



MINNESOTA COOPERATIVE FISH
AND WILDLIFE RESEARCH UNIT

Biennial Report

January 2007— December 2008

U.S. Geological
Survey

University of
Minnesota

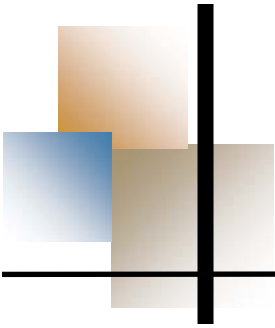
Minnesota
Department of
Natural Resources

The Wildlife
Management
Institute

*U.S. Fish and
Wildlife Service*



U.S. Geological Survey
Minnesota Cooperative Fish and Wildlife Research Unit
University of Minnesota
Department of Fisheries, Wildlife, and Conservation Biology
200 Hodson Hall
1980 Folwell Avenue
St. Paul, Minnesota 55108
Phone: (612) 624-3421
Fax: (612) 625-5299
<http://fwcb.cfans.umn.edu/coop/>



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. That mission continues today, with support from both long-standing and new partners. At the Minnesota Cooperative Fish and Wildlife Research Unit, we emphasize 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 tenth biennial report produced by the Minnesota Coop Unit and summarizes Unit activities during 2007 and 2008. Over the past two years, support for the Unit program in general, and for our Unit in particular, has remained strong. We have worked with a wide range of cooperators, outstanding graduate students, and university, federal, state, and nongovernmental 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

Dr. Bruce Vondracek
Assistant Leader - Fisheries

Dr. David C. Fulton
Assistant Leader - Wildlife

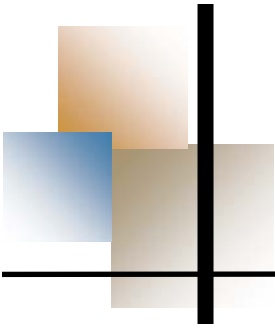
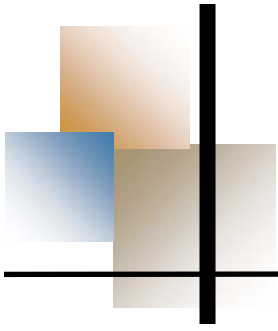


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Personnel and Cooperators

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 and Administrative Assistant

Susan Schroeder, Research Fellow

Jason Bruggeman, Postdoctoral Researcher

Christopher Chizinski, Postdoctoral Researcher

Raintry Salk, Postdoctoral Researcher

UNIT STUDENTS

Dickson Atuke, M.S. (Vondracek, graduated 2007)
Stefanie Bergh, M.S. (Andersen)
Bethany Blick, M.S. (Vondracek)
Rebecca Bronk, M.S. (Vondracek, graduated 2008)
Jeremy T. Bruskotter, Ph.D. (Fulton, graduated 2007)
Veronica Bullock, M.S. (Vondracek)
Joel Chirhart, M.S. (Vondracek)
Louis Cornicelli, Ph.D. (Fulton)
Christine Dolph, Ph.D. (Vondracek)
Carlene Henneman, M.S. (Andersen, graduated 2006)
David Huff, Ph.D. (Vondracek and Newman)
Matt Kocian, M.S. (Vondracek)
John Loomis, M.S. (Vondracek, graduated 2008)
Eric Merten, Ph.D. (Vondracek and Newman)
Fiona Nagle, M.S., Ph.D. (Vondracek and Nelson, completed M.S. 2005, Ph.D 2007)
Matthew Nelson, M.S. (Andersen)
Kara Raymond, M.S. (Vondracek)
Matthew Reiter, M.S., Ph.D. (Andersen, completed M.S. 2006)
Edgar Rudberg, Ph.D. (Fulton)
Kathryn Ruddick, M.S. (Vondracek)
Nicholas Schlessler, M.S. (Vondracek and Newman, graduated 2006)
Susan Schroeder, Ph.D. (Fulton)
Henry Streby, Ph.D. (Andersen)

UNIT AFFILIATED STAFF AND STUDENTS

Brian Ash, M.S. (Wilson, graduated 2007)
Brenda Asmus, M.S. (Perry)
Jessica Koehle, Research Fellow
Luke Kusilek, Research Fellow
Jonathan Hess, Research Fellow
R. Nicholas Mannan, M.S. (Boal)
Loren Miller, Senior Research Associate
Erin Roche, Ph.D. (Cuthbert)
Maiken Winter
Linda R. Wires

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.

<u>Name</u>	<u>Year</u>	<u>Title of Project</u>	<u>Faculty Sponsor</u>
Lisa Pugh	2007-2008	Use of Otoliths to Age Slimy Sculpin	Vondracek



UNIT COORDINATING COMMITTEE

University of Minnesota

Dr. Francesca Cuthbert, Department Head
Department of Fisheries, Wildlife,
and Conservation Biology
200 Hodson Hall, 1980 Folwell Avenue
St. Paul, MN 55108
(612) 624-4228

Dr. Al Levine, Dean
College of Food, Agricultural and Natural
Resource Sciences
277 Coffey Hall
1420 Eckles Ave.
St. Paul, MN 55108
(612) 624-1234

MN Department of Natural Resources

500 Lafayette Road,
St. Paul, MN 55155

Ron Payer
Fisheries Chief
(651) 259-5229

Paul J. (Jack) Wingate (2007)
Fisheries and Wildlife Research Manager
(651) 259-5245

Michael W. DonCarlos
Wildlife Research and Policy Manager
(651) 296-0706

Ed Boggess
Deputy Director for Fish and Wildlife
(651) 259-5224

David R. Schad
Director for Fish and Wildlife
(651) 259-5180

Don Pereira
Fisheries Research and Policy Manager
(651) 259-5231

David I. Wright
Ecological Resources
Monitoring and Control Unit Supervisor
(651) 259-5155

Wildlife Management Institute

Steven A. Williams, President
1440 Upper Bermudian Road
Gardners, PA 17324-9766
(717) 677-4480

Patrick Ruble
Midwest Field Representative
93 Central Station Place
Johnstown, OH 43031-8400
(740) 966-0496

U.S. Geological Survey

Dr. Michael W. Tome, Eastern Region Supervisor
Cooperative Research Units
Leetown Science Center
1700 Leetown Road
Kearneysville, WV 25430
(301) 834-8054

Dr. B. Ken Williams, Division Chief
Cooperative Research Units
12201 Sunrise Valley Drive, MS 303
Reston, VA 20192
(703) 648-4260

U.S. Fish and Wildlife Service (non-voting)

Sean Kelly
Assistant Chief, Migratory Birds
U.S. Fish and Wildlife Service, Region 3
BHW Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056
(612) 713-5470

UNIT COOPERATORS

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

Ira R. Adelman	Kenneth H. Kozak
James Almendinger (adjunct)	Terry Kreeger (adjunct)
Charles Anderson (adjunct)	Thomas J. Landwehr (adjunct)
Gerald Ankley (adjunct)	Michael Larson (adjunct)
Todd Arnold	Jeff Lawrence (adjunct)
Robert Blair	John P. Loegering
Yosef Cohen	Joe Magner (adjunct)
James Cooper (emeritus)	L. David Mech (adjunct)
Francesca J. Cuthbert	Kristen C. Nelson
Glenn DelGiudice (adjunct)	Raymond M. Newman
David DeVault (adjunct)	Karen S. Oberhauser
John R. Fieberg (adjunct)	Stephen O'Brien
Alan Franklin (adjunct)	Donald L. Pereira (adjunct)
Daniel Frenzel (emeritus)	James A. Perry
Julia Frost-Nerbonne (adjunct)	Brian Reilly (adjunct)
David Garshelis (adjunct)	Andrew M. Simons
Marrett Grund (adjunct)	James L. David Smith
Ralph J. "Rocky" Gutiérrez	Peter W. Sorensen
Lorin Hatch (adjunct)	George R. Spangler
Douglas H. Johnson (adjunct)	Edward B. Swain (adjunct)
Peter A. Jordan (emeritus)	Ronald Tilson (adjunct)
Anne R. Kapuscinski	Tom Will (adjunct)
Richard Kimmel (adjunct)	Thomas Waters (emeritus)

FACULTY AS PRINCIPAL INVESTIGATOR IN UNIT RESEARCH

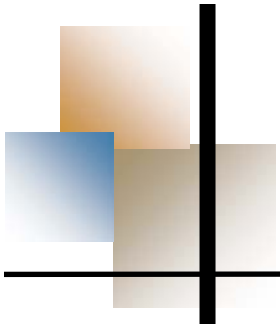
Ira R. Adelman	Kristen C. Nelson
Clint Boal (Texas Cooperative Fish and Wildlife Research Unit)	Raymond M. Newman
Paul Bolstad (Forest Resources)	John Nieber (Bioproducts and Biosystems Engineering)
Francesca J. Cuthbert	Gad Perry (Texas Tech University)
Ralph J. "Rocky" Gutiérrez	James A. Perry
Douglas H. Johnson	Bruce Wilson (Bioproducts and Biosystems Engineering)
Nicholas Jordan (Agronomy and Plant Genetics)	

COOPERATING UNIVERSITY OF MINNESOTA ACADEMIC UNITS

College of Food, Agricultural and Natural Resource Sciences
Conservation Biology Graduate Program
Consortium on Law and Values in Health, Environment, and the Life Sciences
Department of Agronomy and Plant Genetics
Department of Bioproducts and Biosystems Engineering
Department of Fisheries, Wildlife, and Conservation Biology
Department of Forest Resources
Natural Resources Science and Management Graduate Program
Undergraduate Research Opportunities Program
University of Minnesota Graduate School
Water Resources Center
Water Resources Science and Management Graduate Program
Wildlife Conservation Graduate Program

COOPERATING ORGANIZATIONS

American Museum of Natural History
Legislative Committee for Minnesota Resources
Legislative Citizens Committee on Minnesota Resources
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
Mississippi Flyway Council
 U.S. Fish and Wildlife Service
 Canadian Wildlife Service
 Manitoba Conservation
 Minnesota Department of Natural Resources
 Iowa Department of Natural Resources
 Missouri Department of Conservation
 Arkansas Game and Fish Commission
National Council for Air and Stream Improvements
National Science Foundation
Texas Tech University
University of Michigan Biological Station
University of Minnesota
 Cargill Fellowship
 MacArthur Fellowship
U.S. Army National Guard—Camp Ripley
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
 Minnesota Valley National Wildlife Refuge
 Webless Migratory Gamebird Research Program
U.S. Forest Service
 Chippewa National Forest
 Eastern Region
U.S. Geological Survey
 Northern Prairie Wildlife Research Center
 Texas Cooperative Fish and Wildlife Research Unit
Wapusk National Park of Canada
Wisconsin Department of Natural Resources
Woodcock Minnesota



Completed Research



Applied Ecology



Estimating Detectability Rates for Colonial Waterbirds in the U.S. Great Lakes

Investigator: Francesca Cuthbert (Cooperating Faculty)

Staff: Linda Wires, Research Fellow`

Duration: May 2005 to December 2006

Funding Source: U.S. Fish and Wildlife Service
U.S. Geological Survey, Science Support Partnership Program

Project Location: Northern Lakes Michigan and Huron
University of Minnesota

The U.S. Fish and Wildlife Service (USFWS) and Canadian Wildlife Service (CWS) have conducted 3 Great Lakes-wide surveys of breeding colonial waterbirds, one every decade since the 1970s. The last 2 surveys were organized to produce a temporally coordinated database. Data from all 3 surveys are stored at the U.S. Geological Survey's National Bird Population Data Center at Patuxent Wildlife Research Center. This repository archives data on waterbirds throughout their ranges and was facilitated through the North American Waterbird Conservation Plan and the Waterbird Monitoring Partnership. It is publicly accessible and allows biologists to submit and retrieve data over the Internet. Data collected in future Great Lakes colonial waterbird surveys will be deposited there.

In preparation for the 2007-2009 binational survey, we helped convene a workshop at LaCrosse, Wisconsin (as part of the 2000 Annual Meeting of the Waterbird Society) to identify ways to improve the accuracy of the Great Lakes survey and the ability to detect colonial waterbird population trends. As a result of the workshop, we made the following recommendations for research to address information needs:

- (1) determine detection rates to assess accuracy of total nest counts

- (2) develop and test species-specific census strategies to improve the ability to detect trends in Great Lakes colonial waterbird populations
- (3) develop and test sampling designs for large colonies and compare their accuracy with total nest counts
- (4) investigate the feasibility of censusing certain species and/or colonies using aerial photography.

This research project focused on 3 of the recommendations developed at the 2000 LaCrosse workshop: estimation of nest detection rates, development of sampling designs for large colonies, and the feasibility of censusing certain species and/or colonies using aerial photography. We were able to estimate nest detection rates for double-crested cormorants (*Phalacrocorax auritus*), Caspian terns (*Sterna caspia*), common terns (*Sterna hirundo*), ring-billed gulls (*Larus delawarensis*), and herring gulls (*Larus argentatus*). Birds nesting on the ground in little or no vegetation had higher detection rates than those in trees or birds nesting on the ground in dense vegetation. We also determined under which conditions aerial photographs can be used to estimate sizes of colonial waterbird colonies through both complete counts and sampling. In high quality photographs, ground-nesting birds can be easily identified, and birds on nests can be counted. Birds nesting in trees can also be identified and counted in high-quality aerial

photographs. The best estimates (as compared to direct ground counts) are obtained using photos to count cormorants because their black plumage contrasts well against lighter substrates. Because islands do not have to be accessed to obtain data, counting colonial waterbirds using aerial photography includes the following benefits: greatly reduced impacts to nesting birds that can result from human intrusion into colonies and reduction in time, cost, and safety risks. To estimate numbers in large colonies of colonial waterbirds through aerial photography, we assessed the utility of estimating colony size via sampling using a Geographic Information System. Birds on nests within small sections (sample plots) can be counted and an average density for the colony can be estimated. This density can then be extrapolated to the entire area of the colony to estimate the number of breeding pairs. This method appears promising for estimating sizes of large colonies of multiple species, and will enable more frequent survey efforts to be undertaken, which will help detect population changes more rapidly.



Estimation and Evaluation of Demographic Parameters Required for Recovery of the Endangered Great Lakes Piping Plover Population

Investigator: Francesca Cuthbert (Cooperating Faculty)
Student: Erin Roche, Ph.D. (Conservation Biology)
Duration: March 2005 to June 2007
Funding Source: U.S. Geological Survey, Science Support Partnership Program
Project Location: University of Michigan Biological Station
University of Minnesota

The piping plover (*Charadrius melodus*) is a federally endangered migratory shorebird endemic to the Great Lakes, Great Plains, and Atlantic Coast of North America. Piping plovers nested historically along the shoreline of all the Great Lakes and were once considered locally common throughout the region. Due to loss of breeding sites to development and increased use of plover habitat by humans, the population dropped to fewer than 31 breeding pairs in Michigan by 1979. By 1986, when the Great Lakes piping plover was listed as federally endangered under the Endangered Species Act, only 17 pairs remained. In 2000, a population viability analysis of all the piping plover populations projected the Great Lakes population would decline to eventual extirpation. However, since 2000, the Great Lakes population has more than doubled, increasing to an estimated >50 breeding pairs. The discrepancy between model projections and observed population growth necessitates the demographic parameters necessary for population recovery be re-evaluated.

