2009 Coordinating Committee Meeting

14 October 2009

SUMMARY OF ACTIVITIES (2008 AND 2009 CALENDAR YEARS)

PUBLICATIONS

Peer reviewed

- Anderson, D.H. and **Fulton, D.C.** 2008. Experience preferences as mediators of the wildlife related recreation participation-place attachment relationship. *Human Dimensions of Wildlife* 13:73-88.
- Au, L., **D.E. Andersen**, and M. Davis. 2008. Patterns in bird community structure related to restoration of Minnesota dry oak savannas. *Natural Areas Journal* 28:330-341.
- Bruskotter, J.T. and **Fulton**, **D.C.** 2008. Minnesota anglers' fisheries-related value orientations and their stewardship of fish resources. *Human Dimensions of Wildlife* 13:207-221.
- Frost Nerbonne, J.A., B. Ward, A. Ollila, M. Williams, and **B. Vondracek**. 2008. Volunteer sampling bias using multihabitat sampling for macroinvertebrates. *Journal of the North American Benthological Society* 27:640–646.
- Magner, J.A., **B. Vondracek**, and K.N. Brooks. 2008. Channel stability, habitat and water quality in south-eastern Minnesota (USA) streams: assessing managed grazing practices. *Environmental Management* 42:377–390.
- Muenier, J., R. Song, R.S. Lutz, D.E. Andersen, K.E. Doherty, J.G. Bruggink, and E. Oppelt. 2008. Proximate cues for a short-distance migratory species: an application of survival analysis. *Journal of Wildlife Management* 72:440-448.
- Perry, E.F., D.E. Andersen, and J.C. Manolis. 2008. Reduced predation at interior nests in clustered all-purpose territories of least flycatcher (*Empidonax minimus*). Auk 125:643-650.
- Reiter, M.E. and **D.E. Andersen**. 2008. Trends in abundance of collared lemmings near Cape Churchill, Manitoba. *Journal of Mammalogy* 89:138-144.
- 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.
- 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.

Book chapter and symposium proceedings

- Boody, G., C. van Schaik, P. Gowda, J. Westra, P. Welle, B. Vondracek and D. Johnson. 2009. Multifunctional grass farming: science and policy considerations. *In* A. J. Franzluebbers (editor). Farming with grass: achieving sustainable mixed agricultural landscapes. ebook, <u>http://www.swcs.org/en/publications/farming_with_grass/</u>, Soil and Water Conservation Society, Ankeny, Iowa.
- **Fulton, D.C.** and M.J. Manfredo. 2008. The biological context of wildlife values: are there etchings on the slate? Pages 73-89 *in* Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues. Springer, New York, New York.
- 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 (editor) Outcomes-focused management of recreation resources and programs. Venture Publishers: State College, Pennsylvania.
- Schramm, H.L., Jr., W.E. French, and B. Vondracek. 2009. Mortality of walleyes and saugers caught in live-release tournaments. Pages 625-636 in M.S. Allen, S. Sammons, and J.H. Maceina (editors). Balancing fisheries management and water uses for impounded river systems. American Fisheries Society, Symposium 62, Bethesda, Maryland.
- 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 77-95 *in* R. Eades, W. Neal, T. Lang, K. Hunt, and P. Pajak (editors). Urban and community fisheries programs: development, management, and evaluation. American Fisheries Society, Symposium 67; Bethesda, Maryland.

MANUSCRIPTS (AND BOOK REVIEWS) IN PRESS, IN REVIEW, OR IN REVISION

- 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*.
- Asmus, B., J. Magner, **B. Vondracek**, and J. Perry. *In Press*. Physical integrity: the missing link in biological monitoring and TMDLs. *Environmental Monitoring and Assessment*.
- Atuke, D.M., R.M. Newman, and **B. Vondracek**. *In Review*. Suitability of forestry BMPs for riparian and aquatic resource protection in Kenya: exploring the need, application and effective use. *International Journal of Water Resources Development*.
- Atuke, D.M., R.M. Newman, and **B. Vondracek**. *In Revision*. Effects of riparian forest harvest on instream habitat and fish assemblages in eight northern Minnesota streams. *Canadian Journal of Fisheries and Aquatic Sciences*.

