (none, moderate, and high); totally unharvested control sites and the no riparian harvest sites will be paired with 1 treatment on each stream. At each site, fish (and habitat and invertebrates) will be sampled upstream, within, and downstream of

the treatment reach to provide internal controls. For each treatment, the riparian management zone (RMZ) width will be fixed according the current Minnesota forest management guidelines. We have collected data 1 year of pre-harvest (2003) and 1 year of post-harvest (2004). There was high variability in flow regime, temperature, Index of Biological Integrity (IBI) scores, and Quantitative Habitat Evaluation Index (QHEI) values among the sites. We also observed significant variation between years in QHEI scores. Water quality indices were relatively lower in 2004 at most sites. Initial analyses of macroinvertebrate samples from both years indicate differences within and between sites in species composition and abundance (species richness and % EPT). Continued monitoring will be required before we can assess the effects of riparian harvest. Our study will also serve as the basis for longer-term assessment of the effects of riparian harvest on these responses and will provide information about the ecology of forest streams and will be used directly by governing agencies to determine logging policy in the state.

An Evaluation of Storm-water Management in a Watershed of the Minnesota Valley National Wildlife Refuge

Investigator: Bruce Wilson (Cooperating Faculty)

Students: Brian Ash, M.S. (Biosystems and Agricultural Engineering)

Duration: May 2004 to September 2007

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: Minnesota Valley National Wildlife Refuge; Bloomington, MN

This project is studying the magnitude and spatially varied characteristics of contaminant loading into the Minnesota Valley National Wildlife Refuge from subwatersheds within the city limits of Bloomington, Minnesota. Knowledge of these characteristics has important management implications for the Refuge, as well as providing useful information on urban runoff in the Twin Cities metropolitan area.

Seven monitoring stations have been established in the watershed to measure the flow and contaminant loads. Good flow rate data have been collected for the storms of summer, 1994. Problems were experienced in gathering water quality samples. Most of these problems can be related to the limitations of time-increment or flow-depth protocols established by the manufacturer of the instrumentation systems. We have contacted them and discussed the need to modify their software to allow samples to be



taken using cumulative runoff volume. Other problems in sampling were caused by large velocities in the storm sewers and equipment malfunctions. Data gathered over the summer are currently being analyzed.

Geospatial Techniques for National Wildlife Refuge Planning and Management

Investigator: Thomas E. Burk (Cooperating Faculty)

Students: Jennifer Sieracki Karen Walker
Nicole Brown Kari Geurts
Brian Mueller Perry Nacionales
Marcelle Caturia Jim Gonsoski
Leah Rathbun

Duration: August 2000 to September 2005

Funding Source: U.S. Fish and Wildlife Service, Region 3

Project Location: University of Minnesota, St. Paul

This work has focused on developing a framework for generating timely and accurate geo-spatial data in support of National Wildlife Refuge Comprehensive Conservation Planning (CCP). We have gone through several iterations of the framework and have illustrated its application on specific refuges. U.S. Fish and Wildlife Service (USFWS) Region 3 office staff members are now applying the final framework and associated protocols to complete Geographic Information System (GIS) development for other refuges. Vegetation mapping is an important component of GISes of this type. We are developing and applying new procedures for vegetation mapping of National Wildlife Refuge lands. These procedures include a rigorous and valid accuracy assessment protocol, the results of which will be published with the final map products. University staff members continue to meet approximately weekly with USFWS personnel to ensure project work is on-track and is useful to the CCP efforts.

GISes have been completed for additional test refuge cases: Mingo and Rice Lake (including the Sandstone unit) National Wildlife Refuges. Data and metadata have been delivered and the efforts have been documented via publication.

A general approach to vegetation classification, resulting in a product useful for CCP, has been



developed and documented. The approach is imagery independent and uses the National Vegetation Classification System (formation and alliance levels). A detailed approach to accuracy assessment has been formulated, including specification of sampling protocol and statistical analysis. The mapping and assessment approaches have been successfully implemented for the Swan Lake National Wildlife Refuge. This effort utilized Ikonos satellite imagery and resulted in > 85% classification accuracy overall



and for significant (area basis) classes. This specific effort is documented via publication. The approach is in the process of being tested at Rice Lake and Seney (class definition and accuracy assessment only) National Wildlife Refuges.

An important, somewhat unique, issue that will be part of the Rice Lake CCP involves the changing status of the wild rice beds prevalent at the refuge. Assessing this resource is complicated by the high year-to-year variability in wild rice establishment success. We have obtained historical aerial photography, have flown the refuge this year, and have obtained historical (on-the-ground) transect data to begin to examine this issue. We have developed a classification system for the primary vegetation types that occur in the lake, including wild rice, and have obtained reference data to begin

applying the system to the most recent photography.

We will apply it to the older photography as well and use the transect data for accuracy assessment. The more rigorous accuracy assessment methods (including ground visits) described above will be applied to the classification using the most recent photography. At a minimum this work will establish a baseline against which rice bed extent in future years can be compared.

In support of the basic CCP GIS efforts we have developed several additional protocols that are documented via in-house electronic documents. These include: a QA/QC document for evaluating data and metadata delivered from the framework we developed; a metadata generation/verification procedure using new ArcCatalog functionality in conjunction with metaparser; a detailed, step-by-step documentation for ortho-rectification and mosaicing of aerial photography that strikes an appropriate (for CCP usage) tradeoff between producing a “visually appealing” and an analytically useful end product; a document on a protocol for matching internal refuge data layers according to an accuracy hierarchy.

A small side-effort in support of the completed Shiawassee CCP GIS was completed that involved making conservation easement data available for digital analysis.



Groundwater Modelling in Southeast Minnesota

Investigator: Bruce Vondracek

Students: Mary Williams, Ph.D. (Conservation Biology)