We employed 2 single-population stochastic models to project the viability of this population over 20- and 50-year periods. Our goals were to:

1. Clarify assumptions about current demographic parameters of Great Lakes piping plovers (e.g., age of first breeding, age-specific survival).



2. Refine proposed reproductive success estimates required to meet recovery goals established in the 2003 Great Lakes Piping Plover Recovery Plan.
3. Re-assess projected time lines for population recovery utilizing recent demographic data and examine current recovery-program management options (e.g., increasing reproductive success).
4. Estimate genetic variability of the population using non-invasive inferential methods (pedigree analysis) derived from software models developed for management of small populations.

Our results suggest that under current best-case scenarios the Great Lakes population will require a fledging success rate of >1.87 chicks per nest to reach the target population size of 150 pairs in the next 20 years. Vital-rate values necessary to



achieve this goal fall within the range of rates observed in the Great Lakes population since 2000. Using program MARK we estimated

mean > 1st year survival at 77.0% (SE = 1.91%) and 1st year survival at 26.1% (SE = 2.15%). The long-term reproductive rate (measured as chicks fledged per nesting female) was estimated at 1.53 (SE = 0.4) with 36.2% (SE = 8.77%) of laid eggs yielding a fledged chick. We used these vital rates to investigate several model scenarios. These scenarios revealed that environmental stochasticity and the presence of unaccounted-for nesting individuals may play a role in the continued viability of the Great Lakes population. The high level of uncertainty inherent to population viability analysis requires that any conservation plan for the Great Lakes piping plover population account for the potential effects of annual vital rate variation. Limiting the scope of population viability projections and conservation targets to <20 years would allow managers of this population to better assess target vital rates and potential management strategies in light of current population trends.



Factors Affecting Distribution and Detection of Boreal Chorus Frogs and Wood Frogs at Cape Churchill, Manitoba

Investigators: David E. Andersen
Clint Boal (Texas Cooperative Fish and Wildlife Research Unit)
Gad Perry (Texas Tech University)

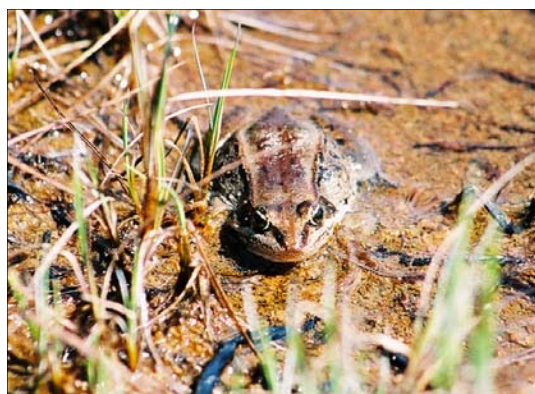
Student: R. Nicholas Mannan, M.S. (Wildlife and Range Sciences)

Duration: June 2005 to January 2008

Funding Source: Texas Tech University
Wapusk National Park of Canada
Minnesota Cooperative Fish and Wildlife Research Unit

Project Location: Cape Churchill, Manitoba, Canada
Texas Tech University

Trends in population size and population dynamics are not well understood for most amphibian populations. In addition, at a global scale, many amphibian populations are thought to be declining. Compared to more temperate areas in North America, information is almost nonexistent regarding anuran populations in subarctic and arctic ecosystems. In Wapusk National Park (WNP) in northern Manitoba, Canada, 2 species of anurans exist in tundra habitats, the boreal chorus frog (*Pseudacris maculata*) and the wood frog (*Rana sylvatica*). While the breeding range of both of these species extend across a large portion of North America, no published information regarding the ecology of either species in tundra environments exists. Based on previous anuran survey work in WNP, boreal chorus frogs and wood frogs appear to be distributed from coastal areas inland to the boreal forest-tundra interface. As an extension of these survey efforts, and to better understand anuran habitat relationships in the tundra biome, we: (1) evaluated associations between anuran occurrence and water body type, vegetative structure, and environmental conditions (pH, salinity, total dissolved solids, and temperature), (2) evaluated and compared abundance of boreal chorus frogs and wood frogs within vegetation patches that have and have not been impacted by lesser snow geese (*Chen caerulescens*) and Ross's geese (*Chen rossii*) her-



bivory, (3) assessed factors influencing anuran detection, including temporal variation of calling rates of each species, both across diurnal periods and across the breeding season, and (4) evaluated plausible anuran survey methodologies by comparing automated call recorders and manual audible surveys and evaluating the effectiveness of broadcasting breeding calls of each species during a survey as a means of eliminating false negatives collected during audible surveys.

Both wood frogs and boreal chorus frogs at Cape Churchill selected sites where vegetation was taller and had a higher composition of sedge (*Carex* spp.) and willow (*Salix* spp.). Both species also selected sites with relatively low pH and conductivity (TDS). Evidence of goose herbivory

was negatively correlated with vegetation height and cover by sedge and willow and positively correlated with pH and conductivity. Both wood frogs and boreal chorus frogs were found more commonly in sites with less evidence of recent goose herbivory. Both species of frogs called from late May through early July, and calling activity was associated with ambient temperature and day of the year. Boreal chorus frog calling was also related to relative humidity and time of day. Wood frog detection rate increased in response to call broadcasts, but there was no difference in detection rate of boreal chorus frogs with or without call broadcasts. Automated recorders were useful in determining presence, but underestimated abundance. Our results provide additional information about calling behavior and detection of tundra-breeding anurans, suggest that goose herbivory

may be impacting breeding anurans in this landscape, and can be used to design effective monitoring strategies for anurans in tundra landscapes.

A final report for this project has been submitted to Wapusk National Park of Canada and Nick Mannan completed his M.S. at Texas Tech in May 2008. Manuscripts for publication in the peer-reviewed literature are currently being prepared for submission.

Red-shouldered Hawk Distribution and Productivity in Relation to Land-use Practices in Central Minnesota

Investigator: David E. Andersen

Student: Carlene Henneman, M.S. (Wildlife Conservation)

Duration: January 2003 to January 2007

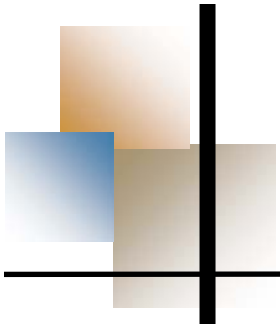
Funding Source: Minnesota Department of Natural Resources

Project Location: Camp Ripley Army National Guard Training Site and surrounding central Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

Little is known about landscape-level habitat requirements for red-shouldered hawks (*Buteo lineatus*) in Minnesota and throughout most of their breeding range. In addition, red-shouldered hawk response to habitat changes is not well understood, which confounds making informed land-management decisions. In this study we examined how red-shouldered hawk distribution and productivity in central Minnesota were related to current and historical land use and management practices. We conducted repeated call-broadcast surveys and nest searches in central Minnesota in 2004 and 2005 to assess habitat characteristics associated with red-shouldered hawk nest sites and occupancy and estimated the probability of detection and occupancy, and assessed habitat associations at 2 spatial scales (100 and 314-ha circular plots, which were based on reported minimum and maximum red-shouldered hawk home-range size). To evaluate red-shouldered hawk habitat associations at nests, we used standard logistic regression methods to compare nests sites to random sites at 3 spatial scales (25-ha, 100-ha, and 314-ha circular plots). For both nest sites and call-broadcast survey locations, we developed models relating habitat characteristics at multiple spatial scales to red-shouldered hawk nest site use and occupancy, and assessed support for these models in an Information-Theoretic framework. Overall, the amount of non-forest (grass, clear-cut area, forest <5 years



old) and the amount of mature deciduous forest (>40 years old) had the strongest association with red-shouldered hawk occupancy and nest sites, but their importance varied across years, study areas, and survey techniques. Most nests and call broadcast sites with red-shouldered hawk responses were associated with $\geq 40\%$ and averaged approximately 50% mature deciduous forest. Our findings suggest that red-shouldered hawks are associated with a high proportion of mature forest and a small proportion of open, non-forested areas across a range of spatial scales.



Completed Research



Human Dimensions,
Management, and
Conservation



2005 Minnesota Waterfowl Hunter Survey and Waterfowl Recruitment Study

Investigator: David C. Fulton

Student: Susan A. Schroeder, Ph.D. (Natural Resources Science and Management)

Duration: January 2006 to July 2007

Funding Source: Minnesota Department of Natural Resources
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

This research was a continuation of a long-term research program initiated in 2000 with Minnesota Department of Natural Resources waterfowl researchers and managers. Two previous studies identified waterfowl hunter preferences/opinions on various waterfowl hunting, management, and regulations issues and identified the experiences and regulatory factors that affect hunter satisfaction and participation. Objectives for the current research were to: (1) continue to trend information collected in previous studies; (2) conduct a follow-up study with participants from the original study to examine changes in individual motivations and participation in waterfowl hunting; (3) identify the factors leading to the recruitment of new waterfowl hunters; and (4) examine the motivations of Minnesota residents who decide to hunt waterfowl in North Dakota. The overall purpose of this study was to further our understanding of the social factors that influence waterfowl hunter participation and satisfaction to improve decision making related to Adaptive Harvest Management.

Four separate project reports were produced summarizing objectives 1-4. These reports are available at the following urls:

Objective 1: Trend information

http://fwcb.cfans.umn.edu/coop/reports/2005_waterfowlreport_final.pdf



Objective 2: Follow-up of original 2000 participants

http://fwcb.cfans.umn.edu/coop/reports/2005_wf_retention_final.pdf

Objective 3: Factors influencing recruitment of new waterfowl hunters

<http://fwcb.cfans.umn.edu/coop/reports/2005%20recruitment%20report%20final.pdf>

Objective 4: Minnesota residents who hunt waterfowl in North Dakota

http://fwcb.cfans.umn.edu/coop/reports/2005_ND_WF_Report_final.pdf

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

Investigators: Bruce Vondracek and Kristen C. Nelson (Cooperating Faculty)

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

Duration: September 1998 to April 2007

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

Project Location: Hawaii and Tasmania

Our 4-member team focused on state and regional policies that designate land for biodiversity reserves in 2 regions, Hawaii and Tasmania. With escalating globalization, development, and biodiversity crises, policy goals to achieve biodiversity face increasingly intense competition from human-oriented land uses. Island landscapes, both oceanic and terrestrial (i.e., geographically isolated areas), foster particularly contentious disputes between management authorities and land users due to the juxtaposition of biodiversity, limited land area, and limited economic alternatives. Disputes over land use in an “environment versus economy” context are notably chronic, long-standing, and socially disruptive. We used policy case studies and disputes that disrupt

policy implementation to explore whether conflict management effectively promotes biodiversity and environmentally sensitive land use. Our objectives were to: (1) develop a framework for decision-making and conflict management, (2) provide a comprehensive set of guidelines by which existing disputes can be evaluated, and (3) develop predictions about what will constitute a 'successful' versus 'unsuccessful' process to manage disputes. We found that Hawaii’s Land Use Commission generated quality agreements that were satisfactory, less confrontational, constructive and productive, and environmentally and socially sustainable in the long term based on the framework for decision-making and conflict management.

Comparison of Effects on Stream Habitat and Fish Nine Years after Harvest Treatments

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

Student: Eric Merten, Ph.D. (Water Resources Science)

Duration: July 2006 to June 2007

Funding Sources: Minnesota Department of Natural Resources
U.S. Forest Service
National Council for Air and Stream Improvement

Project Location: Pokegema Creek System, Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

We examined fish abundances and instream habitat in four headwater streams between 1997 and 2007 in a basin in a northern hardwood forest. The streams were subjected to experimental riparian forest harvest (2-11% of the watershed) in fall 1997, including upland clearcuts with 30-m unharvested buffers and upland clearcuts with 30-m riparian strips thinned to 12.3 m²/ha basal area. Unharvested control sites were also sampled in the basin. We related fish abundances between years to instream habitat (fine substrates and large wood) and environmental conditions (summer water temperature and spring precipitation) at the basin scale. We used Analysis of Co-variance (ANCOVA) to examine the relationships between fish abundances and habitat/environmental variables over time. Fine sediment increased in the streambed throughout the basin by summer 1998. We also noted a significant decrease over the study period for fish index of biotic integrity ($r = 0.91$), and abundance of brook trout (*Salvelinus fontinalis*, $r = 0.99$) and northern redbelly dace (*Phoxinus eos*, $r = 0.86$). Creek chub (*Semotilus atromaculatus*) abundance increased significantly over the study period ($r = 0.79$). Across the basin, abundances of most species were negatively related to mean summer water temperature. We found a significantly lower index of biotic integrity ($r = 0.75$) and lower abundance for brook trout ($r = 0.73$), northern redbelly dace ($r = 0.92$), and brook sticklebacks (*Culaea inconstans*, $r = 0.78$) in relation to summer temperatures, which increased during the study period. Fish variables were not significantly related to fine substrates in the streambed, large wood, or total spring precipitation



at the basin scale. However, some species responded to environmental conditions differently post-harvest than in 1997, the pre-harvest year based on the interactions terms in ANCOVAs. For example, in 1997 there was no significant relationship between northern redbelly dace abundance and water temperatures, in 1998 (the first year post-harvest) a significant, negative relationship developed, in 1999 the significance of the negative relationship was reduced, and in 2000 there was no longer a significant relationship. Stream temperatures warmed significantly across the thinned riparian treatments in relation to riparian buffer treatments based on stream temperatures measured at the end of the study period. However, warming at unharvested control treatments was not significantly different from other treatments (i.e., riparian buffer or thinned riparian). Summer water temperatures were highly correlated with air temperatures. We suggest that summer air temperatures may be more important to

fish communities than fine sediment, large wood, or spring precipitation in forested headwater streams based on the basin-scale relationships and ANCOVAs from this study. Removal of riparian vegetation may exacerbate the effects of warmer air temperatures by reducing shade.



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, Ph.D. (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
University of Minnesota Water Resources Center

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

Two related studies were conducted in Minnesota and Kenya. In northern Minnesota, the effects of riparian forest harvest were evaluated in relation to forestry best management practices (BMPs) on stream habitat, water quality, fish and macroinvertebrates, in eight streams. Site-level effects were evaluated for no harvest, riparian control and 2 levels of riparian harvest 1 year prior to harvest and 3 years post-harvest. In Kenya, government and nongovernmental organization (NGO) officers were interviewed about riparian forests and water quality. Specifically, we assessed the factors that influence the ability to know, comply with, and implement regulations and BMPs for forest harvest in riparian areas. We also evaluated the application and effectiveness of BMPs to protect water quality on government and private forest lands in south-west Mau region of Kenya.