- 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.
- Bruggeman, J.E., **D.E. Andersen**, and J.E. Woodford. *In Review*. Bioregional monitoring for northern goshawks in the western Great Lakes region. *Journal of Wildlife Management*.
- Bruskotter, J.T., **D.C. Fulton**, M. Payton, **B. Vondracek**. *In Revision*. Land conservation in practice: predicting the use of government-sponsored land conservation programs. *Environmental Management*.
- Chizinski, C.J., A. Peterson, J. Hanowski, C. Blinn, **B. Vondracek**, and G. Niemi. *In Review*. Breeding bird response to partially harvested riparian management zones in northern Minnesota. *Forest Ecology and Management*.
- Doherty, K.E., **D.E. Andersen**, J. Meunier, E. Oppelt, R.S. Lutz, and J.G. Bruggink. *In Revision*. Past patch quality as a predictor of future habitat selection: relating movement behavior of American woodcock to environmental factors. *Condor*.
- Dolph C.L., A. Sheshukov, C.J. Chizinski, **B. Vondracek**, and B. Wilson. *In Press*. The Index of Biological Integrity and the bootstrap revisited: an example from Minnesota streams. *Ecological Indicators*.
- Eells, L., R. Vondracek, and B. Vondracek. In Review. Hunting or fishing for information. In Scientific communication for natural resource professionals. C. Jennings, T. E. Lauer, and B. Vondracek (editors). American Fisheries Society, Bethesda, Maryland.
- Fieberg, J., L. Cornicelli, **D.C. Fulton**, and M.D. Grund. *In Revision*. Design and analysis of simple choice surveys for natural resource management. *Journal of Wildlife Management*.
- Gresswell, R. and **B. Vondracek**. *In Press*. Coldwater streams. *In* Inland fisheries management in North America (3rd edition). W. A. Hubert and M. C. Quist (editors). American Fisheries Society, Bethesda, Maryland.
- Henneman, C. and **D.E. Andersen**. In Press. Habitat associations of red-shouldered hawks in central Minnesota landscapes. Journal of Wildlife Management.
- Huff, D.D., L.M. Miller, and **B. Vondracek**. *In Review*. Patterns of ancestry and genetic diversity in reintroduced populations of the slimy sculpin: implications for conservation. *Biological Conservation*.
- Loomis, J.H, **B. Vondracek**, and H.L. Schramm, Jr. *In Review*. The survival and blood chemistry response of walleye to a simulated live-release fishing tournament. *Transactions of the American Fisheries Society*.
- Merten, E., J. Finlay, L. Johnson, R. Newman, H. Stefan, and **B. Vondracek**. *In Review*. Factors influencing wood mobilization in Minnesota streams. *Ecological Modeling*.
- Merten, E.C., N.A. Hemstad, S.L. Eggert, L.B. Johnson, R.K. Kolka, R.M. Newman, and **B. Vondracek**. *In Press.* Relations between fish abundances, summer temperatures, and

forest harvest in a northern Minnesota stream system from 1997 to 2007. *Ecology of Freshwater Fish*.

- Merten, E.C., N.A. Hemstad, R.K. Kolka, R.M. Newman, E.S. Verry, and **B. Vondracek**. *In Review*. Relationship of sediment dynamics in moraine, headwater streams in northern Minnesota to forest harvest. *Journal of the American Water Resources Association*.
- 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*). Fall survival of American woodcock in the western Great Lakes region. *Proceedings of the 10th American Woodcock Symposium*.
- Reiter, M.E. and **D.E. Andersen**. *In Review*. Examining the bird-lemming hypothesis at Cape Churchill, Manitoba. *Condor*.
- 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*.
- Schramm, H.L., Jr., **B. Vondracek**, W.E. French, and P.D. Gerard. *In Press*. Factors associated with mortality of walleye and sauger caught in live-release tournaments. *North American Journal of Fisheries Management*.
- Schroeder, S.A. and **D.C. Fulton**. *In Press*. Land of 10,000 lakes and 2.3 million anglers: conflict, crowding, and coping among Minnesota anglers. *Journal of Leisure Research*.
- Wan, H., C.J. Chizinski, C.L. Dolph, **B. Vondracek** and B. Wilson. *In Review*. The impact of rare taxa on measures of fish index of biotic integrity. *Ecological Indicators*.