Duration: July 2002 to June 2005

Funding Source: Minnesota Department of Natural Resources

Project Location: University of Minnesota, St. Paul

The goal of this project is to develop a better understanding of groundwater input to southeast Minnesota streams. Often stream habitat management treats the symptom (building instream habitat or stocking trout) rather than the problem (modifying terrestrial vegetation and soil that affect hydrology). To appropriately manage southeast Minnesota streams, it is important to understand the mechanisms that may contribute to changes in the quality of streams, principally coldwater input, and the effect on fish communities. Some streams appear to have potential for supporting trout, but do not support healthy trout populations at this time, likely due to insufficient groundwater input. Brook trout (*Salvelinus fontinalis*) have been associated with colder upstream reaches in southeast Minnesota where groundwater inputs are likely. This study will offer insight into the effects of conventional agricultural impacts on water quantity and trout populations of southeastern Minnesota streams. There are 4 objectives: (1) predict locations of groundwater input to streams in southeast Minnesota based on bedrock type, slope, and stream gradient using Geographic Information System (GIS) data layer from Fillmore County

as a template, (2) predict groundwater delivery (volume) to streams in southeast Minnesota based on modelling with the Soil and Water Assessment Tool (SWAT), (3) relate groundwater delivery to trout abundance/size structure, and (4) model change in groundwater delivery based on potential landuse changes, especially forestry practices and agricultural land use. To achieve these objectives the SWAT model will be linked with a GIS to predict locations of groundwater input, simulate groundwater delivery, and assess how changes in land use could affect volume of groundwater input. Land use will be examined under 2 types of simulation: a baseline condition representative of current conventional agriculture and forestry practices and a second condition representative of best management practices and other landuse changes that increase perennial vegetation. Trout population abundance and size structure will be assessed in relation to current and potential groundwater delivery using available Minnesota Department of Natural Resources stream survey data. Stream survey and groundwater inflow information will be linked to the streams coverage in GIS.

Potential Effects and Costs of Sinkhole Buffers in Southeastern Minnesota: Conservation in a Karst

Investigator: Bruce Vondracek

Student: Adam Petersen, M.S. (Conservation Biology)

Duration: September 2004 to May 2005

Funding: U.S. Geological Survey—Minnesota Cooperative Fish and Wildlife Research Unit

Project Location: Southeast Minnesota, University of Minnesota

An estimated 9,000 mapped sinkholes drain approximately 350 km² of land within the karst region of southeast Minnesota. Most of these sinkholes are in agricultural areas and drain row crops that have the potential to contribute pollutants directly to underlying aquifers and groundwater resources. Buffer strips and filter strips have been shown to improve water quality by reducing runoff volume and removing sediment, fertilizers, pesticides, pathogens, and other potential contaminants from agricultural runoff and may be beneficial in improving water quality when placed around sinkholes. We explored the costs and benefits of establishing vegetative buffers around sinkholes in 5 counties of southeast Minnesota. Our goal was to evaluate the potential benefits to stream water quality/quantity when buffers of varying sizes were placed around sinkholes. Water quality benefits of a vegetative sinkhole buffer were explored in terms of the potential reduction of sediment, nitrogen, and phosphorus from agricultural runoff via a soil-water hydrology model (SWAT). We emphasized soil infiltration, runoff reduction, regional hydrology, and potential impacts on coldwater trout habitat. Increasing



buffer width around sinkholes reduced runoff pollutant loads and may be regionally effective in reducing runoff volume in some areas, potentially reducing peak floods and increasing base flow in receiving streams. The cost of establishing buffers was explored with various scenarios of increasing buffer width. Our findings have the potential to influence policy decisions regarding land use in relation to water quality and quantity in groundwater recharge areas.

Stream Classification for TMDL Assessment Using a Dimensionless, Reference Reach Approach

Investigators: Bruce Vondracek, James A. Perry, Bruce Wilson, and John Nieber

Student: Angela Bolton, M.S. (Conservation Biology)

Duration: December 2003 to October 2006

Funding: US Environmental Protection Agency and Minnesota Pollution Control Agency

Project Location: Sites across the state of Minnesota

The overall goal of the project is to develop a simple classification system that is useful in Total Maximum Daily Load (TMDL) assessment. Research objectives are to: (1) investigate the relationship between indicators of stream health and localized stream characteristics, (2) develop and evaluate dimensionless curves using reference reach values as a tool for stream classification and TMDL assessment, and (3) test a stream classification system using the prediction intervals of the dimensionless curves. Three parallel hypotheses will be evaluated to complete the project. The classification method will use regional reference reaches to account for complex factors related to precipitation, land use, soil, and geology. Dependent variables of stream health and independent variables of

localized stream characteristics will be converted into dimensionless form by normalizing their values by those of the reference reach. Dimensionless relationships will be obtained using regression analyses. The variance of predicted values will be used to compute 3 different prediction intervals. These intervals will then be used to classify streams within a given region. Development and evaluation of the proposed classification system will be done using a large data set of stream stations gathered within 4 regions in Minnesota. An independent data set will be used for testing. The classification system will be used to prioritize efforts related to TMDL programs. The approach is well suited for considerations of changes in land use and other watershed practices.

Trends in Human Use and Conservation of Fisheries and Wildlife Resources in Minnesota

Investigators: David C. Fulton

Student: Susan Schroeder, Ph.D. (Natural Resources)

Duration: September 2002 to December 2005

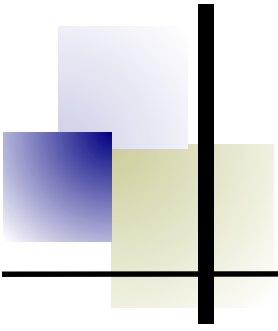
Funding Sources: Minnesota Department of Natural Resources
Division of Fisheries
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

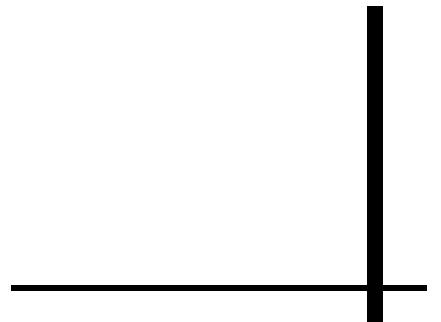
Currently, there is a significant demand from the Minnesota Department of Natural Resources (DNR) to conduct studies focused on the human dimensions aspects of fisheries, wildlife, and ecological management issues. While many of these studies provide funding opportunities for graduate students, including graduate theses, creation of a Human Dimensions (HD) Research Fellow position at the Minnesota Cooperative Fish and Wildlife Research Unit provides a way to collect additional information more cost-effectively. In addition, this position could also help ensure that data are collected in a consistent fashion across activities and issues and over multiple years. Doing so will facilitate the development of a human dimensions information database that is comparable across issues and over time. Such a database would be an important cornerstone in creating an effective human dimensions research partnership between the Minnesota DNR and the University of Minnesota, through the Minnesota Cooperative Fish and Wildlife Research Unit.



A research fellow was hired in fall 2002, and she is currently conducting research related to the 2002 waterfowl hunting season and trends in hunter and angler recruitment and retention in Minnesota.