In northern Minnesota, canopy cover along harvested reaches was significantly reduced and woody cover increased at a few sites. Percentage fine sediments increased in reaches downstream of the intermediate harvest treatment. Percentage tolerant fish species increased in both riparian harvest treatments. Water quality parameters exhibited seasonal and year-to-year variation with harvest effects on nitrate.



Macroinvertebrate abundance increased initially with low harvest but declined to pre-harvest levels in subsequent years. Taxonomic and functional feeding group composition was similar among treatments except for a decline in percent Ephemeroptera, Plecoptera, and Trichoptera, increase in Margalef's richness index, and an increase in proportion of collector-filterers and scrapers.

In Kenyan, riparian areas were under pressure from human activities, and timber harvest had an impact on riparian areas. Government and NGO officers considered lack of sound policy, poor enforcement, corruption, non-compliance, and overexploitation important threats to conservation of riparian forests and water

quality, although there were disagreements on specific causes. Visitation by forestry officers, proportion of land under forestry, and catchment location were important predictors of landowners' knowledge of and compliance with forest regulations and BMPs. Landowner age and knowledge of traditional BMPs significantly influenced landowner decision making.

Application of BMPs was greater in private lands than in government-owned lands. Increased BMP application was associated with reduced sediment delivery into streams. These two studies indicate that BMPs can reduce the impact of harvest on riparian and aquatic resources.



Evaluating Trends in Electronic Licensing Questions

Investigator: David C. Fulton

Student: Jeremy T. Bruskotter, Ph.D. (Natural Resources Science and Management)

Duration: September 2004 to September 2008

Funding Source: Minnesota Department of Natural Resources
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

Since 2000, the Minnesota Department of Natural Resources has sold licenses electronically. At the point of sale each license purchaser has been asked a single question concerning their behavior or attitudes concerning fisheries in Minnesota. These data provide a potential mechanism to further segment license purchasers or provide long-term trend information. This study evaluated the reliability and validity of information collected at the point of sale by re-contacting license purchasers and assessed the accuracy of point-of-sale information. In summary, attitudinal information collected through this mechanism was found to be in error much of the time while descriptive information was accurate 75-80% of the time.

This study provides an important contribution in understanding the psychological measurement challenges involved with social data collection via license sales, and is the first of its kind to attempt to assess the validity of such information that is now routinely being collected by state and federal agencies. Our findings have practical ramifications for using this kind of information in policy decisions or as surrogate information for biological harvest data in programs such as the Harvest Information Program for migratory bird hunting.

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. (Bioproducts and Biosystems 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, Minnesota

The Minnesota Valley National Wildlife Refuge provides valuable habitat for waterfowl, fish, and other wildlife species threatened by commercial and industrial development. Possible contaminants contained in the storm water discharged into the Refuge are a potential pollution problem. An instrumentation system was designed to study contaminants in stormwater from different land use activities in the City of Bloomington. Seven monitoring stations were initially established in the watershed. Because of instrumentation problems, the number of monitoring station was reduced to five. The study was largely focused on gathering samples from rainfall events. Nonetheless, snowmelt samples were gathered in 2005 and 2006. Grab samples were also taken from a seep location in 2004, 2005, and 2006.

An analysis of runoff depth showed the expected trend of increasing runoff depth with storm depth. Considerable scatter in observed concentrations and load-per-area was found in analyzing the water quality data from rainfall events. Nonetheless, significantly different mean concentrations with location in the watershed were found using one-way analysis of variance (ANOVA) for potential contaminants of chromium, lead, manganese, nickel, phosphorus, and total suspended solids. The site at Glenview Lane had consistently the greatest concentrations of potential contaminants. Chloride concentrations for snowmelt events were larger than those measured from rainfall events. Relatively large concentrations of chloride, magnesium, and barium were found at the seep site.



Storm water is treated by Pond C before discharging into the Refuge. Two different methods were used to estimate the removal of contaminants by Pond C, one using a mass definition of trap efficiency and the other using the average influent and effluent concentration. The two different methods gave similar results for many of the chemicals including total suspended solids, arsenic, lead, and barium. For example, the trap efficiency of total suspended solids was 68% using the mass definition and 75% using the concentration definition. The trap efficiencies for barium, chloride, and magnesium were negative, corresponding to more mass leaving than entering the pond. These results were not surprising given the relatively large concentrations in snowmelt and/or groundwater sources that were not included in the computations. The removal of contaminants by detention ponds is storm dependent. No large

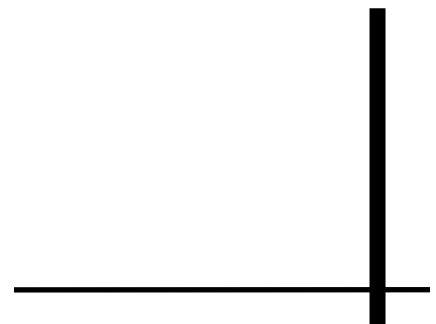


return events occurred during the study period. Therefore the study was unable to assess the possible impact of a large runoff event on the effectiveness of Pond C.

The study also examined the impact of changes in the design of Pond C using the BASIN simulation model. The accuracy of the input parameters to characterize pond geometry and elevation discharge, as well as the hydraulic algorithms, was evaluated using an observed event from 6-10 June 2004. The BASIN simulated outflow rates are in good agreement with those observed. The BASIN model was used to evaluate the performance of Pond C for 3 different

storm events (1 inch, 2 inch, and 6 inch) and for the existing and proposed pond capacity. The change in trap efficiency from the existing to proposed pond capacity increased by roughly 10% for the 1-inch and 6.5% for the 6-inch storm.

A direct comparison of these results to those done as part of the Storm Water Treatment Feasibility Study for the City of Bloomington is difficult. Nonetheless, the predicted trap efficiencies from the Feasibility Study are generally in reasonable agreement with those obtained from the BASIN model. A noteworthy exception is that the Feasibility Study predicted a change in trap efficiencies from existing to proposed conditions that was approximately twice as large as obtained from the BASIN model. Predicted effluent concentrations from the 2 approaches were considerably different. Results from BASIN simulations predicted more than twice the sediment mass will be discharged from Pond C than that obtained from the Feasibility Study. This difference was largely the consequence of using a larger influent concentrations in the BASIN simulations. The influent concentrations for the BASIN simulations were obtained from the data collected as part of the project.



Features of the Farm Bill that Influence Breeding Birds

Investigators: David E. Andersen; Douglas H. Johnson, U.S. Geological Survey, Northern Prairie Wildlife Research Center

Research Associate: Maiken Winter

Duration: January 2006 to August 2006

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

Project Location: U.S. Northern Prairie Region
University of Minnesota

Conservation Reserve Program (CRP) fields have been highly successful in providing habitat for grassland-nesting birds, and CRP fields are linked to recent increases of some grassland bird populations. Recent guidelines for CRP plantings encourage the use of native rather than introduced species. However, native plantings are significantly more expensive than introduced plantings. It is therefore critical to understand how planting type affects grassland-bird communities to better evaluate whether the increased monetary investment is justified. We studied breeding-bird use of CRP fields in 5 north-central states during 2001-2003, involving 128 fields planted either with primarily native or introduced species. Both planting types supported large populations of some grassland bird species, such as bobolinks (*Dolichonyx oryzivorus*) and savannah (*Passerculus sandwichensis*) and grasshopper sparrows (*Ammodramus savannarum*). Some species of conservation concern either were not detected in either planting type [such as Sprague's pipits (*Anthus spragueii*), greater prairie-chicken (*Tympanuchus cupido*)] or occurred in very low numbers [Baird's sparrow (*Ammodramus bairdii*), dickcissel (*Spiza americana*)]. The only species of conservation concern that occurred in high numbers in CRP fields was

grasshopper sparrows. There were 2 major differences in bird communities between native and introduced fields: (1) several grassland birds of conservation concern did not occur in introduced plantings [chestnut-collared longspurs (*Calcarius ornatus*), Henslow's sparrows (*Ammodramus henslowii*), marbled godwit (*Limosa fedoa*), willet (*Catoptrophorus semipalmatus*), Nelson's sharp-tailed sparrow (*Ammodramus nelsoni*)]; and (2) the only grassland bird species that preferred introduced to native plantings were bobolinks and brown-headed cowbirds (*Molothrus ater*). These patterns were consistent among regions and years. Native plantings had lower and less dense vegetation with more litter – a feature that was preferred by species typical of mixed-and short-grass prairie. Therefore, native plantings are likely to be more valuable in the western portion of the Great Plains. In contrast, introduced plantings may be valuable in the eastern portion of the Great Plains as long as fields are allowed to develop litter extensive enough to provide shelter and nest sites.

Fishing in the Neighborhood: Understanding Motivations and Constraints for Angling among Twin Cities Metro Residents

Investigator: David C. Fulton

Student: Susan A. Schroeder, Ph.D. (Natural Resources Science and Management)

Duration: January 2006 to July 2007

Funding Source: Minnesota Department of Natural Resources
Division of Fisheries

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

One constraint to fishing participation in urban areas is lack of perceived opportunity to fish. This study examines urban residents' perceptions of constraints to fishing and awareness of the *Fishing in the Neighborhood Program* in the Twin Cities Metro area through a mail survey. In addition, focus group research was conducted with African-American, Latino, American Indian, Hmong, Cambodian, and Vietnamese residents to identify specific interests and constraints to angling participation. This study makes a substantive contribution to our understanding of constraints to angling. The applied purpose of this study is to help the Minnesota Department of Natural Resources design angling programs to help address recent declines in fishing participation and low participation rates in angling among people of color.



Mortality of Walleye Caught in Live-release Tournaments: Assessment, Reduction, and Determination of Acceptable Levels

Investigators:	Bruce Vondracek and David Fulton
Students:	John Loomis, M.S. (Conservation Biology) Jeremy T. Bruskotter, Ph.D. (Natural Resources Science and Management)
Duration:	July 2004 to December 2007
Funding Source:	Minnesota Department of Natural Resources (Iowa Department of Natural Resources, Michigan Department of Natural Resources, Minnesota Department of Natural Resources, South Dakota Department of Game, Fish and Parks, Wisconsin Department of Natural Resources, and FLW Outdoors™)
Project Location:	Iowa, Michigan, Minnesota, South Dakota, and Wisconsin Minnesota Cooperative Fish and Wildlife Research Unit

Research on black bass (*Micropterus* spp.) tournaments indicates that fish die from hook and handling injury, bacterial disease, or poor conditions in boat livewells or during weigh-in and release. Most mortality is due to poor livewell and tournament handling conditions. Numerous studies of black bass tournaments indicate that total mortality has averaged 28% during the past 2 decades. Assessments of walleye (*Sander vitreus*) tournaments suggest mortality is substantially higher although fewer studies have been completed for walleye. Three issues must be addressed for the conservation of high-quality walleye fisheries in light of walleye tournaments:

- (1) accurate estimates of total mortality in live-release tournaments,
- (2) development and evaluation of procedures to maximize survival of walleye in live-release tournaments, and
- (3) determine levels of mortality that are biologically and socially acceptable.

This research provided information useful to maximize survival of tournament-caught walleye and the effective integration of walleye tournaments in fishery management by tournament organizers and fishery agencies.

Mortality at tournaments was $\leq 25\%$ when water temperatures were $\leq 16^{\circ}\text{C}$, but then decreased



sharply. Initial mortality was negatively related to both livewell and surface water temperature. Pre-release and post-release mortality were negatively related to tournament and livewell temperatures. Mortality measured 5 d after simulated tournaments was 100% when walleye were held in livewells with temperatures $> 22^{\circ}\text{C}$. Median acceptable initial mortality was 5.0% and median acceptable total mortality was 10.0% for licensed walleye anglers.

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

Investigators: Bruce Vondracek, James A. Perry, Bruce Wilson, and John Nieber
(Cooperating Faculty)

Student: Brenda Asmus, M.S. (Water Resources Science)

Duration: November 2003 to May 2008

Funding: U.S. Environmental Protection Agency
Minnesota Pollution Control Agency

Project Location: Redwood River and Snake River basins, Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

Clean rivers, lakes, and streams consistently rank foremost among environmental priorities for citizens of Minnesota. Recent research has emphasized the importance of using physical, chemical, and biological indicators of stream health for diagnosing impaired watersheds and their receiving water bodies. A multidisciplinary team of biologists and hydrologists from the University of Minnesota and the Minnesota Pollution Control Agency (MPCA) developed a regional stream classification system to facilitate Total Maximum Daily Load (TMDL) assessment of impaired waters in Minnesota. The classification used regional reference reaches to account for complex factors related to precipitation, land use, soil, and geology. Objectives were to: (1) investigate the relationship between indicators of stream health and local characteristics, (2) develop and evaluate dimensionless curves using reference reach values for stream classification and TMDL assessment, and (3) test a stream classification system using the prediction intervals of the dimensionless curves.

Objective 1: A potentially useful index of stream stability is the Pfankuch score, which combines geomorphic attributes to obtain a score to represent the likely stability of a stream reach. A low score corresponds to stable channels. Fish-Index of Biological Integrity (F-IBI) scores were correlated with the Pfankuch score.

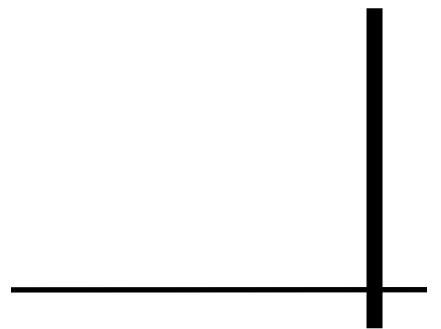


Additional analyses are currently being conducted with combinations of the raw data other than the Pfankuch score.

Objective 2: Several different algorithms have been considered for implementing the dimensionless theoretical framework. The simpler algorithms estimate parameters for a given region independently of information from other regions. More complex algorithms have been proposed that utilize information among the regions.

Objective 3: A dimensionless approach has been developed and tested in this project, but has not yet been vetted through a TMDL priority setting exercise. Logical next steps include testing the dimensionless curve approach in a wider range

of landscapes, and using results of the dimensionless curve analysis in a stakeholder and agency setting to guide TMDL priorities.



Understanding Public Support for Non-toxic Shot Restrictions

Investigator: David C. Fulton

Students: Susan Schroeder, Ph.D. (Natural Resources Science and Management)
Edgar Rudberg, Ph.D. (Natural Resources Science and Management)

Duration: July 2007 to December 2008

Funding Source: Minnesota Department of Natural Resources
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

In a recent report to the Minnesota Department of Natural Resources, the Nontoxic Shot Advisory Committee (NSAC) agreed that further restrictions on the use of lead shot are inevitable at some future time. While no consensus on specific regulations was reached, the NSAC did agree that more restrictive regulations on the use of lead shot in shotgun hunting are warranted.