MANUSCRIPTS IN PREPARATION

- Atuke, D.M., R.M. Newman, **B. Vondracek**, and C.R. Blinn. *In Preparation*. Analysis of the factors that influence knowledge of, compliance with, and implementation of forest policies protecting riparian and aquatic resources in Kenya. *Society and Natural Resources*.
- Atuke, D.M., R.M. Newman, **B. Vondracek**, and C.R. Blinn. *In Preparation*. Application and effectiveness of best management practices for forest harvesting to protect water quality in south-west Mau, Kenya. *Journal of Tropical Ecology*.
- Atuke, D.M., R.M. Newman, and **B. Vondracek**. *In Preparation*. Influence of riparian forest harvest on water quality and macroinvertebrate communities in northern Minnesota streams. *Journal of the North American Benthological Society*.
- Beck, M.W., L.K. Hatch, **B. Vondracek**, and R.D. Valley. *In Preparation*. Development of a macrophyte-based Index of Biotic Integrity for Minnesota lakes. *Ecological Indicators*.

- Blann, K.L. and **B. Vondracek**. *In Preparation*. Fish distribution in relation to spatial scale: lessons from southeastern Minnesota. *Transactions of the American Fisheries Society*.
- Cornicelli, L., **D.C. Fulton** and M. Grund. *In Preparation*. Minnesota deer hunters' preferences for alternative regulations. *Journal of Wildlife Management*.
- Cornicelli, L.J. Fieberg, and **D.C. Fulton**. *In Preparation*. Development of a simplified choice method to identify hunter preferences for regulatory action. *Journal of Wildlife Management*.
- Doherty, K. and **D.E. Andersen**. *In Preparation*. Kernel home range estimation using conventional telemetry data from birds: the example of American woodcock. *Journal of Field Ornithology*.
- Dolph, C.L., D.D. Huff, C.J. Chizinski, and **B. Vondracek**. *In Preparation*. Development of a multivariate predictive model based on multiple taxonomic groups for the bioassessment of Minnesota streams. *Ecological Indicators*.
- **Fulton, D.C.,** S. Schroeder, J. Lawrence. *In Preparation*. A study of motivational and preferences changes in a panel of Minnesota waterfowl hunters 2000-2005. *Human Dimensions of Wildlife*.
- **Fulton, D.C.** and M.J. Manfredo. *In Preparation.* The effects of regulatory restriction on hunter participation and satisfaction. *Human Dimensions of Wildlife.*
- Manolis, J.C., F.J. Cuthbert, and **D.E. Andersen**. *In Preparation*. Predation of artificial nests in relation to clearcut edges in an extensively forested landscape. *Auk*.
- Merten, E., J. Finlay, L. Johnson, R. Newman, H. Stefan, and **B. Vondracek**. *In Preparation*. Entrapment of wood in Minnesota streams determined by a length ratio and weight. *Journal of Hydrological Processes*.
- Nagle, F., T. Fuitak, K.C. Nelson, and **B. Vondracek**. *In Preparation*. Empowering conservation decisions: establishing authenticity in arenas for environmental conflict management. *Negotiation and Conflict Management Research Journal*.
- Oppelt, E., J.G. Bruggink, K.E. Doherty, **D.E. Andersen**, J. Meunier, and R.S. Lutz. *In Preparation.* Fall survival of American woodcock in the western Great Lakes region. *Journal of Wildlife Management.*
- Reiter, M.E. and **D.E. Andersen**. *In Preparation*. Species interactions and habitat influence the range-wide distribution of breeding Canada geese in northern Manitoba. *Journal of Wildlife Management*.
- Reiter, M.E. and **D.E. Andersen**. *In Preparation*. Impacts of lesser snow goose-mediated habitat alteration on Canada goose nest density. *Condor*.
- Reiter, M.E. and **D.E. Andersen**. *In Preparation*. Evidence of territoriality and inter-specific interactions from point-pattern analysis of subarctic-nesting geese. *Auk*.