Activities





Publications

PEER-REVIEWED

2003

- Andersen, D.E.**, T.R. Laurion, J.R. Cary, R.S. Sikes, M.A. McLeod, and E.M. Gese. 2003. Aspects of swift fox ecology in southeastern Colorado. Pages 139-117 in Sovada, M.A. and Carbyn, L., *The Swift Fox: Ecology and Conservation of Swift Foxes in a Changing World*. Canadian Plains Research Center, Regina. 250 pp.
- Boal, C.W., **D.E. Andersen**, and P.L. Kennedy. 2003. Home range and residency status of northern goshawks breeding in Minnesota. *Condor* 105:811-816.
- Dougherty, E.M., **D.C. Fulton**, and D.H. Anderson. 2003. The Influence of gender on the relationship between wildlife value orientations, beliefs, and the acceptability of lethal deer control in Cuyahoga Valley National Park. *Society and Natural Resources* 16:603-623.
- Meneks, M.L., **B. Vondracek**, and J. Hatch. 2003. Larval fish distribution in relation to physical and chemical factors in the Red River of the North. *Journal of Freshwater Ecology* 18:141-154.
- Nerbonne, J.A. and **B. Vondracek**. 2003. Volunteer macroinvertebrate monitoring: assessing training needs through examining error and bias in untrained volunteers. *Journal of the North American Benthological Society* 22:152-163.
- Perry, E.F. and **D.E. Andersen**. 2003. Advantages of clustered nesting for least flycatchers in north-central Minnesota. *Condor* 105:756-770.
- Ruetz, C.R., III, A.L. Hurford, and **B. Vondracek**. 2003. Interspecific interaction between brown trout and slimy sculpin: competition and facilitation. *Transactions of the American Fisheries Society* 132:611-618.
- Vondracek, B.**, J.K.H. Zimmerman, and J.V. Westra. 2003. Setting an effective TMDL for suspended sediment: an assessment of sediment loading and effects of suspended sediment on fish. *Journal of the American Water Resources Association* 39:1005-1015.
- Zimmerman, J.K.H., **B. Vondracek**, and J.V. Westra. 2003. Agricultural land use on sediment loading and fish assemblages in two Minnesota basins. *Environmental Management* 32:93-105.

2004

Fulton, D.C. and K. Hundertmark. 2004. Assessing the effects of a selective harvest system on moose hunters' behaviors, beliefs, and satisfaction. *Human Dimensions of Wildlife* 9:1-16.

Fulton, D.C. and K. Skerl. 2004. Beliefs and attitudes toward lethal management of deer in Cuyahoga Valley National Park. *Wildlife Society Bulletin* 32:1166-1176.

Fulton, D.C. and M. J. Manfredo. 2004. A panel design to assess the effects of regulatory induced reductions in opportunity on deer hunters' satisfaction. *Human Dimensions of Wildlife* 9:35-56.

Nack, R.R. and **D.E. Andersen**. 2004. Distribution of Eastern Prairie Population (EPP) Canada geese broods near Cape Churchill, Manitoba 1977-2002: potential influence of increased snow goose abundance. Pages 130-136 in T.J. Moser, K.C. VerCauteren, R. D. Lien, K. F. Abraham, **D.E. Andersen**, J.G. Bruggink, J.M. Coluccy, D.A. Graber, J.O. Leafloor, D.R. Luukkonen, and R.E. Trost, editors. *Proceedings of the 2003 International Canada Goose Symposium*, Madison, Wisconsin, USA.

Ruetz, C.R., III, **B. Vondracek**, and R.M. Newman. 2004. Top-down control in an algal-based food web: slimy sculpin, grazers, and periphyton. *Journal of the North American Benthological Society* 32:271-286.

Westra, J.V., J.K.H. Zimmerman, and **B. Vondracek**. 2004. Do conservation practices and programs benefit the intended resource concern? *Agricultural and Resource Economics Review* 33:105-120.

In Press, Review, or Revision

Andersen, D.E., S. DeStephano, M.I. Goldstein, K. Titus, C. Crocker-Bedford, J.J. Keane, R.G. Anthony, and R.N. Rosenfield. *In Press*. Technical review of the status of northern goshawks in the western United States. *Journal of Raptor Research*.

Andersen, D.E., T.B. FitzHenry, R.S. Sikes, D.K. Warnke, M.W. Meyer, C.J.R. Dykstra, and W.H. Karasov. *In Revision*. Response of nesting bald eagles around western Lake Superior to human activity. *Journal of Raptor Research*.

Blann, K. and **B. Vondracek**. *In Review*. Landscape and site factors affecting brook trout distribution. Symposium Proceedings: Influences of landscape on stream habitat and biological communities.

Boal, C.W., **D.E. Andersen**, and P.L. Kennedy. *In Press*. Breeding season foraging habitat of breeding male northern goshawks in the Laurentian Mixed Forest Province, Minnesota. *Journal of Wildlife Management*.

Boal, C.W., **D.E. Andersen**, P.L. Kennedy, and A.M. Roberson. *In Press*. Northern goshawk ecology in the western Great Lakes region. *Studies in Avian Biology*.

Boal, C.W., **D.E. Andersen**, and P.L. Kennedy. *In Press*. Productivity and mortality of goshawks in Minnesota. *Journal of Raptor Research*.

- Boal, C.W. and **D.E. Andersen**. *In Press*. Microhabitat characteristics of Lapland longspur (*Calcarius lapponicus*) nests at Cape Churchill, Manitoba. *Canadian Field-Naturalist*.
- Boody, G., **B. Vondracek**, D. Andow, J. Westra, P. Welle, C. Flora, J. Flora, M. Krinke, S. Light, D. French, C. Berg. *In Press*. Multifunctional agriculture in the United States. *BioScience*.
- Cummings, D., E.F. Perry, J.E. Sammler, and **D.E. Andersen**. *In Revision*. Nest visitation rates near fledging of least flycatchers and red-eyed vireos in northcentral Minnesota: implications for nest monitoring. *Journal of Field Ornithology*.
- Fulton, D.C.**, D.H. Anderson, and J. Rosendahl. *In Review*. Experience preferences as mediators of the wildlife related recreation participation-place attachment relationship. *Society and Natural Resources*.
- Nack, R.R. and **D.E. Andersen**. *In Press*. Influence of snow geese on brood movements of Eastern Prairie Population Canada geese. *Journal of Wildlife Management*.
- Payton, M., **D.C. Fulton**, and D.H. Anderson. *In Press*. Influence of place attachment and trust on civic action: a case study at Sherburne National Wildlife Refuge. *Society and Natural Resources*.
- Roberson, A.M., **D.E. Andersen**, and P.L. Kennedy. *In Press*. Does breeding phase and detection distance influence the effective area surveyed for northern goshawks? *Journal of Wildlife Management*.
- Schroeder, S. A. and **Fulton, D. C.** *In Review*. He said, she said: gender and angling motivations, ethics, and behaviors. *Human Dimensions of Wildlife*.
- Schroeder, S.A., **D.C. Fulton**, and J. Lawrence. *In Review*. A typology of waterfowl hunters in Minnesota. *Wildlife Society Bulletin*.
- Smithers, B.L., C.W. Boal, and **D.E. Andersen**. *In Press*. Northern goshawk food habits in Minnesota: an analysis using time-lapse video recording systems. *Journal of Raptor Research*.
- Westra, J.V., J.K.H. Zimmerman, and **B. Vondracek**. *In Press*. Economic and environmental benefits of mandated agricultural best management practices. *Journal of American Water Resources Association*.
- Westrick, M., **B. Vondracek**, J.A. Perry, and L.C. Ferrington. *In Review*. Multivariate versus a multimetric approach: how do they compare? *Journal of the North American Benthological Society*.