The purpose of this study was to provide information about small game hunter perceptions and knowledge of using toxic/non-toxic shot and help identify appropriate message points for information and education programs addressing the issue of restricting the use of lead shot. Specific objectives of this proposal were to:

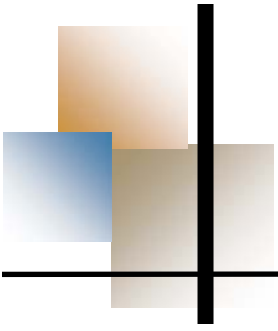
- (1) Identify levels of use of lead and non-toxic shot in the farmland zone by small game hunters;
- (2) Identify attitudes toward restrictions on toxic shot;
- (3) Identify support/opposition for restrictions on the use of toxic shot;
- (4) Identify the key beliefs affecting attitudes toward restrictions on toxic shot;
- (5) Identify the influence of conservation/stewardship values in shaping attitudes and beliefs about restricting the use of toxic shot;

- (6) Develop and test the effectiveness of targeted messages in changing attitude, beliefs, and behaviors concerning restrictions on the use of toxic shot.

This study involved 3 distinct phases of research:

- (1) An elicitation study and preliminary research on important beliefs affecting attitudes and behavior toward restrictions on the use of toxic shot;
- (2) A statewide cross-sectional survey of small game hunters to determine the baseline information in objectives 1 through 5;
- (3) A field experiment to test the effectiveness of persuasive communication in building support for restricting the use of toxic shot.

Data were collected from 2 study strata: the 7-county Twin Cities metropolitan area and the non-metropolitan areas of the state. Respondents were about equally divided in their support for a ban of using lead shot in the farmland zone within the next 5 years with 42% indicating they are likely to support a ban and 44% reporting they are unlikely to support a ban. Support for a ban was strongly correlated with attitudes toward a ban, and respondents with different attitudes toward a ban differed on their beliefs about the outcomes of such a ban.



Ongoing Research



Applied Ecology



Ammonia, Nitrite, and Nitrate Toxicity to the Topeka Shiner

Investigator: Ira R. Adelman (Cooperating Faculty)

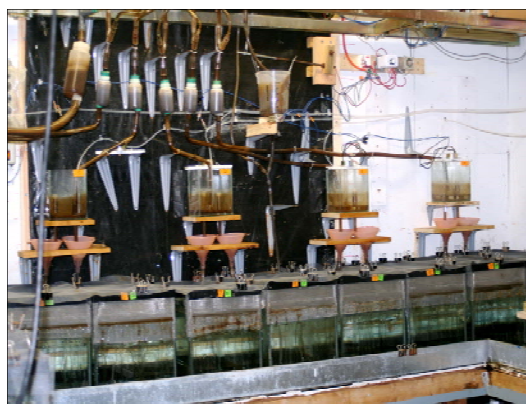
Research Fellows: Jessica Koehle, Luke Kusilek, Jonathan Hess

Duration: May 2006 to July 2009

Funding Source: U.S. Fish and Wildlife Service
U.S. Geological Survey, Science Support Partnership Program

Project Location: University of Minnesota

Experiments were conducted to determine the toxicity of ammonia, nitrite, and nitrate to the Topeka shiner (*Notropis topeka*) because current water quality criteria may not be protective of this federally listed endangered species. Data for acute lethal tests conducted with Topeka shiners are reported as 96-h LC50s for total and unionized ammonia, nitrite, and nitrate. Data from 30-d growth experiments with Topeka shiners and fathead minnows (*Pimephales promelas*) are reported as the no observable effect level (NOEL), the lowest observable effect level (LOEL), and their geometric mean. Embryo-larval tests were conducted with fathead minnows for the 3 nitrogen compounds because Topeka shiner embryos were not available. Water quality criteria guidelines stress the importance of data on early life history stages. Therefore, toxicity to Topeka shiner embryos and larvae was predicted by comparing relationships between 30-d growth tests and embryo-larval tests with fathead minnows. Final conclusions were that current U.S. Environmental Protection Agency criteria for total ammonia, nitrite, and nitrate would protect Topeka shiners if those criteria were maintained throughout the Topeka shiner's habitat.



*Photo: Partial view of the toxicant dosing apparatus and several of the test aquaria.
(by Ira Adelman)*

Ecological and Genetic Characteristics of Slimy Sculpin in Southeast Minnesota Streams

Investigators: Bruce Vondracek and Loren Miller (Cooperating Faculty)

Students: David Huff, Ph.D. (Conservation Biology)
Rebecca Bronk, M.S. (Conservation Biology)

Duration: July 2006 to December 2009

Funding Source: Minnesota Department of Natural Resources
Cargill Fellowship

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

The Departments of Natural Resources in Iowa, Minnesota, and Wisconsin have implemented a “reintroduction” program for sculpin (*Cottus* spp.) in streams in the Driftless Area Ecoregion of each state. The goal of this program is to increase the distribution of sculpin by re-establishing viable, self-sustaining populations in trout streams where native populations are presumed to have been present historically, but were extirpated and unable to recolonize (<http://www.dnr.state.mn.us/areas/fisheries/lanesboro/management.html>). This effort will potentially restore an ecologically important species to these coldwater streams and provide an additional forage component to wild trout populations. Sculpin were successfully reintroduced to a southwest Wisconsin stream in the 1970s. However, the reintroduction programs were instituted with limited information about the ecological suitability of the streams selected for reintroduction.

The purpose of the ecological portion of our study was to understand the relationship between macroinvertebrate composition, habitat, sculpin diet, and sculpin density to provide suggestions for choosing future reintroduction sites. Between July 2006 and May 2008, 10 stream reaches in Minnesota’s reintroduction program that included streams used to provide sculpin for reintroduction and recipient stream reaches were evaluated. Source and recipient stream reaches



were similar in macroinvertebrate composition, habitat, and sculpin diet. Recipient stream reaches contained sculpin densities that were not significantly different from source stream reaches, indicating that the reintroduction program has been successful. Nonmetric multidimensional scaling (NMDS) ordination based on macroinvertebrate composition revealed 2 groups. The groups were differentiated by highest 7-day maximum temperatures (Multidimensional Response Permutation Procedure (MRPP), $p = 0.005$). The groups could be subdivided by velocity to classify stream reaches as cold-fast, warm-fast, cold-slow, and warm-slow (MRPP, $p = 0.0007$). Velocity was positively related to percent of coarse substrate ($r^2 = 0.47$) and wetted width ($r^2 = 0.37$). Sculpin density was related to amount of surface area covered by vegetation, wood, or



boulders ($r^2 = 0.93$), wetted width ($r^2 = 0.66$), and percent coarse substrate ($r^2 = 0.3$). There was a gradient in sculpin density across the 4 stream classes and sculpin density was highest at cold-fast and lowest at warm-slow stream reaches, but was not significantly different between groups identified with the NMDS ordination. Sculpin diet mirrored the pattern based on macroinvertebrate composition and was significantly different across the 4 stream classes (MRPP, $p = 0.006$). Diet was related to boulder presence ($r^2 = 0.36$), sculpin density ($r^2 = 0.35$), highest 7-day maximum temperature ($r^2 = 0.35$), and cover area ($r^2 = 0.16$). To promote future reintroduction success and maximize efficiency, we suggest that future reintroductions chose reaches that are similar to the cold-fast streams.

Often reintroduced populations are smaller and more geographically isolated than native populations. Reintroductions may therefore exacerbate the genetic erosion initially caused by population fragmentation by reducing the effective population size of the reintroduced populations. Mixing genetically divergent sources is thought to alleviate this issue by increasing genetic diversity. We evaluated the consequences of mixed stock reintroductions from 3 source populations on the ancestral composition and genetic variation of slimy sculpin at 9 distinct reintroduction sites in southeast Minnesota. We used 8 microsatellite loci developed for *Cottus* species that resolved genetic variation to evaluate several aspects of genetic diversity, characterize overall ancestry, evaluate genetic identity and identify individual ancestry. Greater genetic variation in source strains corresponded to a greater proportion of more genetically variable pure strain individuals persisting in the reintroduction sites. Reintroduction sites exhibited higher levels of heterozygosity and allelic richness than the sources, but only slightly higher than the most diverse source. Ancestry analysis revealed that 1 source outperformed the other 2 sources at nearly every site, although the less abundant source ancestry persisted in the form of intrapopulation hybrids. Furthermore, hybridization among source strains may actually be detrimental to the most successful strain's fitness. We suggest using a single source for future reintroductions.



Empowering Water Quality Decisions: Reducing Uncertainty and Bounding Variability of Stream Ecosystem Indicators

Investigator: Bruce Vondracek
Student: Christine Dolph, Ph.D. (Water Resources Science Program)
Duration: July 2007 to June 2009
Funding Source: Minnesota Department of Natural Resources
Project Location: Throughout Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

Increasingly, multimetric indices such as the Index of Biological Integrity (IBI) are used by management agencies to make water quality impairment decisions under the Clean Water Act. However, important questions about the variability of these indices have not been thoroughly addressed in the scientific literature. In this study, we used a bootstrap approach to quantify variability associated with fish IBIs developed for streams in 2 Minnesota river basins, the St. Croix ($n = 293$ site visits) and Upper Mississippi ($n = 210$ site visits). We further placed this variability into a management context by comparing it to impairment thresholds currently used in water quality determinations for Minnesota streams. We found that 95% percentile confidence intervals ranged as high as 40 points for IBIs scored on a 0-100 point scale. On average, however, 90% of IBI scores calculated from bootstrap replicate samples for a given stream site yielded the same impairment status as the original IBI score. We suggest that sampling variability in IBI scores is related to the number of fish in a field collection, as well as to stream drainage area. A comparison of the effects of different scoring methods on IBI variability further indicates that a continuous scoring method may reduce the amount of bias in IBI scores.

We will also investigate the influence of removing rare fish taxa (comprising < 5% total abundance) on IBI scores and on individual

metrics. We compared IBI scores before and after removal of rare taxa and observed a close relationship between the sensitivity of the root mean square error (RMSE) of the resampled IBI metric scores and the original IBI metric scores to the sample abundance and total taxa richness. Most sensitivity was observed in samples with the least number of taxa. There was no difference in mean RMSE between singletons (abundance = 1), doubletons (abundance = 2), or other rare taxa (abundance >2) that were removed. Removal of all rare taxa indicated substantial changes in metric values. Metrics based on proportions of fish taxa abundance were the least sensitive to the loss of rare species, whereas those based on taxa richness were the most sensitive. Thus, we suggest that appropriate sampling procedures must be utilized to properly assess rare taxa to provide the least biased IBI calculations.

Evaluating Riparian Timber Harvesting Guidelines: Phase 3

Investigators:	Bruce Vondracek and Raymond M. Newman (Cooperating Faculty)
Student:	Eric Merten, Ph.D. (Water Resources Science Program)
Postdoc:	Christopher Chizinski
Duration:	July 2007 to June 2009
Funding Source:	Legislative Citizens Committee on Minnesota Resources
Project Location:	Northern Minnesota Minnesota Cooperative Fish and Wildlife Research Unit

Riparian guidelines have been the most controversial of the 7 components of Minnesota's forest management guidelines. Research addressing the long-term effectiveness of riparian guidelines is critical to resolving riparian management conflicts, informing the ongoing revisions of the Minnesota Forest Resources Council's (MFRC) riparian guidelines, and sustaining Minnesota's forest resources. This project will evaluate the long-term effectiveness of Minnesota's riparian guidelines on 8 northern Minnesota sites and at 12 previously established sites in the Pokegama Creek basin, and combine and synthesize data from the multiple study components through a "meta-analysis".

Instream habitat variables (percent canopy cover over the stream, percent unstable banks, percent woody cover, percent fine sediment, percent riffles, and mean depth), benthic macroinvertebrates, and fish were collected prior to harvest and for 3 years after harvest in both studies. We observed strong interannual variation in many of the instream habitat variables assessed (e.g., unstable banks, woody cover, fines, riffles, and depth). There was very little change in the ranking of the invertebrate functional groups in both studies. Prior to harvest, the assemblages were dominated by collectors (filterers and gatherers) and this continued after harvest. We observed interannual variation in macroinvertebrate assemblage, but few effects related to harvest

treatments. Interannual variation was evident in the fish assemblages but we were able to detect changes in the stream fish assemblages associated with partially harvested riparian management zones. In both studies, fish assemblage turnover in the intermediate residual basal area treatment was the largest where brook stickleback (*Culaea inconstans*) and central mudminnow (*Umbra limi*), 2 relatively tolerant fish species, increased.

Avian surveys were conducted 1 year pre-harvest and for 3 years post-harvest. Our analysis indicated a significant response of the avian community to varying amounts of residual basal area. Although avian community metrics (counts, diversity, and richness) did not indicate significant treatment effects, turnover and community composition indicated substantial changes in the avian community following harvest in the treatment plots. The primary changes observed were marked by the replacement of mature forest species by early successional avian species, primarily seen by the increase in white-throated sparrows (*Zonotrichia albicollis*) and chestnut-sided warblers (*Dendroica pensylvanica*) and the decline of ovenbirds (*Seiurus aurocapilla*) and red-eyed vireos (*Vireo olivaceus*). Redundancy analysis indicated a transition of greater basal area and association of mature forest habitat avian species to an increase in the influence of understory woody biomass and avian species associated with early successional habitat. Despite this

general transition, there were only small differences observed between the intermediate basal area treatment and riparian control plots, excluding the decrease in ovenbird abundance. Riparian harvest along reaches ≤ 200 m in length on both sides of the stream that leaves $RBA \geq 11.5 \text{ m}^2 \cdot \text{ha}^{-1}$, or riparian harvest on 1 side of the stream that retains $RBA \geq 5.7 \text{ m}^2 \cdot \text{ha}^{-1}$ may be adequate to maintain instream habitat and invertebrate and fish assemblages in low gradient streams, but may affect the avian community.



Factors Affecting Detection of American Woodcock on Singing-ground Surveys

Investigator: David E. Andersen

Student: Stefanie Bergh, M.S. (Natural Resources Science and Management)

Duration: May 2008 through December 2010

Funding Source: U.S. Fish and Wildlife Service
Webless Migratory Gamebird Research Program
U.S. Geological Survey

Project Location: Pine County, Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

American woodcock (*Scolopax minor*) are migratory game birds that occur in forested landscapes in eastern and central North America. Woodcock are cryptically colored shorebirds found throughout the eastern U. S. and Canada in a variety of early successional forest habitats that include a mix of open habitats where woodcock display. Male woodcock use different types of openings (natural openings, clearcuts, agricultural fields, etc.) as singing-grounds for their spring courtship display. Woodcock populations are monitored via the Singing-ground Survey (SGS), coordinated by the U. S. Fish and Wildlife Service (FWS) and the Canadian Wildlife Service. This survey has been conducted throughout the primary woodcock breeding range since 1968 and is used as an index of abundance and population trend. The survey is made up of approximately 1,500 routes that are 3.6 miles in length with 10 equally spaced listening points. Observers begin surveys shortly after sunset and record the number of woodcock heard peenting (a vocalization made during courtship displays by male woodcock) at each listening point during a 2-minute listening period.