- Salk, R., **D.C. Fulton** and J. Vlaming. *In Preparation*. Developing a fishing opportunity spectrum: an example of Minnesota trout anglers. *North American Journal of Fisheries Management*.
- Schroeder, S.A. and **D.C. Fulton**. *In Preparation*. Do outdoor recreation and place attachment relate to Minnesota lake home owners' attitudes about protecting their lake? *Society and Natural Resources*.
- Schroeder, S. A. and **D.C. Fulton**. *In Preparation*. Place attachment as an affective precursor in norm activation theory: predicting personal norms and behavioral intentions for protection and removal of native aquatic plants by Minnesota lakeshore property owners. *Human Dimensions of Wildlife*.
- Schroeder, S.A. and **D.C. Fulton**. *In Preparation*. Political action and philanthropy for lake protection: do outdoor recreation participation and place attachment predict intention to conserve Minnesota lakes? *Society and Natural Resources*.
- Vondracek, B., H.L. Schramm, Jr., W.E. French, and C.J. Chizinski. *In Preparation*. Factors associated with initial mortality of walleye and sauger caught in live-release tournaments. *North American Journal of Fisheries Management*.
- Vondracek, B., H.L. Schramm, Jr., D.C. Fulton, J.H. Loomis, J.T. Bruskotter, W.E. French, C.J. Chizinski, and P.D. Gerard. *In Preparation*. Survival of walleye caught in live-release tournaments and assessment of acceptable levels for anglers. *North American Journal of Fisheries Management*.
- Vondracek, B., J. Stucker, and F. Cuthbert. *In Preparation*. Macroinvertebrate communities and riparian physical habitats of southeastern Minnesota. *Oecologia*.
- Williams, M.A. and **B. Vondracek**. *In Preparation*. Spring distributions in Winona County, Minnesota, USA. *Journal of Environmental Management*.

TECHNICAL REPORTS

Final reports

- Mannan, R.N. 2008. An assessment of survey methodology, calling activity, and habitat associations of wood frogs (*Rana sylvatica*) and boreal chorus frogs (*Pseudacris maculata*) in a tundra biome. M.S. thesis, Texas Tech University, Lubbock, Texas. Final Report to Wapusk National Park of Canada, Churchill, Manitoba, Canada.
- Vondracek, B., R.M. Newman, and E.C. Merten. 2009. Factors influencing instream wood transport in northern Minnesota streams. Final Report to the Minnesota Department of Natural Resources.
- Vondracek, B., B.N. Wilson, C.L. Dolph, C.J. Chizinski, H. Wan, and A. Sheshukov. 2009. Empowering water quality decisions: reducing uncertainty and bounding variability of stream ecosystem indicators. Final Report to the Minnesota Department of Natural Resources.

Wilson, B., B. Vondracek, J. Nieber, and J. Perry. 2008. A stream classification for TMDL assessment using a dimensionless, reference reach approach. Final Report to the U.S. Environment Protection Agency for EPA Agreement Number: RD-83136601-1.

Annual Reports

- Andersen, D.E., et al. 2008. Production of EPP Canada geese near Cape Churchill in 2007. Annual Report to the Mississippi Flyway Council. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Andersen, D.E., et al. 2009. Production of EPP Canada geese near Cape Churchill in 2008. Annual Report to the Mississippi Flyway Council. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Andersen, D.E., M. Gillespie, and G. Ball. 2008. Mississippi Flyway Eastern Prairie Population (EPP) Canada goose monitoring. Annual Report to Wapusk National Park of Canada, Churchill, Manitoba, Canada.
- Andersen, D.E., M. Gillespie, and G. Ball. 2009. Mississippi Flyway Eastern Prairie Population (EPP) Canada goose monitoring. Annual Report to Wapusk National Park of Canada, Churchill, Manitoba, Canada.
- Bergh, S.M. and D.E. Andersen. 2008. Factors affecting detection of American woodcock on Singing-ground Surveys: 2008 summary report. Annual Report to U.S. Fish and Wildlife Service. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Bruggeman, J.E., **D.E. Andersen**, and J.E. Woodford. 2009. Bioregional monitoring for northern goshawks in the western Great Lakes Bioregion. Final Rport to U.S. Forest Service. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Mannan, R.N. and **D.E. Andersen**. 2008. Distribution and habitat relationships of frogs in coastal tundra at Cape Churchill. Annual Report to Wapusk National Park of Canada, Churchill, Manitoba, Canada.
- Nelson, M.R., **D.E. Andersen**, and J.R. Kelly. 2008. 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: 2007 summary report. Annual Report to the U.S. Fish and Wildlife Service, Webless Migratory Game Bird Research Program. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Nelson, M.R., **D.E. Andersen**, and J.R. Kelly. 2009. 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: 2008 summary report. Annual Report to the U.S. Fish and Wildlife Service, Webless Migratory Game Bird Research Program. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Reiter, M.E. and **D.E. Andersen**. 2008. Sympatric nesting Eastern Prairie Population (EPP) Canada geese and lesser snow geese on the Hudson Bay Lowlands: nest depredation and

spatial distribution. Annual Report to the Mississippi Flyway Council. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.