TECHNICAL AND SEMI-TECHNICAL

2004

- Andersen, D.E.**, S. DeStefano, M.I. Goldstein, K. Titus, C. Crocker-Bedford, J.J. Keane, R.G. Anthony, and R.N. Rosnefield. 2004. The status of northern goshawks in the western United States. Wildlife Society Technical Review 04-1. The Wildlife Society, Bethesda, Maryland, USA. 24 pp.

Cooperating Faculty Publications

PEER-REVIEWED

2003

Hove, M., M. Berg, K. Dietrich, C. Gonzalez, D. Hornbach, K. Juleen, M. Ledford, M. Marzec, M. McGill, C. Nelson, B. J. Ritger, J. Selander, and A. Kapuscinski. 2003. High school students participate in snuffbox host suitability trials. *Ellipsaria* 5:19-20.

Wires, L.R., D.N. Carss, F.J. Cuthbert, and J.J. Hatch. 2003. Transcontinental connections in relation to cormorant-fisheries conflicts: perceptions and realities of a "bête noire" (black beast) on both sides of the Atlantic. *Die Vogelwelt* 124, Suppl. 389-400.

2004

Brady, T., M. Hove, C. Nelson, R. Gordon, D. Hornbach, and A. Kapuscinski. 2004. Suitable host fish species determined for hickorynut and pink heelsplitter. *Ellipsaria* 6:14-15.

Steingraeber, M., M. Hove, M. Bartsch, D. Hornbach, C. Nelson, T. Newton, J. Kalas, A. Kapuscinski, and E. Simonsen. 2004. Two fish species identified as hosts for winged mapleleaf (*Quadrula fragosa*). *Ellipsaria* 6:7-8.

In Press, Review, or Revision

Burdett, C., L.D. Mech, G.J. Niemi, E.L. Lindquist, and R.A. Moen. Breeding of Canada lynx in Minnesota. *Journal of Mammalogy*.

Hove, M., M. Steingraeber, T. Newton, M. Bartsch, C. Nelson, J. Kurth, E. Simonsen, M. McGill, W. Taylor, and A. Kapuscinski. *In Review*. Factors influencing winged mapleleaf (Mollusca: Bivalvia) glochidia transformation success. *American Midland Naturalist*.

Moen, R.A. Habitat use of Canada lynx in Minnesota: a comparative analysis of VHF and GPS collar locations. *Journal of Wildlife Management*.

Moen, R.A., C. Burdett, G.J. Niemi, L.D. Mech, and E.L. Lindquist. Evaluating different GPS collars under controlled cover types. *Wildlife Society Bulletin*.

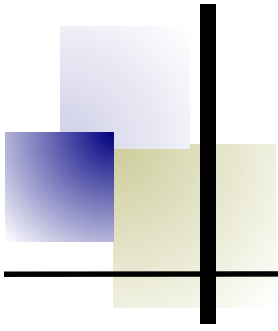
Moen, R.A., N.G. McCann, G.J. Niemi, L.D. Mech, and E.L. Lindquist. Calibrating 24-hour activity counts with video-taped observations of radiocollared Canada lynx. *Canadian Journal of Zoology*.

Moen, R.A., G.J. Niemi, L.D. Mech, and E.L. Lindquist. Persistence of Canada lynx in Minnesota based on genetic and population analyses. *Conservation Biology*.

TECHNICAL AND SEMI-TECHNICAL

Barber, S.M., P.J. White, and L.D. Mech. 2004. Multi-trophic level ecology of wolves, elk, and vegetation in Yellowstone National Park: elk calf mortality study. NRPP Project #71604, Annual Accomplishment Report, FY 2003.

- Brown, N.L., T.E. Burk, P.V. Bolstad and M. Balogh. 2004. Construction of a geographic information system for wildlife refuge planning: Rice Lake National Wildlife Refuge. University of Minnesota, Department of Forest Resources Staff Paper Series No. 172. 32 pp.
- Geurts, K.A., T.E. Burk, P.V. Bolstad and M. Balogh. 2004. Construction of a geographic information system for wildlife refuge planning: Mingo National Wildlife Refuge. University of Minnesota, Department of Forest Resources Staff Paper Series No. 171. 21 pp.
- Gonsoski, J.A., T.E. Burk, P.V. Bolstad and M. Balogh. 2004. Swan Lake National Wildlife Refuge vegetation cover (2000). University of Minnesota, Department of Forest Resources Staff Paper Series No. 175. 28 pp.
- Grandmaison, D., J.M. Mayasich and D. Etnier. 2003. Crystal darter status assessment report. NRRI/TR – 2003/19.
- Grandmaison, D., J.M. Mayasich and D. Etnier. 2004. Eastern sand darter status assessment report. NRRI/TR – 2003/40.
- Kapuscinski, A., T. Patronski, R. Millen, P. Najmaie. 2004. Genetic methods of biological control of non-native fish in the Gila River system. Draft progress report. Submitted to the U.S. Fish and Wildlife Service- Region 2.
- Mayasich, J.M., D. Grandmaison and C. Phillips. 2003. Eastern hellbender status assessment report. NRRI/TR –2003/09.
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- Moen, R.A., C. Burdett, G.J. Niemi, and L.D. Mech. 2003. Canada Lynx in the Great Lakes region. 2003 Annual report to U.S. Department of Agriculture Forest Service and Minnesota Cooperative Fish and Wildlife Research Unit. NRRI Technical Report No. NRRI/TR-2004-01.
- Stucker, J., F. J. Cuthbert and C. D. Haffner. 2003. Piping plover breeding biology and management in the Great Lakes, 2003. Report to U.S. Fish and Wildlife Service East Lansing Field Office and Natural Heritage and Endangered Species Programs of Michigan Department of Natural Resources Lansing, Michigan.