The SGS was designed to incorporate factors that influence the male mating display and in turn the counts from the survey. However, the relationship between the number of woodcock heard on surveys and the number of woodcock



present is unknown. One important underlying and untested assumption of the SGS is that all male breeding woodcock at each listening point are heard peenting on the night of the survey, or that a constant proportion of birds present are detected among years. As with most indices of abundance, the SGS is based on an assumed relationship between counts and population size that is not well documented. Spatial and temporal variation in detection probability introduces potentially significant noise into the relationship between counts and population size. There are many factors that can influence detection probability of displaying male woodcock in the SGS including weather conditions, observer error, woodcock behavior, woodcock density, change in singing-ground sites, and the distance from and orientation of a peenting woodcock relative to the listening

point. Behavioral studies of woodcock suggest that male breeding woodcock can display at more than 1 singing ground per night and subdominant males will display at a singing ground when the dominant male is absent. The spatial extent of surveys is also not well established, limiting the ability to estimate density of displaying male woodcock based on counts from the SGS. Currently, the effective area surveyed at a listening stop is not known, and may vary as a function of landscape type (e.g., forest, agriculture, urban, etc.), environmental conditions under which surveys are conducted, abilities of observers, and other factors.

To address some of these issues that confound interpretation of counts from the SGS, we initiated this research project in 2008, with the following specific objectives:

- (1) Estimate the likelihood of detecting a woodcock at an SGS point if a woodcock is present.
- (2) Estimate how detection probability varies within and between seasons.



- (3) Estimate the likelihood of detecting specific woodcock associated with a specific SGS route and what factors might influence their detection.
- (4) Estimate the effective distance surveyed from SGS points.
- (5) Estimate how the effective distance surveyed varies as a function of habitat.

Genetic Determination of the Boundary between Northern and California Spotted Owls

Investigator: Ralph J. “Rocky” Gutiérrez (Cooperating Faculty)
Duration: August 2006 to July 2010
Funding Source: U.S. Fish and Wildlife Service
Project Location: Northern California, the University of Minnesota, and the American Museum of Natural History

Understanding the boundaries between populations of northern (*Strix occidentalis caurina*) and California spotted owls (*S. o. occidentalis*) is important for management and conservation of the species. Morphometric characteristics have proved unreliable in delineating subspecies, but the boundary between subspecies occurs somewhere in northern California. Currently, there are no relevant samples from north-central California that could be used to delineate this range boundary. The objective of this project is to use genetic analysis to evaluate whether this boundary exists in the vicinity of the Pit River in northeastern California.

This project has been extended due to unforeseen difficulties coordinating access to



collect genetic samples, and unexpected health issues of key project personnel. Sample collection is currently scheduled for spring 2009.

Habitat Use of Post-fledging Forest-nesting Songbirds in Northern Hardwood-coniferous Forests in Northern Minnesota

Investigator: David E. Andersen
Student: Henry Streby, Ph.D. (Natural Resources Science and Management)
Duration: January 2005 to September 2010
Funding Source: U.S. Fish and Wildlife Service
U.S. Geological Survey, Science Support Partnership Program
Project Location: Chippewa National Forest, Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

Compared to use of nesting habitat, habitat use by forest-nesting songbirds following fledging is relatively poorly understood. Recent studies based on point counts and mist-netting, and monitoring movement of fledglings via radio-telemetry, suggest that for at least some species of forest-nesting songbirds, habitat use post-fledging can be quite different from breeding-habitat use. To date, information regarding habitat use following fledging for forest-nesting birds is limited to a few studies from eastern (Virginia and West Virginia) and southern (Missouri) deciduous forests, and from only a few species of forest-nesting birds. No published information regarding post-fledging habitat use exists for northern hardwood-coniferous forest birds in the western Great Lakes region. Forest-management plans that incorporate considerations for forest-nesting birds generally do not consider habitat use following fledging. A more complete understanding of habitat use by forest-nesting birds in northern hardwood-coniferous forests would provide the basis for better incorporating considerations for forest-nesting birds in forest management in the western Great Lakes region. To address these information needs, we initiated this project to (1) determine what species of forest-nesting birds use early successional habitats during the post-fledging period, (2) how fledgling interior-forest nesting birds use habitat after leaving the nest, and (3) what factors influence habitat use and



movements. We have completed 1 pilot season in 2005 (focusing on mist-netting) and 3 field seasons (2006-2008), focusing on mist-netting and telemetry monitoring of fledgling songbirds.

We located and monitored nest success of ovenbirds (*Seiurus aurocapillus*; $n = 57, 89,$ and 95 nests in 2006, 2007, and 2008, respectively) and hermit (*Catharus guttatus*; $n = 2, 12,$ and 2) and wood thrushes (*Hylocichla mustelina*; $n = 2, 2,$ and 0) in 3 study areas in the Chippewa National Forest, located in tracts of mature deciduous forest that included at least 2 ages of clearcuts (1-6 and 7-12 years since harvest). We estimated both nest success and post-fledging survival for ovenbirds ($n = 15, 47,$ and 64 radio-marked nestlings in 2006, 2007, and 2008, respectively) and hermit thrushes ($n = 5, 10,$ and 2). Both nest success and fledgling survival

varied among years, but not in the same direction, suggesting that estimating nest success alone would be an inadequate indicator of recruitment. In 2007, ovenbird nest success and fledgling survival were higher near older regenerating clearcuts, with a similar trend in 2008, suggesting that post-fledging habitat may be an important factor influencing reproduction, and that older regenerating clearcuts may provide habitat components (e.g., food and vegetation structure that provides escape cover) important to fledgling survival. We also employed mist nets in regenerating clearcuts during the post-fledging period, and captured over 3,000 birds in regenerating clearcuts from 2005-2008—over a third of these captures were of species that breed in mature forest habitats.

We are planning for an abbreviated field season in 2009, focusing on mist-netting in



regenerating clearcuts to assess habitat use of both adult and fledgling forest-nesting songbirds. Data analyses are currently underway, with a final report expected in early 2010.



Predicting Large Wood Transport and Effects on Stream Geomorphology in Northern Minnesota Streams

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

Student: Eric Merten, Ph.D. (Water Resources Science Program)

Duration: July 2007 to June 2009

Funding Source: Minnesota Department of Natural Resources

Project Location: Northern Minnesota along Lake Superior
Minnesota Cooperative Fish and Wildlife Research Unit

Wood in streams provides a wide variety of ecosystem functions, including habitat enhancement for key species in stream food webs, geomorphic and hydraulic heterogeneity, and retention of organic matter. Given the role of wood in streams, factors that influence wood inputs, retention, and transport are critical to stream ecology. Locations of wood pieces were determined in summer 2007 and after an overbank stormflow event in fall 2007 in 9 streams along the shore of Lake Superior in Minnesota.



Wood entrapment, the process of wood coming to rest after being mobilized and swept downstream at least 10 m, is poorly understood yet important for predicting stream function and success of restoration efforts. Data on entrapment were collected for a wide range of natural wood pieces ($n = 344$), stream geomorphology, and hydraulic conditions. The ratio of length of a wood piece to effective stream width (length ratio) and the momentum of the piece were determined to be of primary importance to wood entrapment using logistic regression. There are likely 2 reasons that both factors were important. First, multiple measurements on each piece were made in numerous 10-m sections of stream, with a resolution similar to that of flume studies. Second, a wide, natural range of wood pieces and stream characteristics were examined. This study can inform stream modifications to discourage entrapment around road crossings or

other infrastructure by determining the effective stream width required to pass most wood pieces. Conversely, these results could also be used to determine conditions that encourage entrapment where wood is valued for ecological functions. Although the predictive model was significant, only 24% of the variability in entrapment was explained. Entrapment remains difficult to predict in natural streams, and often may occur where wood piece are located when high water recedes. The process of wood entrapment in streams merits further study, particularly under natural conditions.

Wood mobilization (when a stationary piece of wood is displaced by at least 10 m) is also a critical process in determining the residence time of wood in a specific location. The characteristics and locations of 865 undisturbed wood pieces (usually > 0.1 m in diameter for a portion > 1 m in length) were documented to

determine the factors that influence the mobilization of stationary wood pieces in natural streams. Discharge in the streams during the entire study period was determined using calibrated hydraulic simulation models. Multiple logistic regression identified 5 predictor variables of 11 potential predictor variables considered in the study as significant to mobilization; burial, ratio of piece length to effective stream width (length ratio), effective depth, bracing, and rootwad presence ($p < 0.001$, $r^2 = 0.38$). Overall, the composition of the final model indicates that wood mobilization under natural conditions is a complex function of both mechanical factors (burial, length ratio, bracing, rootwad presence) and submergence

(effective depth). Although our study only included 1 stormflow event, the 9 streams exhibited a wide range of geomorphic and hydraulic conditions, thus our model should be applicable to at least a similarly wide range of conditions in other watersheds. The model can provide guidance to stream management and restoration. For example, if stable pieces are a goal for stream management then features such as partial burial, length relative to channel width, low effective depth, bracing against other objects (i.e., stream banks, trees, rocks, or larger wood pieces), and rootwads are desirable. Using the model equations from this study, stewards of natural resources can better manage instream wood for the benefit of stream ecosystems.



Scaleable Indices of Watershed Health

Investigators:	Bruce Vondracek and Paul Bolstad (Cooperating Faculty)
Student:	Bethany Blick, M.S. (Water Resources Science Program)
Duration:	July 2008 to June 2009
Funding Source:	Minnesota Department of Natural Resources
Project Location:	Throughout Minnesota Minnesota Cooperative Fish and Wildlife Research Unit

A watershed-based approach is increasingly recognized as the most comprehensive framework for understanding and managing natural resource systems, including streams and lakes. However, for this approach to be successful, a large amount of information regarding the current state of watershed resources is necessary. Unfortunately, despite the large amount of existing geographic information system (GIS) information that could be utilized, this information is not readily available for managers in an easily accessible, broadly applicable, summarized form. The Watershed Assessment Tool Project is designed to bridge this gap by acquiring background information on watershed concepts and developing a comprehensive series of GIS layers. This information will be organized in a 5-component framework of hydrology, geomorphology, biology, connectivity, and water quality to facilitate quantification of healthy watershed function and interactions. We are developing a meta-analysis and syntheses to support the broad-scale, long-term quantification of watershed health in major Minnesota watersheds (8-digit hydrologic unit code boundaries), the selection of a set of health indices, and the application of these health indices for all such watersheds in Minnesota. This work is specifically designed to support the development of the Minnesota Department of Natural Resources watershed assessment tool.

Understanding the Importance of Weak-tie Networks in Complex Human-environment Systems: Ecosocial Feedback in Multifunctional Agriculture

Investigators: Bruce Vondracek and Nicholas Jordan (Cooperating Faculty)

Student: Kara Raymond, M.S. (Water Resources Science Program)

Duration: September 2007 to June 2009

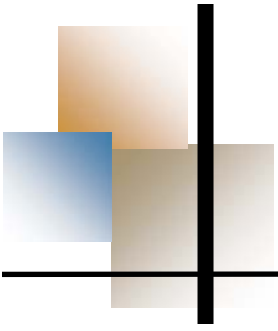
Funding source: National Science Foundation

Project Location: Driftless Area Ecoregion in Iowa, Minnesota, and Wisconsin
Minnesota Cooperative Fish and Wildlife Research Unit

In agriculture, ‘multifunctionality’ refers to production of a range of agricultural commodities and conservation of biodiversity and water quality. Multifunctional agriculture addresses a range of social and ecological challenges to sustainability. This project is conducted by an interdisciplinary team to evaluate multifunctional agriculture as a coupled human-environment system driven by ecosocial feedback, weak-tie social networks, and multiple biophysical benefits. Rotational grazing is an alternative management system for livestock and dairy operations, which can mitigate the impacts of continuous grazing on stream morphology, water quality, aquatic habitat, and biotic communities and can be part of a multifunctional system. Our portion of the project has 3 objectives: (1) to evaluate the aquatic habitat and stream channels adjacent to rotational grazing compared to continuous grazing, (2) evaluate macroinvertebrate assemblages adjacent to rotational grazing compared to continuous grazing, and (3) examine the use of chironomid pupal exuviae as biological indicators in agricultural landscapes. Channel data, benthic macroinvertebrate larval samples, and chironomid pupal exuviae samples were collected at 18 sites within the Driftless Area Ecoregion. Rotational grazing was found to result in significantly greater habitat quality, more bank stability, larger substrate sizes in the



streambed, and less soil compaction. The aquatic macroinvertebrate assemblages did not indicate a difference between rotational and continuous grazing sites. However, weather conditions during sampling and land use throughout the watershed may have affected the biotic community composition. The chironomid pupal exuviae community metrics were not strongly correlated with stream habitat variables; however chironomid pupal exuviae biotic index scores were significantly correlated with benthic macroinvertebrate larval biotic index scores, indicating that the 2 assemblages had similar responses to water quality impacts.



Ongoing Research



Human Dimensions,
Management, and
Conservation



Alternative Deer Management Strategies in Minnesota State Parks

Investigator: David C. Fulton

Student: Louis Cornicelli, Ph.D. (Natural Resources Science and Management)

Duration: January 2006 to December 2009

Funding Source: Minnesota Department of Natural Resources
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

Developing hunting regulations that help reduce white-tail deer (*Odocoileus virginianus*) numbers and balance deer sex ratios is a challenge throughout the eastern half of the United States. Working closely with the Minnesota Department of Natural Resources statewide big game manager, this project is designed to assess hunter attitudes and behavior in reaction to experimental regulations designed to help reduce deer numbers. This project will assist Minnesota Department of Natural Resources managers in selecting regulations that will be both effective and supported by hunters.

Data have been collected over 3 annual deer hunting seasons (2005, 2006, 2007) to examine hunter support for regulatory alternatives, change in support for regulatory alternatives after experience with the alternatives, and the relationship between hunter support and



biological effectiveness. The student dissertation is being drafted and will be available by October 2009. Yearly progress summaries are available from the Minnesota Department of Natural Resources.