- Reiter, M.E. and **D.E. Andersen**. 2009. Sympatric nesting Eastern Prairie Population (EPP) Canada geese and lesser snow geese on the Hudson Bay Lowlands: nest depredation and spatial distribution. Annual Report to the Mississippi Flyway Council. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Reiter, M.E. and **D.E. Andersen**. 2008. Interactions between nesting Canada geese and lesser snow geese. Annual Report to Wapusk National Park of Canada, Churchill, Manitoba, Canada.
- Streby, H.M. and D.E. Andersen. 2008. Habitat use of post-fledging forest-nesting songbirds in northern hardwood-coniferous forests in northern Minnesota: 2007 summary report.
 Annual Report to the U.S. Geological Survey (SSP) and the U.S. Fish and Wildlife Service. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Streby, H.M. and D.E. Andersen. 2009. Habitat use of post-fledging forest-nesting songbirds in northern hardwood-coniferous forests in northern Minnesota: 2008 summary report.
 Annual Report to the U.S. Geological Survey (SSP) and the U.S. Fish and Wildlife Service. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.

GRANT PROPOSALS

Funded

David E. Andersen

Bioregional monitoring for northern goshawks in the western Great Lakes. Funding: U.S. Forest Service - \$117,452; Wisconsin Department of Natural Resources - \$3,000.

American woodcock singing ground surveys in the western Great Lakes region: assessment of trends in woodcock counts, forest cover types along survey routes, and landcover type composition.

Funding: U.S. Fish and Wildlife Service (Webless Migratory Game Bird Research Program) - \$88,063; Minnesota Department of Natural Resources - \$19,500; Wisconsin Department of Natural Resources - \$9,000; Woodcock Minnesota - \$2,500; Minnesota Cooperative Fish and Wildlife Research Unit - \$5,000.

Factors affecting detection of American woodcock on Singing-ground Surveys. Funding: U.S. Fish and Wildlife Service - \$155,000.

The use of satellite telemetry to evaluate migration chronology and breeding, migratory, and wintering distribution of Eastern Population sandhill cranes. Funding: U.S. Fish and Wildlife Service - \$324,316

Effects of imperfect detectability on inferences from monitoring. Funding: U.S. Geological Survey (Northern Prairie Wildlife Research Center) – \$212,688

David C. Fulton

Encouraging lake shore habitat restoration. Funding: Minnesota Department of Natural Resources - \$35,000

Understanding human behaviors concerning lake shoreline management. Funding: Minnesota Department of Natural Resources - \$95,000

Understanding support for non-toxic shot regulations. Funding: Minnesota Department of Natural Resources - \$18,000

Bruce Vondracek

Scaleable indices of watershed health. Funding: Minnesota Department of Natural Resources - \$110,000

Quality assessments and restoration potential of groundwater fed streams within the watersheds of Minnesota. Funding: U.S. Fish and Wildlife Service (Quick Response Program) - \$10,000

OUTREACH AND TECHNICAL ACTIVITIES

David E. Andersen

Assisted in operational data collection for Eastern Prairie Population Canada Goose Committee of the Technical Section of the Mississippi Flyway Council at Cape Churchill, Manitoba, Canada

Member, Eastern Prairie Population Canada Goose Committee of the Technical Section of the Mississippi Flyway Council.

Popular articles for The Splash (Woodcock Minnesota) on woodcock research in Minnesota.

Posters for Woodcock Minnesota fundraiser describing woodcock research and management activities in Minnesota.

Woodcock Minnesota and Finlayson-Geise Sportsman's Club private land woodcock initiative, Pine County, Minnesota.

American Woodcock Information Needs Assessment Workshop. U.S. Fish and Wildlife Service. Bloomington, Minnesota.

David C. Fulton

Member of the Human Dimensions review team to develop models for integrating social science on hunter recruitment and retention into Adaptive Harvest Management for waterfowl in North America.