Completed Theses and Dissertations of Minnesota Coop Unit Students

2003

Au, Leakhena. 2003. Patterns in bird community structure related to restoration of Minnesota dry oak savannas. M.S. Thesis, University of Minnesota, St. Paul. 84 pp.

Abstract: There is limited understanding of the influence of fire and vegetation structure on bird communities in dry oak savannas of the upper Midwest. We examined the relationship between bird communities and some environmental variables, including vegetation characteristics and site prescribed-burn frequencies, across a habitat gradient from prairie to closed canopy oak woodland. During the breeding seasons of 2001 and 2002, we conducted 10-minute fixed-radius point counts ($n = 120$) within habitats with either a prairie groundcover or a predominately oak canopy. We described canopy and groundcover characteristics within 2 11-m radius plots at a sub-sample ($n = 28$) of non-prairie points, and collected canopy and woody species richness data for all points. We also obtained average prescribed burn frequencies over the last 20 years for all points. Canopy cover and burn frequency were most strongly related to observed patterns in bird communities. Most savanna points had bird communities that were distinct from those found at oak woodland or burned woodland points. Savanna points similar to oak woodland points were in areas managed by periodic cutting rather than burning. Remnant savanna bird communities were more strongly associated with prescribed burning than those in other habitat types, but it is unclear whether ≥ 20 years of prescribed burning in woodlands have resulted in bird communities comparable to those in remnant savannas.

Frost Nerbonne, Julia. 2003. Volunteer macroinvertebrate monitoring as a tool for empowering citizen groups in the United States. Ph.D. Dissertation, University of Minnesota, St. Paul. 177 pp.

Abstract: Volunteer Macroinvertebrate Monitoring (VMM) is a way for citizens to track the health of local watersheds. I investigate the utility of this tool as a means for empowering citizen groups to promote environmental change. In chapter 1, I assess the power of VMM as a tool for answering questions about land use. Standard macroinvertebrate metrics were not able to identify anthropogenic influences on streams at the farmstead scale. However they were able to detect differences at the microhabitat scale indicating that while VMM may not be an appropriate tool for citizens to answer questions about individual land use in their watershed, it could be a valuable tool for understanding long-term trends in watershed health. In chapter 2, I illustrate that untrained volunteers are biased when it comes to sorting and identifying macroinvertebrates, thus I conclude that organizers should strive to match protocols with volunteer ability, and should plan to put substantial time into training volunteers to correctly sort and identify macroinvertebrates. In chapters 3 and 4 I investigate the citizen groups that are using VMM. I conducted a national survey to understand the demographics of these groups, what their goals were, and how they felt VMM impacted their ability to act in the world. In chapter three, I conclude that the majority of VMM groups surveyed were primarily interested in public education. In concert with their goals, the majority of groups also perceived that they were more effective at promoting awareness than legislative change. As expected, opportunity structures at the state level

significantly impact the character of VMM groups. A networked support structure in which states support, rather than run, VMM programs tend to support larger and possibly more independently motivated groups. Lastly, in chapter 4, I find that data quality is not clearly correlated with either data use or perceived outcomes. This is concerning because it illustrates that volunteers may not be rewarded for investing resources in collecting quality data and may ultimately undermine efforts to create legitimate and open dialogue with scientists and policy makers.

Payton, Michelle A. 2003. Influence of place attachment and social capital on civic action: a study at Sherburne National Wildlife Refuge. M.S. Thesis, University of Minnesota, St. Paul. 85 pp.

Abstract: Agencies are changing their model of natural resource management from an agency as authority approach to a collaborative effort involving the public and the agency. This new model faces its own unique challenges. Some research suggests that the U.S. has experienced a decrease in social capital, or level of trust between individuals and the involvement of citizens in their communities. Promoting collaboration in an environment of declining citizen involvement and public trust is a difficult task.

Understanding what factors influence civic action is essential to the success of the new collaborative management model. This study examines two factors that potentially have a strong influence on civic action: place attachment (functional and emotional ties that connect people to places) and social capital (the relationships and trust among individuals and groups).

A visitor survey was conducted at Sherburne National Wildlife Refuge to better understand visitors' motives, perceptions, and experiences. Using the data from the visitor survey, this study examines the relationships among visitors' level of place attachment to the refuge, level of social capital, and level of civic action. Both place attachment and social capital accounted for a significant amount of variance in civic action. Social capital was found to partially mediate the relationship between emotional place attachment and civic action. Managers can use information on visitors' levels of place attachment and social capital to help shape and design citizen participation programs. These constructs provide valuable information on how managers can effectively direct civic action programs for the benefit of the natural landscape, community, and agency.

Nack, Robert R. 2003. Brood movements and distribution of Eastern Prairie Population (EPP) Canada geese (*Branta canadensis interior*) in northern Manitoba: potential influence of increased snow goose (*Chen caerulescens caerulescens*) abundance. M.S. Thesis, University of Minnesota, St. Paul. 66 pp.

Abstract: In 2001 and 2002, we conducted aerial surveys to compare indices of Eastern Prairie Population (EPP) Canada goose (*Branta canadensis interior*) brood distribution and abundance near Cape Churchill, Manitoba with those obtained in 1977 and 1978. Since the late 1970s, many of the coastal salt marsh areas used for brood-rearing have been degraded as a result of increased foraging pressure from locally breeding and migrating light geese [snow geese (*Chen caerulescens*) and Ross's geese (*C. rossii*)] and the density of nesting Canada geese has declined. The mean Canada goose brood density across the entire survey area in 2001-2002 was not different from 1977-1978 (difference between means \pm 95% CI; $0.20 \text{ broods/km}^2 \pm 0.36$); however, the mean brood density in the southern portion of the survey area was significantly higher in 2001-2002 than in 1977-1978 (0.45 ± 0.39). In 2002, the mean snow goose brood density was higher than the mean Canada goose brood density (27.31 ± 10.92), with higher densities of snow geese in northern coastal flats/beach ridge areas and higher densities of Canada geese in southern coastal flats/beach ridge areas. The mean number of Canada goose broods observed on 15 traditional brood-rearing areas decreased since 1977 (-8.67 ± 6.19) and the mean number of snow goose broods observed increased (43.91 ± 38.22). Canada goose broods appear to have shifted use of brood-rearing areas in response to reduced food availability, direct interactions with snow geese

on brood-rearing areas, or both. Loss and degradation of brood-rearing habitat may be a factor in declines in nest density of Canada geese and has implications for EPP management.