American Woodcock Singing-ground Surveys in the Western Great Lakes Region: Assessment of Trends in Woodcock Counts, Forest Cover Types Along Survey Routes, and Landscape Cover Type Composition

Investigator: David E. Andersen

Student: Matt Nelson, M.S. (Natural Resource Science and Management)

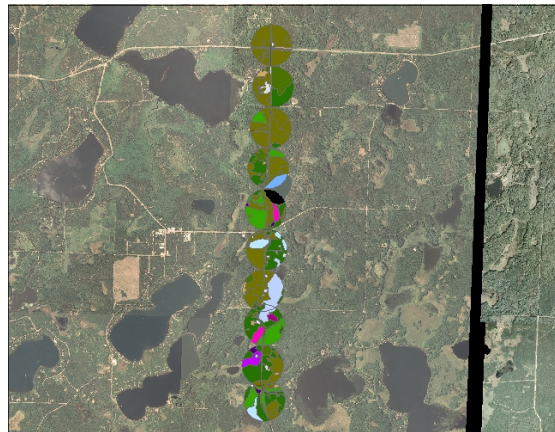
Duration: June 2006 to June 2010

Funding Source: U.S. Fish and Wildlife Service
Minnesota Department of Natural Resources
Wisconsin Department of Natural Resources
Woodcock Minnesota
Minnesota Cooperative Fish and Wildlife Research Unit

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

Our overall objective is to better understand the relationship(s) between changes in counts of American woodcock (*Scolopax minor*) on Singing-ground Surveys in Minnesota and Wisconsin and forest land cover. We plan to assess patterns in annual counts of woodcock along existing survey routes, assess changes in time in land cover types along these routes, relate temporal changes in woodcock counts to changes in land cover composition, and compare current cover type composition along routes to current landscape cover type composition. If possible, we will also compare past cover type composition along survey routes to landscape cover composition. Specific project objectives are as follows:

- (1) Assess patterns in annual counts of American woodcock along survey routes in Minnesota and Wisconsin,
- (2) Assess changes through time in land cover types along Singing-ground Survey routes in Minnesota and Wisconsin,
- (3) Relate temporal changes in land cover types to woodcock counts,
- (4) Compare current cover type composition along routes to current landscape composition, and if possible, compare past cover type composition along routes to past



landscape composition.

To date, we have digitized all Singing-ground Survey routes in Minnesota and Wisconsin, and verified all (MN) or most (WI) of these routes with volunteers who conduct the surveys. We have compiled land-use and habitat data at a coarse spatial scale for both Minnesota and Wisconsin, and identified land-use geographic information system coverages for multiple time periods in both states. We are currently delineating cover types at the spatial scale of individual routes, and when that delineation is complete, will begin analyses to address specific project objectives.

Bioregional Monitoring for Northern Goshawks in the Western Great Lakes

Investigator: David E. Andersen

Postdoc: Jason Bruggeman

Duration: June 2006 to August 2009

Funding Source: U.S. Forest Service, Eastern Region
Wisconsin Department of Natural Resources
Minnesota Cooperative Fish and Wildlife Research Unit

Project Location: Western Great Lakes Region
Minnesota Cooperative Fish and Wildlife Research Unit

Little is known regarding northern goshawk (*Accipiter gentilis*) abundance, distribution, and population trend at the scale of the western Great Lakes region. Following a regional goshawk meeting in Wisconsin in 2004, there was consensus among natural resource agencies and researchers that development of a regional biomonitoring program for northern goshawks was desirable, and the U.S. Forest Service provided funding to support a postdoc to develop a sampling program and compile necessary landcover information to conduct such a program. The objectives of this program are to assess goshawk population status in the western Great Lakes region, and provide a baseline for monitoring population trend across the region.

Following development of survey protocols in 2007, bioregional surveys were conducted cooperatively in Minnesota, Wisconsin, and Michigan in 2008. To date, project accomplishments include, (1) developing a nesting habitat model for northern goshawks in the western Great Lakes region, (2) using that nesting habitat model to delineate high and low quality nesting habitat at a broad spatial scale, (3) developing a survey protocol based on the national biomonitoring protocol developed by



the U.S. Forest Service and incorporating access and habitat quality throughout the region, (4) allocating sampling units based on available resources and the geographic extent over which inference was desired, and (5) coordinating survey implementation across the region. Survey data have been summarized and distributed to project cooperators, and a final report is being developed and will be distributed to project cooperators in draft form in early 2009.

Eastern Prairie Population Canada Goose Breeding Ecology

Investigator: David E. Andersen

Student: Matt Reiter, M.S. and Ph.D. (Wildlife Conservation)

Duration: January 2004 to December 2009

Funding Sources: Mississippi Flyway Council (U.S. Fish and Wildlife Service, Canadian Wildlife Service, Manitoba Conservation, Minnesota Department of Natural Resources, Iowa Department of Natural Resources, Missouri Department of Conservation, Arkansas Game and Fish Commission)
U.S. Geological Survey
University of Minnesota (Graduate School Dissertation Fellowship)

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

For almost 40 years, the breeding grounds of Eastern Prairie Population (EPP) Canada geese (*Branta canadensis interior*) at Cape Churchill, Manitoba have been monitored as part of a larger research and management program for this flock. In the 1980s, monitoring efforts indicated that a rapidly increasing snow goose (*Chen caerulescens*) population might be displacing Canada geese from traditional brood-rearing and foraging areas by both reducing the extent of and altering available habitat. The objectives of this study are to document current levels of interaction between these 2 species with respect to nesting and brood-rearing behavior of Canada geese, ascertain whether increased snow goose abundance has had an adverse impact on habitat quality, and if so, what are the implications for productivity of Canada geese. As an extension of a previous project, we will also focus on Canada goose-snow goose interactions across a range of historic conditions in the central sub-Arctic, and assess existing survey data to describe and understand how factors identified as important at a local scale are translated across the breeding range.

We collected data on 2 study locations in northern Manitoba (Nestor One and the Broad



River) with different histories of nesting by Canada geese and snow geese in 2005 and 2006. In addition, we used long-term data collected at Nestor One as part of ongoing monitoring efforts to assess trends in nesting Canada goose and snow goose abundance and potential interactions between these 2 species. Finally, we are using existing data from annual breeding-range-wide surveys of nesting EPP Canada geese to assess changes in abundance and distribution of both Canada geese and snow geese at a broad spatial scale, based on relationships observed at smaller spatial scales. Data analyses are currently underway, and we expect to have a draft final report completed by early summer 2009. Upon completion of this

portion of this long-term study, we are planning on expanding the scope of this project to next focus on banding data related to birds banded on the breeding grounds during the summer. The affiliation of birds associated with EPP breeding grounds during summer is not well understood, especially the abundance, distribution, and importance of molt-migrant Canada geese from other populations.



Long-term Research and Monitoring of Human Dimensions Information on Fisheries and Wildlife Management Issues in Minnesota

Investigator: David C. Fulton

Student: Susan A. Schroeder, Ph.D. (Natural Resources Science and Management)

Duration: July 2006 to December 2010

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

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

This project is the continuation of a long-term research effort established in 2002 that provides funding for a full-time research fellow to work closely with Minnesota Department of Natural Resources fisheries and wildlife researchers and managers to collect timely information to assist in the evaluation of management programs. The primary focus of this position is on developing experience-based management information for fisheries and wildlife management in Minnesota and to use this information to further our understanding of what factors influence angler and hunter experience satisfaction and level of support for management programs. This project

provides a consistent process to develop a long-term database to improve our understanding of factors influencing trends in both recreational participation in fisheries and wildlife-based activities and to examine how attitudes and beliefs about fish and wildlife management issues are changing over time. This project provides a unique contribution nationally by providing a long-term research program with consistent measurement that will allow examination of long-term trends in values, attitudes, and behavior from a theory-directed perspective.

Managing Walleye in Minnesota

Investigator: David C. Fulton

Students: Susan Schroeder, Ph.D. (Natural Resources Science and Management)

Duration: January 2008 to December 2009

Funding Source: Minnesota Department of Natural Resources
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

Walleye (*Sander vitreus*) is the most popular fish targeted by Minnesota anglers. Anglers fished for walleye an average of 18 days during 2003.

The objectives of this study are to:

- (1) Characterize the sociodemographics, involvement, preferred experiences, use histories, and management and regulatory preferences of Minnesota resident and nonresident anglers;
- (2) Examine the use histories, fishing destinations, catch orientations, and preferred attributes of lakes of walleye anglers.

Data were collected via mail-out surveys from 3 strata: resident anglers from the 7-county Twin Cities metropolitan area (target sample of $n = 400$), resident anglers from outside the



metropolitan area (target sample of $n = 400$), and nonresident anglers (target sample of $n = 400$). Walleye anglers will be identified through the survey. The sampling frame for anglers was the Minnesota Electronic License Data System and 1,000 anglers in each stratum were contacted for a total of 3,000 anglers. Data collection is finalized, and a final report will be available October 2009.

Understanding Human Behaviors Concerning Lake Shoreline Management

Investigator: David C. Fulton

Student: Edgar Rudberg, Ph.D. (Natural Resources Science and Management)

Duration: October 2007 to September 2009

Funding Source: Minnesota Department of Natural Resources
Division of Wildlife

Project Location: Minnesota Cooperative Fish and Wildlife Research Unit

Rapid residential development around Minnesota's fisheries lakes during the past 3 decades has led to dramatic changes in lake shorelines. Sandy beaches, rip rap, and grassy lawns now cover significant proportions of shorelines that once held native vegetation important as wildlife habitat and as biological filters to maintain water quality. Although the cumulative impacts are difficult to quantify, there is general agreement that anthropogenic changes are leading to declines in water quality and fish habitat. The purpose of this study is to understand the values, attitudes, norms, and beliefs that lead to household behaviors about how privately held residential land will be managed around lakes. Ultimately, understanding the psychological and social factors that drive these decisions can help us design information and education efforts to decrease undesirable behaviors and increase desirable behaviors such as restoration of native vegetation on residential properties

This study involves 2 distinct phases of research:

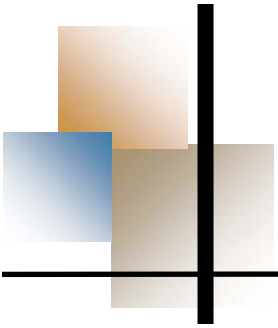
- (1) An elicitation study and preliminary research on important beliefs affecting attitudes and behavior toward maintaining and restoring native vegetation on private residential properties around lakes;



- (2) A statewide cross-sectional survey of residential property owners on Minnesota lakes to assess the relationships among pro-environmental values, attitudes, norms, beliefs and behaviors concerning managing for native shoreline vegetation.

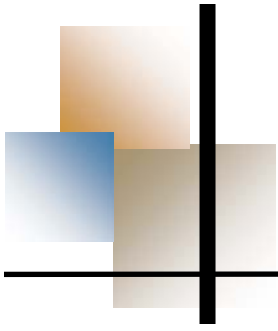
Completion of this study will provide the foundation for a third research phase that would be funded separately if pursued:

- (3) A field experiment to test the effectiveness of persuasive communication in building support for maintaining/restoring native vegetation on lake shorelines.



Activities





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Reiter, M.E. and **D.E. Andersen**. 2008. Comparing egg floatation and egg candling to estimate incubation day of Canada Goose nests. *Journal of Field Ornithology* 79:429-437.

Refsnider, J., J. Moore, and **H. Streby**. 2008. *Sphenodon punctatus* (common tuatara): prey detection. *Herpetological Review* 39:347-348.

Sammler, J.E., **D.E. Andersen**, and S. Skagen. 2008. Population trends of tundra-nesting birds at Cape Churchill, Manitoba, in relation to increasing goose populations. *Condor* 110:325-334.

Streby, H.M., J.M. Refsnider, S.M. Peterson, and D.E. Andersen. 2008. Barred owl predation on hermit thrush and ovenbird fledglings. *Journal of Raptor Research* 42:296-298.

In Press, Review, or Revision

Asmus, B., J. Magner, **B. Vondracek**, and J. Perry. *In Review*. Physical integrity: the missing link in biological monitoring and TMDLs. *Environmental Monitoring and Assessment*.

Blann, K.L., J. Anderson, G. Sands, and **B. Vondracek**. *In Press*. Effects of agricultural subsurface drainage on aquatic ecosystems: a review. *Critical Reviews in Environmental Science and Technology*.

Bruskotter, J.T., **Fulton, D.C.**, Payton, M., and Vondracek, B. *In Review*. Land conservation in practice: predicting the use of government-sponsored land conservation programs. *Environmental Management*.

Eells, L., R. Vondracek, and **B. Vondracek**. *In Review*. Hunting or fishing for information. (Solicited chapter intended for Scientific Communication for Natural Resource Professionals. C. Jennings, T.E. Lauer, and B. Vondracek (eds.).

Fieberg, J., L. Cornicelli, L. and **D.C. Fulton**. *In Review*. Design and analysis of simple choice surveys for natural resource management. *Journal of Wildlife Management*.

Gresswell, R., and **B. Vondracek**. *In Review*. Coldwater streams. (Solicited chapter in the 3rd edition of Inland Fisheries Management in North America. W.A. Hubert and M.C. Quist (eds.).

Streby, H.M. J.M. Refsnider, S.M. Peterson, and **D.E. Andersen**. *In Press*. Barred owl predation on hermit thrush and ovenbird fledglings. *Journal of Raptor Research*.

Andersen, D.E., M.E. Reiter, K.E. Doherty, and D.C. Fulton. *In Press*. Magnitude and spatial distribution of American woodcock hunting pressure in a central Minnesota wildlife management area. *Proceedings of the 10th American Woodcock Symposium*.

Henneman, C. and **D.E. Andersen**. *In Press*. Habitat associations of red-shouldered hawks in central Minnesota landscapes. *Journal of Wildlife Management*.

Meunier, J., L.S. Lutz, K.E. Doherty, **D.E. Andersen**, E. Oppelt, and J.G. Bruggink. *In Press*. Fall diurnal habitat use by adult female American woodcock in the western Great Lakes region. *Proceedings of the 10th American Woodcock Symposium*.

Oppelt, E., J.G. Bruggink, K.E. Doherty, **D.E. Andersen**, J. Meunier, and R.S. Lutz. *In Press (Abstract only)*. Fall survival of American woodcock in the western Great Lakes region. *Proceedings of the 10th American Woodcock Symposium*.

Reiter, M.E., **D.E. Andersen**, and C.W. Boal. *In Press*. Species composition, distribution, and habitat associations of anurans in a subarctic tundra landscape near Cape Churchill, Manitoba, Canada. *Canadian Field-Naturalist*.

Schroeder, S.A. and **Fulton, D.C.** *In Review*. Land of 10,000 lakes and 2.3 million anglers: conflict, crowding, and coping among Minnesota anglers. *Journal of Leisure Research*.

Technical and Semi-Technical

2007

Andersen, D.E. 2007. Raptor survey techniques. Pages 89-100 in D.M. Bird and K. Bildstein (eds.). *Raptor Research and Management Techniques (revised edition)*. Hancock House Publishers, Blaine, Washington, USA.