Bruce Vondracek

- Invited to a special one-day workshop on "Groundwater Sustainability: Towards a Common Understanding". Sponsored by the University of Minnesota Water Resources Center and the Freshwater Society in cooperation with Department of Natural Resources, Minnesota Geological Survey, Met Council, Minnesota Department of Health, Environmental Quality Board, USGS, and the Minnesota Groundwater Association.
- Invited to be a member of a Science Advisory Panel coordinated by the Water Resources Center at the University of Minnesota on behalf of the Minnesota Pollution Control Agency. The Panel serves as a technical consultant for the Stakeholder Advisory Committee to resolve technical issues related to the State of Minnesota's Lake Pepin TMDL and the Minnesota River TMDL. The Panel first convened in February 2005.
- Invited participant, Impaired Waters Symposium that targeted a group of researchers, implementers, NGO, and decision-makers, including key Minnesota Legislature Committee chairs, to develop a research agenda to identify needs for the Clean Water Council, State Agencies, Legislature, and Researchers. The symposium was sponsored by the Minnesota Department of Agriculture, Board of Water and Soil Resources, Minnesota Department of Agriculture, Minnesota Department of Planning (Environmental Quality Board), Minnesota Pollution Control Agency and University of Minnesota Water Resources Center. February 2008.
- Invited member of Phase 2 of the statewide comprehensive plan for the conservation and preservation (CPCP) of Minnesota's environment and natural resources. The goal of the plan is to provide both short-term and long-term guidance on the conservation and preservation of Minnesota's environment and natural resources. The plan will enable a wide variety of public and private decision makers to work together to achieve common overall environment and natural resource goals and ensure their sustainability. The plan will also enable the Legislative Citizen's Committee for Minnesota Resources to be effective in strategically recommending funds to future applicants to help implement the shared vision of the plan to conserve, preserve, restore, and enhance Minnesota's environment and natural resources. This plan will also be used to help inform funding recommendations for the Environment and Natural Resources Trust Fund.
- Technical Advisory Committee, member, Browns Creek Biological TMDL for the Browns Creek Watershed District and the Washington Conservation District. The Technical Advisory Committee first convened in April 2007.

PRESENTATIONS

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

- 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.
- Chizinski, C.J., D. Atuke, 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.
- Chizinski, C.J., C.R. Blinn, and **B. Vondracek**. 2009. Response of riparian fish and invertebrate assemblages to timber harvesting in northern Minnesota streams. Joint meeting of the Minnesota, Ontario, and Wisconsin Chapters of the American Fisheries Society, Duluth, Minnesota.
- Chizinski, C.J., H. Wan, C.L. Dolph, **B. Vondracek**, and B. Wilson. 2009. The impact of rare taxa on measures of fish Index of Biotic Integrity (IBI) in Minnesota. 139th Annual Meeting of the American Fisheries Society, Nashville, Tennessee.
- Dolph, C.L., D.D. Huff, C.J. Chizinski, B. Vondracek. 2009. Linking changes in macroinvertebrate community composition to sources of water quality impairment in Minnesota streams. 57th Annual Meeting of the North American Benthological Society, Grand Rapids, Michigan. (POSTER)
- Dolph, C.L. 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.
- Dolph, C.L. and **B. Vondracek**. 2008. Development of a multivariate predictive model for assessing the quality of streams in Minnesota. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio.
- **Fulton, D.C.** 2008. *(Invited).* Boomers, Xers and Y's in the workforce: what they mean for the management of fish and wildlife. Western Association of Fish and Wildlife Agencies Annual Meeting, Rapid City, South Dakota.
- **Fulton, D.C.** 2009. *(Invited)*. Human-wildlife conflict: beyond biology. Annual Meeting of Society of Conservation Biology, Beijing, China.
- Fulton, D.C. and R. Dodd. 2008. Managing muskie in Minnesota. Annual Meeting of the American Fisheries Society, Ottawa, Canada.
- **Fulton, D.C.**, A. Raedeke, J. Enck, D. Humburg, and K. Hunt. 2008. Development of a waterfowl hunter recruitment and retention strategy. Pathways to success: integrating human dimensions into fish and wildlife management, Estes Park, Colorado.
- **Fulton, D.C.,** S.A. Schroeder, E. Rudberg, W. Penning, and K. DonCarlos. 2008. Influence of persuasive messages on support for restricting lead shot in Minnesota. Pathways to success: integrating human dimensions into fish and wildlife management, Estes Park, Colorado.