2004

Blann, Kristen L. 2004. Landscape-scale analysis of stream fish communities and habitats: lessons from southeastern Minnesota. Ph.D. Dissertation, University of Minnesota, St. Paul. 153 pp.

Abstract: In southeastern Minnesota, as in many other parts of the U.S., stream biological communities have been under dramatic and continuous pressure throughout the 20th century, subjected to the cumulative impacts of land use practices, exploitation, channel diversions and alteration, reductions in and wider extremes of instream flow, habitat loss and degradation, and point and non-point source pollution. Concern over these challenges has translated into primarily site-level restoration and management strategies, while larger-scale processes (at the watershed or subwatershed level) that drive many of the observed habitat losses remain poorly understood or addressed.

The goal of my research was to generate more integrated understanding of stream systems in southeastern Minnesota in historical and landscape context, using both geographic analysis of long-term quantitative monitoring data of stream fish and habitats, as well as qualitative focus groups and surveys with anglers and landowners. How do we link long-term, large-scale data and information about catchment to site-level conditions to generate understanding of the system as a whole? Significant patterns in habitat, fish communities and trout abundance were identified in relation to land use and ecoregional landscape characteristics, and results provided lessons pertaining to future research design and analysis. Results are discussed in the context of spatial and temporal scale, sample size, social values and trends. Further research into the interactions of geology, groundwater, and stream thermal regimes is needed. Improving the integration of physical and biological disciplines and models could potentially be productively addressed through interdisciplinary working groups focused on integrated assessment, priority-setting, research design, and modelling, perhaps in conjunction with existing watershed scale entities.

Doherty, Kevin E. 2004. Fall movements patterns of adult female American woodcock (*Scolopax minor*) in the western Great Lakes region. M.S. Thesis, University of Minnesota, St. Paul. 59 pp.

Abstract: In 2002 and 2003, I collected movement and habitat data for 58 adult female woodcock during fall across 3 pairs of study sites in Minnesota, Wisconsin, and Michigan. Distances between subsequent daily locations were highly variable (C.V. = 2.188), and the majority (90.9%) of distances between subsequent daily locations of woodcock were <400 m, with 47.7% of distances <50 m. Habitat variables related to food, weather, and predator avoidance were used in general mixed linear models using Information-theoretic methods to assess the importance of these variables as predictors of distance between subsequent daily locations of individual woodcock. Models incorporating all movements explained 71.56% of the process variation among individual birds. Woodcock were more likely to make large movements (>500 m) and forage in new areas when environmental conditions were not favorable, such as in the case of low earthworm abundance (biomass). Large movements into new foraging areas were correlated with the interaction between soil porosity and rainfall, presumably because earthworm availability increased following precipitation. Woodcock were also more likely to make longer movements in warmer temperatures with >2/3 of movements >500 m occurring when the daily low temperature was above the median low temperature of 2.4° C. My results suggest that the primary determinants of woodcock movements during fall (prior to migration) were low local food availability and the potential for increased food availability elsewhere. Longer movements were influenced by weather conditions, and there was little evidence that predator avoidance influenced movements between subsequent days. Adult female woodcock appear to incorporate prior knowledge of previously used

areas into the decision of foraging location on a particular day, and generally return to the previous day's foraging area unless conditions become more favorable elsewhere.

Laudon, Matthew. 2004. The importance of terrestrial arthropods to trout in Valley Creek, Minnesota. M.S. Thesis, University of Minnesota, St. Paul. 114 pp.

Abstract. Our goal was to evaluate the prey sources that drive high trout production in Valley Creek, Minnesota with emphasis on terrestrial arthropods in the diets of brown *Salmo trutta* and rainbow *Oncorhynchus mykiss* trout. We describe the taxonomic composition, abundance, and size (length and biomass) of invertebrates drifting in the water column and ingested by trout, and assess the selectivity and overlap in diet. We collected drift before dawn and in the afternoon on five dates in June, July, and August in three sequential riffles. Immediately following drift sampling, we collected brown and rainbow trout, 13 - 20cm in length, in pools immediately below the riffles where drift was collected. Terrestrial invertebrates comprised about 3% of the drift across times and dates. Eleven taxa comprised almost 95% of the total number of invertebrates in the drift; seven aquatic taxa comprised 93% of the total and four terrestrial taxa 2%. Brown and rainbow trout ingested terrestrial invertebrates when available and invertebrates of terrestrial origin made up approximately 10% of the diet by number overall. Seven aquatic taxa contributed almost 84% of the total number of invertebrates to the diet of both trout. Trout were size selective, preferring larger invertebrates by both length (7 - 12.9mm) and biomass. *Gammarus pseudolimnaeus* made up about 75% of the diet of brown trout and about 60% of the diet of rainbow trout based on biomass. Diet overlap was >60% for both trout in relation to total individuals, length, and biomass of invertebrate prey. The high production of *Gammarus* in Valley Creek is integral to the high production of trout.



Presentations

INVITED PRESENTATIONS

2003

- Andersen, D.E.** 2003. Demography of northern goshawks in North America: an overview. International Northern Goshawk Symposium and Annual Meeting of The Raptor Research Foundation, Inc., Anchorage, Alaska.
- Fulton, D.C.** 2003. Understanding angler knowledge and ethics: user ethics in recreational fisheries. Society of Conservation Biology, Duluth, Minnesota.
- Schroeder, S. A., **D.C. Fulton** and J. Lawrence. 2003. A typology of waterfowl hunters in Minnesota. The Wildlife Society Annual Conference, Burlington, Vermont.
- Vlaming, J. and **D.C. Fulton**. 2003. Fly vs. worm: comparing fly and bait anglers on southeast Minnesota trout streams. Minnesota Chapter American Fisheries Society, Chaska, Minnesota.
- Vlaming J. and **D. C. Fulton** 2003. Social and environmental classification of trout streams. Minnesota Chapter American Fisheries Society, Chaska, Minnesota.
- Vondracek, B.**, J. K. H. Zimmerman, and J. Westra. 2003. Setting an effective TMDL for suspended sediment. American Water Resources Association 2003 Spring Specialty Conference, Kansas City, Missouri.
- Westra, J., J. K. H. Zimmerman, and **B. Vondracek**. 2003. Economic and environmental benefits of mandated agricultural best management practices. American Water Resources Association 2003 Spring Specialty Conference, Kansas City, Missouri.

2004

- Andersen, D.E.** 2004. Northern goshawks: status review and ecology in North America. Agricultural University of Hebei, Baoding, Hebei, China.
- Andersen, D.E.** 2004. Imperiled Arctic ecosystems: snow goose impacts on tundra birds. Agricultural University of Hebei, Baoding, Hebei, China.
- Fulton, D.C.** 2004. Motivations for and economic impacts of coldwater recreational fishing in Lake Superior, Minnesota. American Fisheries Society. Madison, Wisconsin.