Bruskotter, J.T. and **D.C. Fulton**. 2007. The influence of angler value orientations on fisheries stewardship norms. Pages 157-167 in B.A. Knuth and W.F. Siemer (eds.). *Aquatic Stewardship Education in Theory and Practice*. American Fisheries Society Symposium 55. Bethesda, Maryland, USA.

Fulton, D.C. and M.J. Manfredo. 2008. The biological context of wildlife values: are there etchings on the slate? Pages 29-48 in M.J. Manfredo (ed.). *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. Springer, New York, New York, USA.

Fulton, D.C., M.J. Manfredo, and D.H. Anderson. 2008 Application of experienced-focused and outcomes-focused management to fisheries and wildlife management. Pages 385-396 in B.L. Driver (ed.). *Outcomes-Focused Management of Recreation Resources and Programs*. Venture Publishers, State College, Pennsylvania, USA.

2008

Schroeder, S.A., **D.C. Fulton**, M. Nemeth, R. Sigurdson, and R. Walsh. 2008. Fishing in the neighborhood: understanding motivations and constraints to angling among Twin Cities metro residents. Pages 77-97 in R. Eades, W. Neal, T. Lang, K. Hunt, and P. Pajak (eds.). *Urban and Community Fisheries Programs: Development, Management, and Evaluation*. American Fisheries Society, Symposium 76. Bethesda, Maryland, USA.

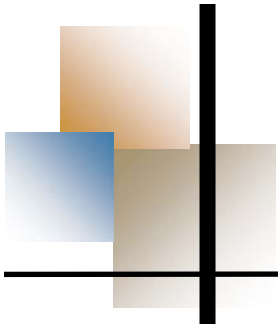
Cooperating Faculty Publications

Peer-Reviewed

2008

Cuthbert, F.J. and E.A. Roche. 2008. The piping plover in Michigan: a 100 year perspective. *Michigan Birds and Natural History* 15:29-38.





Completed Theses and Dissertations of Minnesota Coop Unit Students

2007

Bruskotter, J.T. 2007. Value orientations and the practice of conservation: applications in fisheries management and agriculture. Ph.D., Natural Resources Science and Management, University of Minnesota, St. Paul, Minnesota, USA. 163pp. (David Fulton)

Abstract: Research on natural resource-related values and value orientations has grown substantially over the past decade. However, existing studies have focused almost exclusively on value orientations related to wildlife and forests. This paper reports data from two mail surveys of Minnesota anglers used to develop scales for measuring fisheries-related value orientations. In addition, we report results of regression analyses examining the relationship between (1) several sociodemographic factors and anglers' value orientations; and (2) the influence of sociodemographic factors and value orientations on fishing license sales in Minnesota. Results indicate 10 items reliably measure three value orientations we termed, utilitarianism, dominance, and protectionism. Regression analyses suggest utilitarian value orientations are greatest among older people, people with lower levels of income and people with lower levels of education; dominance orientations are greatest among people with higher levels of education, and women; and protection orientations are greatest among women and people with lower levels of education. Finally, results indicate the frequency of fishing license purchasing (i.e. number of licenses purchased in previous 5 years) is negatively related with sex, urban residency, and utilitarian value orientation, and positively related with years in residence in Minnesota.

Nagle, F. A. 2007. Empowering conservation decisions: towards a theory of authentic arenas for environmental conflict management and decision-making. Ph.D., Conservation Biology, University of Minnesota, St. Paul, Minnesota, USA. 266pp. (Bruce Vondracek)

Abstract: Environmental decision-making is challenged by the complexity and intensity of environmental problems, social needs, and moral values. One way to address these challenges is to facilitate empowered and effective arenas for problem-solving. Toward that end, I have synthesized the Authentic Arena Theoretical Framework (AATF). The AATF is a holistic, practical, interdisciplinary, and theory-based approach to creating and improving decision-making arenas. The driving force of the AATF is the concept of authenticity, which fosters decisions that are satisfactory, implemented, effective, and environmentally and socially sound. I base the framework and concept of authenticity on an earlier definition of authentic arenas, three case studies, and a broad multidisciplinary literature review. This review includes conflict management, conservation biology, political science, and anthropology, as well as adaptations of authenticity from the fields of leadership, public governance, and eastern philosophy.

I suggest that authenticity in an arena is critical because it determines the relevancy and favorableness of decisions to a society and to an environment. To explore this idea, I evaluate the authenticity of three arenas using the AATF as my analytical lens. The three arenas are the Land Use Commission (LUC) of

Hawaii, the Kona/Kohala Natural Resources Roundtable (KKRT) in Hawaii, and the Resource Management and Planning Appeal Tribunal (RMPAT) of Tasmania, Australia. Each arena addresses disputes between conservation and development to varying degrees of success. My focus is on the functionality, empowerment, and effectiveness of the three arenas for dispute resolution and decision-making. Data collection included archival extraction, in-depth interviews, questionnaires, and personal observation. I find the LUC is functionally authentic, the KKRT had limited authenticity, and RMPAT appears functionally authentic but, when tested by a particular dispute, has limited authenticity. These studies show the AATF can be used to diagnose strengths and weaknesses in an arena and to identify areas for improvement. A final comparative assessment of the arenas provides insights on the power of authenticity for decision-making and demonstrates the utility of the AATF as a problem-solving tool. I conclude arenas with greater degrees of authenticity tend to have more capable decision-making and more effective decisions.

Schlesser, N. J. 2007. Effects of riparian forest harvest on instream habitat and fish assemblages in northern Minnesota. M.S., Conservation Biology (Fisheries and Aquatic Biology track), University of Minnesota, St. Paul, Minnesota, USA. 81pp. (Bruce Vondracek)

Abstract: We designed a study to evaluate effects of forest harvest within riparian zones of eight streams in northern Minnesota on fish and macroinvertebrates, instream habitat, and water quality. Our work is part of a larger study with the U.S. Forest Service and Department of Forest Resources (vegetation) and the Natural Resources Research Institute (birds). The goal of the overall project is to make scientifically sound recommendations for harvest in riparian areas in Minnesota forests. Data were collected in 2003 (pre-harvest) and in 2004 and 2005 (post-harvest). We compare three levels of riparian harvest: no harvest and four streams each with intermediate residual basal area remaining (RBA) or low RBA remaining. Fish were collected with a backpack electroshocker and an Index of Biotic Integrity (IBI) was calculated. Stream habitat data were evaluated with a Quantitative Habitat Evaluation Index (QHEI). Pre- and post-harvest QHEI and IBI scores indicate significant variation ($p < 0.05$) across sites and across years with no consistent indication of harvest effects although there was an increase in number of fish sampled in 2005 at all streams compared to previous years. Mean quantitative habitat evaluation index (QHEI) scores ranged from 45 to 76 of a maximum 100 points. Analyses of macroinvertebrate samples from 2003 and 2004 indicate differences within and between sites in species composition and abundance (species richness and %EPT). There was high variability in flow regime and water temperature across years. Water quality indices were relatively lower in 2004 at most sites.

2008

Atuke, D. 2008. Effectiveness of riparian forestry best management practices to protect stream habitat and biota: lessons from temperate and tropical systems. Ph.D., Conservation Biology (Fisheries and Aquatic Biology track), University of Minnesota, St. Paul, Minnesota, USA. 273pp. (Bruce Vondracek)

Abstract: I conducted related studies in Minnesota and Kenya. In northern Minnesota, I evaluated effects of riparian forest harvest with forestry best management practices (BMPs) on stream habitat, water quality, fish and macroinvertebrates, in eight streams. Site-level effects were evaluated for no harvest, riparian control and two levels of riparian harvest one year prior to harvest and 3 years post-harvest. In Kenya, I assessed government and nongovernmental organization (NGO) officers views on riparian forests and water quality, the factors that influence the ability to know, comply with, and implement regulations and BMPs for forest harvest in riparian areas and evaluated application and effectiveness of BMPs to protect water quality on government and private forest lands in south-west Mau region of Kenya.

In northern Minnesota, canopy cover along harvested reaches was significantly reduced and woody

cover increased at a few sites. Percentage fine sediments increased in reaches downstream of the intermediate harvest treatment. Percentage tolerant fish species increased in both riparian harvest treatments. Water quality parameters exhibited seasonal and year-to-year variation with harvest effects on nitrate.

Macroinvertebrate abundance increased initially with low harvest but declined to pre-harvest levels in subsequent years. Taxonomic and functional feeding group composition were similar among treatments except for a decline in percent EPT, increase in Margalef's richness index, and an increase in proportion of collector-filterers and scrapers.

In Kenyan, riparian areas were under pressure from human activities, and timber harvest had an impact on riparian areas. Government and NGO officers considered lack of sound policy, poor enforcement, corruption, non-compliance, and overexploitation important threats to conservation of riparian forests and water quality, although there were disagreements on specific causes. Visitation by forestry officers, proportion of land under forestry, and catchment location were important predictors of landowners' knowledge of and compliance with forest regulations and BMPs. Landowner age and knowledge of traditional BMPs significantly influenced landowner decision making. Application of BMPs was greater in private lands than in government-owned lands. Increased BMP application was associated with reduced sediment delivery into streams. These two studies indicate that BMPs can reduce the impact of harvest on riparian and aquatic resources.

Bronk, R. 2008. Macroinvertebrate composition, habitat, and diet in relation to the reintroduction of slimy sculpin in southeast Minnesota. M.S., Conservation Biology (Fisheries and Aquatic Biology track), University of Minnesota, St. Paul, Minnesota, USA. 44pp. (Bruce Vondracek)

Abstract: Slimy sculpin (*Cottus cognatus*) are benthic fish that are thought to be historically widespread across the Driftless Area Ecoregion. Their habitat was disturbed by riparian logging and sedimentation of streambeds by agricultural practices in the early twentieth century and local populations of sculpin were likely extirpated from many stream reaches. In 2001, the Minnesota Department of Natural Resources (MN DNR) began a reintroduction program for sculpin, to restore the biotic community of coldwater trout streams. Success of sculpin reintroduction has varied. The purpose of this study was to understand the relationship between macroinvertebrate composition, habitat, sculpin diet and sculpin density to provide suggestions for choosing future reintroduction sites. Between July 2006 and May 2008, I studied 10 stream reaches in Minnesota's reintroduction program; 5 source streams, used to provide sculpin for reintroduction, and 5 recipient stream reaches where sculpin had been stocked by the MN DNR. Source and recipient stream reaches were similar in macroinvertebrate composition, habitat, and sculpin diet. Recipient stream reaches contained sculpin densities that were not significantly different from source stream reaches, indicating that the reintroduction program has been successful. Nonmetric multidimensional scaling (NMDS) ordination based on macroinvertebrate composition revealed 2 groups. The groups were differentiated by highest 7-day maximum temperatures (Multidimensional response permutation procedure (MRPP), $p = 0.005$). The groups could be subdivided by velocity to classify stream reaches as cold-fast, warm-fast, cold-slow, and warm-slow (MRPP, $p = 0.0007$). Velocity was positively related to percent of coarse substrate ($r^2 = 0.47$) and wetted width ($r^2 = 0.37$). Sculpin density was related to amount of surface area covered by vegetation, wood, or boulders ($r^2 = 0.93$), wetted width ($r^2 = 0.66$), and percent coarse substrate ($r^2 = 0.3$). There was a gradient in sculpin density across the four stream classes and sculpin density was highest at cold-fast and lowest at warm-slow stream reaches, but was not significantly different between groups identified with the NMDS ordination. Sculpin diet mirrored the pattern based on macroinvertebrate composition and was significantly different across the four stream classes (MRPP, $p = 0.006$). Diet was related to boulder presence ($r^2 = 0.36$), sculpin density ($r^2 = 0.35$), highest 7-day maximum temperature ($r^2 = 0.35$), and cover area ($r^2 = 0.16$). To promote future reintroduction success and maximize efficiency, I suggest that

future reintroduction efforts are structured such that recipient stream reaches that are most similar to the cold-fast streams from this study.

Dolph, C. 2008. Empowering water quality decisions: reducing uncertainty and bounding variability of stream ecosystem indicators. Plan B Paper, M.S., Water Resources Science, University of Minnesota, St. Paul, Minnesota, USA. 65pp. (Bruce Vondracek)

Abstract: Increasingly, multimetric indices such as the Index of Biological Integrity (IBI) are used by management agencies to make water quality impairment decisions under the Clean Water Act. However, important questions about the variability of these indices have not been thoroughly addressed in the scientific literature. In this study, we used a bootstrap approach to quantify variability associated with fish IBIs developed for streams in two Minnesota river basins. We further placed this variability into a management context by comparing it to impairment thresholds currently used in water quality determinations for Minnesota streams.

We found that 95% percentile confidence intervals ranged as high as 40 points for IBIs scored on a 0-100 point scale. On average, however, 90% of IBI scores calculated from bootstrap replicate samples for a given stream site yielded the same impairment status as the original IBI score. We suggest that sampling variability in IBI scores is related to the number of fish in a field collection, as well as to stream drainage area. A comparison of the effects of different scoring methods on IBI variability further indicates that a continuous scoring method may reduce the amount of bias in IBI scores.

Loomis, J. H. 2008. The survival and blood chemistry response of walleye *Sander vitreus* to a simulated live-release fishing tournament. . M.S., Water Resources Sciences, University of Minnesota, St. Paul, Minnesota, USA. 51pp. (Bruce Vondracek)

Abstract: Live-release walleye tournaments are increasing in number and participation. Estimates of walleye mortality due to tournament procedures over a range of environmental conditions are needed by fisheries managers to make informed decisions when evaluating permits for live-release tournaments. I examined survival of walleye related to ambient water temperature and live-well water temperature and dissolved oxygen in a laboratory setting. Additionally, I characterized some of the response of blood chemistry associated with stress of walleye subjected to simulated tournament conditions at three live-well temperatures. Analyses suggest walleye can survive tournament-related procedures at high rates at or below 18°C, but are increasingly vulnerable as temperatures exceed 18°C. Significant osmoregulatory stress resulted from simulated tournament activity indicating a potential mechanism for decreased survival. Anglers may be able to increase survival through careful manipulation of live-well water temperature.

Theses and Dissertations supported by RWOs

2007

Ashman, B. 2007. Hydraulic and sediment response of a regional stormwater detention pond using the BASIN model. Plan B Paper, M.S., Biosystems and Agricultural Engineering, University of Minnesota, St. Paul, Minnesota, USA. 128 pp. (Cooperating Faculty – Bruce Wilson)

Abstract: Urban communities increasingly use multifunctional landscape elements as alternatives to retention ponds in treating runoff. Rain-gardens are an important element in most of these low-impact designs. Ideally, they remove contaminants, reduce runoff and require minimal maintenance to support attractive healthy vegetation. Continuous weather simulations allow performance assessment of these

features under many possible climate conditions. This report presents a simple continuous water-balance model for rain-gardens that relies on local soil, catchment, and climate parameters to predict runoff, infiltration, and evaporation. The model is coded as Visual Basic for Applications (VBA) within the common spreadsheet program Microsoft Excel. Result analysis can reveal secondary trends that arise as soil and vegetation respond to the broad spectrum of likely weather patterns. These are relevant to a broad variety of specific design goals. (Such as: what time of year maximum daily runoff most frequently occurs, periods when plant desiccation is likely, the percent of storm events retained in rain garden soil, and mean annual surface water volume reduction).