- Gillespie, M. and **D.E. Andersen**. 2008. *(Invited)*. Canada geese in the Hudson Bay Lowlandshow research compliments management actions. Wapusk National Park Research and Monitoring Conference, Winnipeg, Manitoba, Canada.
- 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. (POSTER)
- Huff, D.D., L.M. Miller, and **B. Vondracek**. 2009. Native fish reintroductions: why is there variation in the persistence among ancestral groups of slimy sculpins? 23rd Annual Meeting of the Society of Conservation Biology, Beijing, China.
- Loomis, J.H., **B. Vondracek**, and H.L. Schramm, Jr. 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. (BEST STUDENT PRESENTATION)
- Loomis, J.H., **B. Vondracek**, and H.L. Schramm, Jr. 2008. The effects of simulated live-release walleye tournaments on survival and blood chemistry. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio.
- Merten, E.C., J.C. Finlay, H.G. Stefan, R.M. Newman, **B. Vondracek**, L.B. Johnson. 2009. Ecohydraulics of wood transport in streams: empirical models from Minnesota. 57th Annual Meeting of the North American Benthological Society, Grand Rapids, Michigan.
- Merten, E., N. Hemstad, R.M. 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.
- 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 goosemediated habitat alteration. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio.
- Reiter, M.E. and **D.E. Andersen**. 2009. Evaluating the influence of lesser snow goose nests on survival of Canada goose nests in northern Manitoba. Cooper Ornithological Society Annual Meeting, Tucson, Arizona.
- Reiter, M.E. and D.E. Andersen. 2009. Evidence from spatial point-pattern analyses of territoriality and inter-specific interactions among sympatrically nesting Canada geese and lesser snow geese. Cooper Ornithological Society Annual Meeting, Tucson, Arizona. (POSTER)
- Reiter, M.E. and **D.E. Andersen**. 2009. The influence of species interactions and habitat on the range-wide distribution of breeding Canada geese in Manitoba. 15th Annual Meeting of The Wildlife Society, Monterey, California.

- Ruddick, K. and **B. Vondracek**. 2009. Walleye forage in Mille Lacs Lake: a preliminary measure of mayfly abundance. Joint meeting of the Minnesota, Ontario, and Wisconsin Chapters of the American Fisheries Society, Duluth, Minnesota.
- Rudberg, E. and **D.C. Fulton**. 2009. Understanding the conservation of lakeshore buffers in Minnesota, USA. Annual Meeting of the Society of Conservation Biology, Beijing, China.
- Rudberg, E., D.C. Fulton, S.A. Schroeder, W. Penning, and K. DonCarlos. 2008.
 Understanding the beliefs affecting attitudes toward lead shot restrictions in Minnesota.
 Pathways to success: integrating human dimensions into fish and wildlife management, Estes Park, Colorado.
- Rudberg, E., D.C. Fulton, S.A. Schroeder, W. Penning, and K. DonCarlos. 2008. Understanding the beliefs affecting attitudes toward lead shot restrictions in Minnesota 15th Annual Meeting of The Wildlife Society, Miami, Florida.
- Ruddick, K. and **B. Vondracek**. 2009. Walleye forage in Mille Lacs Lake: a preliminary measure of mayfly abundance. Joint meeting of the Minnesota, Ontario, and Wisconsin Chapters of the American Fisheries Society, Duluth, Minnesota.
- Schroeder, S.A., D.C. Fulton, W. Penning, and K. DonCarlos. 2008. Influence of persuasive messages on support for restricting lead shot in Minnesota. 15th Annual Meeting of The Wildlife Society Annual Meeting, Miami, Florida.
- Schramm, H.L., Jr., **B. Vondracek**, and W.E. French. 2008. Mortality of walleye caught in liverelease tournaments. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio.
- 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.
- Vondracek, B., P. Bolstad, I. Chisholm, B. Knudsen, B. Blick, and P. Nacionales. 2009. (*Invited*). Watershed assessment tool: developing an index of watershed health. 57th Annual Meeting of the North American Benthological Society, Grand Rapids, Michigan.
- **Vondracek, B.**, H.L. Schramm, Jr., and **D.C. Fulton**. 2008. Mortality of walleye caught in liverelease tournaments: assessment and determination of acceptable levels by nontournament anglers. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio.

TEACHING

David C. Fulton

Instructor

Fall 2008 ESPM 5245: Sustainable Land Use Planning

Spring 2009 **Human Dimensions of Fisheries**—shortcourse for MNDNR Department of Fisheries, Wildlife, and Conservation Biology

Invited lecture

Spring 2009 **CB 8004: Economic and Social Aspects of Conservation Biology** Conservation Biology Program, University of Minnesota (*1 lecture*)

Bruce Vondracek

Instructor

Fall 2008 **CBIO8201: Seminar- How to Excel in Graduate School** Department of Fisheries, Wildlife, and Conservation Biology

Invited lecture

Fall 2008 **GEO 8601: Introduction to Stream Restoration** Department of Fisheries, Wildlife, and Conservation Biology

STUDENT THESES AND AWARDS (2008/2009)