Vondracek, B. and K. L. Blann. 2004. Landscape and site factors affecting brook trout distribution. 134th Annual Meeting of the American Fisheries Society, Madison, Wisconsin.

Vondracek, B. 2004. Influences of agricultural practices on water quality and native aquatic communities in the Midwest. 134th Annual Meeting of the American Fisheries Society, Madison, Wisconsin.

CONTRIBUTED PRESENTATIONS

2003

Altinger, N., J. K. Zimmerman, and **B. Vondracek**. 2003. Species interactions and sedimentation effects on two trout species in Valley Creek. Annual meeting of the Minnesota Chapter of the American Fisheries Society, Chaska, Minnesota. (*Poster*)

Andersen, D.E., S. DeStefano, M.I. Goldstein, K. Titus, C. Crocker-Bedford, J.J. Keane, R.G. Anthony, and R.N. Rosenfield. 2003. Technical review of the status of northern goshawks in the western United States. 2003 International Northern Goshawk Symposium and Annual Meeting of The Raptor Research Foundation, Inc., Anchorage, Alaska.

Au, L., **D.E. Andersen**, and M. Davis. 2003. Patterns in bird community structure related to restoration of Minnesota dry oak savannas. 64th Midwest Fish and Wildlife Conference, Kansas City, Missouri.

Blann, K. L. and **B. Vondracek**. 2003. Landscape analysis of stream fish communities and trout abundance in GIS: lessons and limitations. 64th Midwest Fish and Wildlife Conference, Kansas City, Missouri.

Boal, C.W., **D.E. Andersen**, and P.L. Kennedy. 2003. Productivity and nesting habitat of northern goshawks in Minnesota. 2003 International Northern Goshawk Symposium and Annual Meeting of The Raptor Research Foundation, Inc., Anchorage, Alaska.

Payton, M.A. and **D.C. Fulton**. 2003. Minnesota fisheries stewardship and management: an angler's perspective. 64th Midwest Fish and Wildlife Conference, Kansas City, Missouri.

Smithers, B.L., C.W. Boal, and **D.E. Andersen**. 2003. Assessment of northern goshawk food habits using time-lapse video monitoring systems. Texas Chapter of The Wildlife Society 38th Annual Meeting, Waco, Texas.

Vondracek, B., J. K. Zimmerman, and J. V. Westra. 2003. Setting an effective TMDL for suspended sediment. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Chaska, Minnesota.

Wagner, K., P. Bobzin, J. K. H. Zimmerman, **B. Vondracek**. 2003. Seasonal change of benthic invertebrate species and abundance in differing environments. 15th Annual St. Croix River Research Rendezvous, Marine on St. Croix, Minnesota. (*Poster*)

Westra, J.V., J. K. H. Zimmerman and **B. Vondracek**. 2003. Potential economic and environmental effects of select conservation programs of the 2002 Farm Bill. Workshop on linkages between agricultural and conservation policies, Portsmouth, New Hampshire.

- Williams, M. A., and **B. Vondracek**. 2003. Groundwater modeling in karst terrain: hydrological flow in southeast Minnesota. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Chaska, Minnesota.
- Williams, M. A. and **B. Vondracek**. 2003. Groundwater modeling in karst terrain: hydrological flow in southeast Minnesota. 17th Annual Meeting of the Society for Conservation Biology, Duluth, Minnesota.
- Zimmerman, J. K. H. and **B. Vondracek**. 2003. Community-level consequences of trout introductions: interactions between native and nonnative species in a small coldwater stream. 15th Annual St. Croix River Research Rendezvous. Marine on St. Croix, Minnesota.
- Zimmerman, J.K.H. and **B. Vondracek**. 2003. Community-level consequences of trout introductions: interactions between native and nonnative species in a small coldwater stream. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Chaska, Minnesota.
- Zimmerman, J.K.H. and **B. Vondracek**. 2003. Community-level consequences of trout introductions: interactions between native and nonnative species in a small coldwater stream. 51st Annual Meeting of the North American Benthological Society, Athens, Georgia.
- Zimmerman, J. K. H. and **B. Vondracek**. 2003. Community-level consequences of trout introductions: interactions between native and nonnative species in a small coldwater stream. 133rd Annual Meeting of the American Fisheries Society, Quebec City, Quebec, Canada. (*Poster*)
- Zimmerman, J. K. H., **B. Vondracek**, and J. V. Westra. 2003. Setting an effective TMDL: sediment loading and effects of suspended sediment on fish. 133rd Annual Meeting of the American Fisheries Society, Quebec City, Quebec, Canada.

2004

- Doherty, K., **D.E. Andersen**, J. Meunier, E. Oppelt, J. G. Bruggink, and R. S. Lutz. 2004. Distance-based analysis of the effects of habitat and weather on movement patterns of adult female American woodcock (*Scolopax minor*). The Wildlife Society Annual Meeting, Calgary, Alberta, Canada.
- Fulton, D.C.** and M.A. Payton. 2004. Southeastern Minnesota landowners opinions on land conservation techniques and programs. Minnesota Chapter American Fisheries Society, St. Cloud, Minnesota.
- Oppelt, E., J.G. Bruggink, K. Doherty, **D.E. Andersen**, J. Muenier, and R.S. Lutz. 2004. Fall survival of American woodcock in the western Great Lakes Region. 65th Midwest Fish and Wildlife Conference, Indianapolis, Indiana.
- Payton, M. A., **D.C. Fulton**, and D.H. Anderson. 2004. Sense of place and community life: the influences of sense of place on trust and civil involvement. Society for Human Ecology, 12th International Conference, Cozumel, Mexico.
- Payton, M.A. and **D.C. Fulton**. 2004. Southeastern Minnesota landowners opinions on land conservation techniques and programs. International Symposium on Society and Natural Resources Management, Keystone, Colorado.