Roche, E.A. 2007. Great Lakes piping plover persistence despite projected declines: can predictive inaccuracy inform management? M.S., Conservation Biology, University of Minnesota, St. Paul, Minnesota, USA. 64 pp. (Cooperating Faculty—Francesca Cuthbert)

Abstract: The piping plover is a federally endangered migratory shorebird endemic to the Great Lakes, Great Plains, and Atlantic Coast of North America. Although previous population viability analyses projected the Great Lakes population will decline to eventual extirpation, the Great Lakes population has undergone steady population growth since 1993. We employed two single-population stochastic models to identify influential demographic parameters and investigate potential explanations for discrepancies between model projections and observed growth. Our models projected decline and extirpation for the Great Lakes population under baseline conditions but had low predictive accuracy. One explanation for low predictive accuracy is lower than expected juvenile survival. Results of our sensitivity analyses suggested the population is most sensitive to changes in juvenile and adult survival. Depressed estimates of hatch year survival may result if year old piping plovers breed in unsurveyed areas of the Great Lakes. If they are the offspring of undiscovered breeding pairs, the presence of unbanded breeding adults could explain the disparity in model projections and observations and indicate the current population is larger and more widely dispersed than currently believed. Unavailable estimates prevent complete understanding of population dynamics and projection of potential management strategies; region wide participation in survey efforts is required to minimize this impact and encourage greater conservation success.

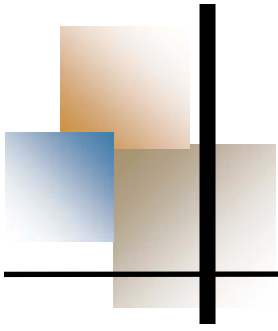
Student Awards

David Huff. 2008. University of Minnesota Graduate School Doctoral Dissertation Fellowship for 2008-2009 academic year.

John Loomis. 2008. Best Student Presentation, Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Alexandria, Minnesota.

Matthew Reiter. 2008. University of Minnesota Graduate School Doctoral Dissertation Fellowship for 2008-2009 academic year.

Henry Streby. 2008. Dayton-Wilkie Research Fellowship, Bell Museum of Natural History.



Presentations

Invited Presentations

2007

Andersen, D.E. and H.M. Streby. 2007. Minnesota Cooperative Fish and Wildlife Research Unit forest bird monitoring: forest-nesting songbirds, forest raptors, and American woodcock. Minnesota Breeding Birds Inventory and Monitoring Workshop, Duluth, Minnesota.

Fulton, D.C. 2007. Hunting satisfaction, participation and regulations. Minnesota Waterfowl Association Annual Meeting, Bloomington, Minnesota.

Loomis, J., **B. Vondracek**, and H.L. Schramm. 2007. Walleye mortality associated with livewell operating procedures for simulated live-release angling tournaments. Walleye Technical Committee, 2007 Summer Meeting, Cloquet Forestry Center, University of Minnesota, Cloquet, Minnesota.

Schroeder, S.A. and **D.C. Fulton**. 2007. Fishing in the neighborhood: understanding motivations and constraints for angling among Minneapolis-St. Paul, Minnesota metro residents. 137th Annual Meeting of the American Fisheries Society, San Francisco, California.

Schroeder, S.A. and **D.C. Fulton**. 2007. Untangling the line: constraints to fishing participation in communities of color. 137th Annual Meeting of the American Fisheries Society, San Francisco, California.

Schroeder, S.A., **D.C. Fulton**, J.L. Lawrence, S.D. Cordts. 2007. Changes in Minnesota waterfowl hunting 1995-2005. Minnesota Waterfowl Association Annual Meeting. Bloomington, Minnesota.

2008

Andersen, D.E. 2008. Survey techniques. 2008 Annual Meeting of the Raptor Research Foundation, Inc. Workshop on Raptor Research and Management Techniques. Missoula, Montana.

Gillespie, M. and **D.E. Andersen**. 2008. Canada geese in the Hudson Bay Lowlands—how research compliments management actions. Wapusk National Park Research and Monitoring Conference, Winnipeg, Manitoba, Canada.

Contributed Presentations

2007

Asmus, B., J. Magner, **B. Vondracek**, and J. Perry. 2007. Channel stability or habitat quality? Which drives fish IBI in midwestern streams? 55th Annual Meeting of the North American Benthological Society, Columbia, South Carolina.

Atuke, D. and **B. Vondracek**. 2007. Summary of evaluating riparian timber harvesting guidelines: aquatic systems. Northeast Forest Soils Conference 2007, Cloquet, Minnesota - Thunder Bay, Ontario.

Atuke, D.M., R.M. Newman, and **B. Vondracek**. 2007. Evaluating the response of instream habitat, water quality and macroinvertebrate assemblages to riparian forest harvest in northern Minnesota. 55th Annual Meeting of the North American Benthological Society, Columbia, South Carolina.

Atuke, D.M., R.M. Newman, and **B. Vondracek**. 2007. Evaluating effects of riparian forest harvest on instream habitat and fish assemblages in northern Minnesota. 40th Annual Meeting of the Minnesota Chapter of the American Fisheries Society, St. Cloud, Minnesota.

Bruggeman, J., **D.E. Andersen**, and J. Woodford. 2007. Northern goshawk monitoring in the western Great Lakes region. 68th Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Bruskotter, J.T., **D.C. Fulton**, and **B. Vondracek**. 2007. Land conservation in practice: attitudinal correlates of southeast Minnesota landowner's conservation behavior. 4th Annual Meeting of the Minnesota Chapter of the Society for Conservation Biology, Sandstone, Minnesota.

Bruskotter, J.T. and **D.C. Fulton**. 2007. Assessing accuracy of angler information collected at point of sale. 68th Midwest Fish and Wildlife Conference, Madison, Wisconsin.

French, W.E., **B. Vondracek**, and H.L. Schramm, Jr. 2007. Mortality of walleye captured in catch and release tournaments. 40th Annual Meeting of the Minnesota Chapter of the American Fisheries Society, St. Cloud, Minnesota.

Fulton, D.C., S.A. Schroeder, J.S. Lawrence, and S.D. Cordts. 2007. Changes in waterfowl hunter participation, motivations and satisfaction over time. Minnesota Waterfowl Association Annual Meeting, Bloomington, Minnesota.

Huff, D.D., L.M. Miller and **B. Vondracek**. 2007. Review of animal reintroductions: applying ecological and genetic exchangeability and anthropogenic disturbance to the decision making process. 68th Midwest Fish and Wildlife Conference, Madison, Wisconsin. (POSTER)

Huff, D.D., L.M. Miller, and **B. Vondracek**. 2007. Proposed research: hybridization and relative fitness of reintroduced slimy sculpin populations in southeastern Minnesota streams. 40th Annual Meeting of the Minnesota Chapter of the American Fisheries Society, St. Cloud, Minnesota. (POSTER)

Lawrence, J.S., S.A. Schroeder, **D.C. Fulton**, and S. D. Cordts. 2007. Waterfowl hunters and resource agency employees: do they view waterfowl hunting the same? 68th Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Loomis, J., **B. Vondracek**, and H.L. Schramm, Jr. 2007. Walleye mortality associated with livewell operating procedures for simulated live-release angling tournaments. 40th Annual Meeting of the Minnesota Chapter of the American Fisheries Society, St. Cloud, Minnesota.

Reiter, M.E. and **D.E. Andersen**. 2007. Cycles and synchrony in historical trends of collared lemming abundance near Cape Churchill, Manitoba, Canada. 14th Annual Meeting of The Wildlife Society, Tucson, Arizona.

Schramm, H.L., Jr., W.W.E. French, and **B. Vondracek**. 2007. Mortality of walleye caught in live-release tournaments: a regional perspective. 2007 Iowa Department of Natural Resources Fisheries Bureau statewide meeting, Des Moines, Iowa.

Schramm, H.L., W.W.E. French, and **B. Vondracek**. 2007. Mortality of walleye in live-release tournaments. 4th International Reservoir Symposium, Atlanta, Georgia.

Schroeder, S.A. and **D.C. Fulton**. 2007. Political action and philanthropy for lake protection: do outdoor recreation participation and place attachment predict intention to conserve Minnesota lakes? 13th International Symposium on Society and Resource Management. Snowbird, Utah.

Schroeder, S.A., **D.C. Fulton**, J.S. Lawrence, and S.D. Cordts. 2007. The great hunter migration: why some Minnesota residents hunt waterfowl exclusively in North Dakota while others hunt at home. 68th Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Streby, H.M. and **D.E. Andersen**. 2007. Habitat use of post-fledging forest-nesting songbirds in northern hardwood-coniferous forests of northern Minnesota. Annual Meeting of the Minnesota Chapter of The Wildlife Society, Alexandria, Minnesota.

Streby, H.M. and **D.E. Andersen**. 2007. Post-fledging habitat use by forest nesting songbirds on the Chippewa National Forest. Chippewa National Forest Ecologist and Managers Meeting. Cass Lake, Minnesota.

Streby, H.M. and **D.E. Andersen**. 2007. Post-fledging habitat use by ovenbirds on the Chippewa National Forest, Minnesota. 68th Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Vondracek, B. 2007. The Farm Bill and fisheries habitat. 2007 Biennial Department of Natural Resources Section of Fisheries Training Session, Brainerd, Minnesota.

2008

Bronk, R. and **B. Vondracek**. 2008. Effects of macroinvertebrate availability, diet, and habitat on reintroduction success of slimy sculpin in southeast Minnesota. Annual Meeting of the North American Benthological Society, Salt Lake City, Utah.

Bronk, B., D.D. Huff, and **B. Vondracek**. 2008. Effects of macroinvertebrate availability, diet, and habitat on reintroduction success of slimy sculpin in southeast Minnesota. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Alexandria, Minnesota.

Chizinski, C.J., D. Auke, N. Hemstad, E. Merten, **B. Vondracek**, R.M. Newman, and C. Blinn. 2008. Effects of riparian forest harvesting on the aquatic ecosystem in northern Minnesota streams. 93rd Annual Meeting of the Ecological Society of America, Milwaukee, Wisconsin.

Dolph, C. and **B. Vondracek**. 2008. Use of simulated data to understand the variability of biological indicators in streams. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Alexandria, Minnesota.

Huff, D.D., L.M. Miller and **B. Vondracek**. 2008. Native fish reintroductions: applying ecological and genetic exchangeability and anthropogenic disturbance to the decision making process. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Alexandria, Minnesota.

Loomis, J., **B. Vondracek**, and H.L. Schramm. 2008. Walleye mortality and blood chemistry associated with livewell operation during simulated live-release tournaments. Annual Meeting of the Minnesota Chapter of the American Fisheries Society, Alexandria, Minnesota.

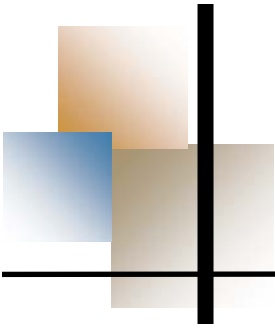
Merten, E., N. Hemstad, R. Newman, **B. Vondracek**, L. Johnson, R. Kolka, E.S. Verry, and S. Eggert. 2008. Forest harvest effects on a northern Minnesota stream system: a study spanning 11 years. 93rd Annual Meeting of the Ecological Society of America, Milwaukee, Wisconsin.

Streby, H.M and **D.E. Andersen**. 2008. Edge effects and ovenbirds in northern hardwood forests: are clearcuts really all that bad? 15th Annual Meeting of The Wildlife Society, Miami, Florida.

Streby, H.M. and **D.E. Andersen**. 2008. Survival and habitat use of fledgling forest nesting songbirds in a managed forest landscape. U.S. Fish and Wildlife Service Regional Office. Minneapolis, Minnesota.

Streby, H.M., Sean M. Peterson, and **D.E. Andersen**. 2008. Minnesota Coop Unit forest bird project. Chippewa National Forest Naturalist Series. Marcell, Minnesota.

Reiter, M.E. and **D.E. Andersen**. 2008. Factors influencing nest density of Eastern Prairie Population Canada geese in northern Manitoba: potential impacts of lesser snow goose-mediated habitat alteration. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio.



Unit News

Sometimes, no news is good news! Over the past two years, things at the Minnesota Cooperative Fish and Wildlife Research Unit have been pretty stable. The University of Minnesota completed the merger of the former Colleges of Natural Resources (where the Department of Fisheries, Wildlife, and Conservation Biology was situated) and Agricultural, Food, and Environmental Sciences into a new College of Food, Agricultural, and Natural Resource Sciences. Retirements in the Minnesota Department of Natural Resources and the U.S. Fish and Wildlife Service resulted in new representatives on our Coordinating Committee, but our relationships with our partners remain strong.

The Cooperative Research Units program within the U.S. Geological Survey has managed to continue operating efficiently, albeit with fewer resources than at other times in the past. Hattie Saloka continued to keep everything running smoothly in the Coop Unit office. We accomplished a lot in 2007 and 2008, but compared with events that occurred in some previous biennia, this one seems relatively uneventful.

Bruce Vondracek (Assistant Leader-Fisheries) continues to be involved in running the fisheries graduate program, teaching, working with cooperators, working with students and research, and still manages to find some time to fish now and then. David Fulton (Assistant Leader-Wildlife) continues to work closely with the Minnesota

Department of Natural Resources to address information needs, and Sue Schroeder continues to assist him in these efforts in her position as a Research Fellow. David Andersen (Leader) spent several weeks in both 2007 and 2008 in northern Manitoba, continuing a long-term collaboration centered on Eastern Prairie Population Canada geese.



A few things have changed at the Minnesota Cooperative Fish and Wildlife Research Unit in the past couple of years. Several students have finished their degree programs and moved on to new places and new things and students new to the Coop Unit have begun working on new and interesting projects with Coop Unit scientists. A

few faces on our Coordinating Committee have changed (for example, Jack Wingate retired and Kevin Whalen attended our 2008 meeting), and the administrative support structure and accounting systems at the University of Minnesota have changed. For the most part, however, none of these changes has been major, or had major impacts on the functioning of the Coop Unit. So, although there weren't many major happenings to report on at the Coop Unit, 2007 and 2008 were productive years for us, that seemed to have gone by quickly.

Once again, thanks to all of the students, staff, cooperators, supporters, and other interested parties who have supported and continue to support the Minnesota Cooperative Fish and Wildlife Research Unit.