- Schlesser, N., D. Atuke, **B. Vondracek**, and R. Newman. 2004. Effects of riparian forest harvest on habitat and fish assemblages in northern Minnesota. 65th Midwest Fish and Wildlife Conference, Indianapolis, Indiana. (*Poster*)
- Schroeder, S. A. and **D.C. Fulton**. 2004. He said, she said: gender and angling motivations, ethics, and behaviors. Society for Human Ecology, 12th International Conference. Cozumel, Mexico.
- Schroeder, S. A. and **D.C. Fulton**. 2004. He said, she said: gender and angling motivations, ethics, and behaviors. Minnesota Chapter American Fisheries Society, St. Cloud, Minnesota.
- Schroeder, S. A. and **D.C. Fulton**. 2004. Land of 10,000 lakes and 2.3 million anglers: crowding, conflict, and coping among Minnesota anglers. International Symposium on Society and Natural Resources Management, Keystone, Colorado.
- Westra, J. V., J. K. H. Zimmerman, and **B. Vondracek**. 2004. Economic and fisheries effects of select conservation programs of the 2002 Farm Act. 59th Annual Conference of the Soil and Water Conservation Society, St. Paul, Minnesota.
- Williams, M. A. and **B. Vondracek**. 2004. Geospatial spring identification in southeast Minnesota. 59th Annual Conference of the Soil and Water Conservation Society, St. Paul, Minnesota.
- Williams, M. A. and **B. Vondracek**. 2004. Geospatial spring characteristics in southeast Minnesota. Joint Annual Meeting of the Minnesota Chapters of the American Fisheries Society and the Society for Conservation Biology, St. Cloud, Minnesota.
- Williams, M. A. and **B. Vondracek**. 2004. Geospatial spring identification in southeast Minnesota. 18th Annual Meeting of the Society for Conservation Biology, New York, New York.
- Williams, M. A. and **B. Vondracek**. 2004. Geospatial characteristics of karst springs in southeast Minnesota. 134th Annual Meeting of the American Fisheries Society, Madison, Wisconsin.
- Zimmerman, J. K. H. and **B. Vondracek**. 2004. Stream enclosure effects on drifting invertebrates and fish growth: do enclosure experiments produce biased results? 16th Annual St. Croix River Research Rendezvous. Marine on St. Croix, Minnesota.
- Zimmerman, J. K. H. and **B. Vondracek**. 2004. Stream enclosure effects on drifting invertebrates and fish growth: do enclosure experiments produce biased results? Joint Annual Meeting of the Minnesota Chapters of the American Fisheries Society and the Society for Conservation Biology, St. Cloud, Minnesota. (*Best student presentation*)
- Zimmerman, J. K. H. and **B. Vondracek**. 2004. Stream enclosure effects on drifting invertebrates and fish growth: do enclosure experiments produce biased results? 52nd Annual Meeting of the North American Benthological Society, Vancouver, British Columbia, Canada. (*Frigid Units Award for best presentation emphasizing methodology*)
- Zimmerman, J. K. H. and **B. Vondracek**. 2004. Stream enclosure effects on drifting invertebrates and fish growth: do enclosure experiments produce biased results? 134th Annual Meeting of the American Fisheries Society, Madison, Wisconsin.

Cooperating Faculty Presentations

CONTRIBUTED PRESENTATIONS

2003

Hove, M., M. Berg, K. Dietrich, C. Gonzalez, D. Hornbach, K. Juleen, M. Ledford, M. Marzec, M. McGill, C. Nelson, B.J. Ritger, J. Selander, and A. Kapuscinski. 2003. Host fish identification of rare St. Croix River mussels. 15th Annual St. Croix River Research Rendezvous, Marine on St. Croix, Minnesota.

Phillips, C., J. Mayasich, and D. Grandmaison. 2003. Status assessment for the eastern hellbender. Hellbender Symposium, Helen, Georgia.

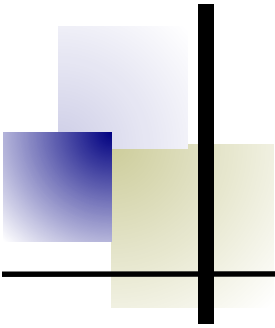
2004

Cuthbert, F.J. 2004. Great Lakes piping plover habitat. 2004 Least Tern and Piping Plover Workshop and Symposium, Sioux City, Nebraska.

Haffner, C.D. and F.J. Cuthbert. 2004. Breeding season spatial requirements of Great Lakes piping plovers (*Charadrius melodus*), 2004 Least Tern and Piping Plover Workshop and Symposium, Sioux City, Nebraska. (*Poster*)

Lindquist, E.L., R.A. Moen, C. Burdett, G.J. Niemi, and S.L. Loch. 2004. Development of a cooperative research project to study Canada lynx in the western Great Lakes region. Carnivores 2004: Expanding Partnerships in Carnivore Conservation, Santa Fe, New Mexico.

Stucker, J. H., F. J. Cuthbert, and L. C. Wemmer. 2004. The Great Lakes piping plover population banding program 1993-2003: summary and evaluation. 2004 Least Tern and Piping Plover Workshop and Symposium, Sioux City, Nebraska.



Unit News

Over the past 2 years, Hattie Saloka (formerly Curtner) has continued in her position as Administrative Assistant for the Minnesota Cooperative Fish and Wildlife Research Unit. She married Chad Saloka in 2004, and she and Chad traveled to the South Pacific at the end of the year.

In her spare time, she takes classes (fun things, like organic chemistry) in pursuit of a degree in Veterinary Medicine.

Hattie continues to keep the Coop Unit operating efficiently, and in 2004, worked with a friend of hers to redesign the Minnesota Cooperative Fish and Wildlife Research Unit logo (which adorns this report).

In 2004, David Fulton (Assistant Leader-Wildlife) was promoted to GS-13 through the federal Research Grade Evaluation process, and to Adjunct

Associate Professor in the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota. Still the only social scientist in the Coop Units program, David has developed a highly regarded research program working with Unit cooperators in the area of Human Dimensions. Bruce Vondracek (Assistant Leader-Fisheries) and David Andersen (Leader) have continued their research programs to help meet cooperator-identified priorities and to further the Unit' research mission. In recognition of the

quality of science pursued and high level of productivity, the Minnesota Cooperative Fish and Wildlife Research Unit was awarded a "Research Program Excellence Award" by the Cooperative Research Units Program for 2004.



Other Minnesota Coop Unit news includes a reorganization at the Minnesota Department of Natural Resources, which resulted in changes to the Coordinating Committee. Tim Bremicker and Mike DonCarlos served on the Coordinating Committee in 2003, but reassignments within the Minnesota Department of Natural Resources resulted in their departure from the Coordinating Committee in 2004—we thank both Tim and Mike for their contributions to the Minnesota Coop Unit. Similarly, Rob Manes left

his position with the Wildlife Management Institute, and Dr. Rollie Sparrow retired as President of the Wildlife Management Institute—we thank both Rob and Rollie for their efforts on our behalf. Finally, we would like to acknowledge the hard work and productivity of past and current graduate students, technicians, research associates, and others who helped make the Minnesota Cooperative Fish and Wildlife Research Unit what it is today.