- Atuke, D.M. 2008. Effectiveness of riparian forestry best management practices to protect stream habitat and biota: lessons from temperate and tropical systems. Ph.D. Dissertation. University of Minnesota. 273pp. (B. Vondracek)
- Bronk, R. 2008. Macroinvertebrate composition, habitat, and diet in relation to the reintroduction of slimy sculpin in southeast Minnesota. M.S. Thesis, University of Minnesota. 44pp. (B. Vondracek)
- Dolph, C.L. 2008. Empowering water quality decisions: reducing uncertainty and bounding variability of stream ecosystem indicators. M.S. Thesis, University of Minnesota. 63pp. (B. Vondracek)
- Loomis, J.H. 2008. The survival and blood chemistry response of walleye *sander vitreus* to a simulated live-release fishing tournament. M.S. Thesis, University of Minnesota. 51pp. (B. Vondracek)
- Mannan, R.N. 2008. An assessment of survey methodology, calling activity, and habitat associations of wood frogs (*Rana sylvatica*) and boreal chorus frogs (*Psuedacris maculate*) in a tundra biome. M.S. Thesis, Texas Tech University, Lubbock, Texas.
 80pp. (D.E. Andersen, C.W. Boal, and G. Perry)
- Raymond, K. 2009. The effects of rotational grazing on stream channels and macroinvertebrate communities. M.S. Thesis, University of Minnesota. 99pp. (B. Vondracek)
- Reiter, M.E. 2009. Sympatric nesting Eastern Prairie Population Canada geese and lesser snow geese on the Hudson Bay Lowlands: nest survival and spatial distribution. Ph.D. Dissertation, University of Minnesota. 170pp. (D.E. Andersen)
- Ruddick, K. 2009. Walleye forage in Mille Lacs Lake: a preliminary measure of mayfly abundance. M.S. Thesis, University of Minnesota. 19 pp. (B. Vondracek)

Schroeder, S.A. 2009. Quality connections: recreation, property ownership, place attachment and conservation of Minnesota lakes. Ph.D. Dissertation, University of Minnesota. 202pp. (D.C. Fulton)

Student Awards

David Huff. 2008-2009. Graduate School Dissertation Fellowship, University of Minnesota.

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

Matthew Reiter. 2009. Student Travel Grant, Cooper Ornithological Society.

Matthew Reiter. 2008-2009. Graduate School Dissertation Fellowship, University of Minnesota.

Henry Streby. 2009-2010. Graduate School Dissertation Fellowship, University of Minnesota.

GRADUATE STUDENTS ADVISED

<u>David E. Andersen</u>

Matthew Nelson – M.S., Natural Resources Science and Management (Wildlife Ecology and Management)

Matthew Reiter – Ph.D., Wildlife Conservation

Henry Streby – Ph.D., Natural Resources Science and Management (Wildlife Ecology and Management)

Stefanie Bergh – M.S., Natural Resources Science and Management (Wildlife Ecology and Management)

R. Nicholas Mannan – M.S., Wildlife Science (Texas Tech University, co-advisor with Gad Perry and Clint Boal)

David C. Fulton

Louis Cornicelli – Ph.D., Natural Resource Science and Management (Environmental Science Policy and Management)

Susan A. Schroeder – Ph.D., Natural Resource Science and Management (Environmental Science Policy and Management)

Ed Rudberg – Ph.D., Natural Resource Science and Management (Environmental Science Policy and Management)

<u>Bruce Vondracek</u>

Dickson Atuke – Ph.D., Conservation Biology (Fisheries and Aquatic Biology track) Bethany Blick – M.S., Water Resources Science

Rebecca Bronk – M.S., Conservation Biology (Fisheries and Aquatic Biology track) Veronica Bullock – M.S., Conservation Biology (Fisheries and Aquatic Biology track) Joel Chirhart – M.S., Water Resources Science

Christine Dolph – Ph.D., Water Resources Science

David Huff – Ph.D., Conservation Biology (Fisheries and Aquatic Biology track) Matt Kocian – M.S., Conservation Biology (Fisheries and Aquatic Biology track) John Loomis – M.S., Water Resources Science Kara Raymond – M.S., Water Resources Science Kathrine Ruddick – M.S., Conservation Biology (Fisheries and Aquatic Biology track)

RESEARCH SUPERVISION

David E. Andersen

Jason Bruggeman, Research Fellow, Department of Fisheries, Wildlife, and Conservation Biology, June 2007-August 2009.

David C. Fulton

Susan A. Schroeder, Research Fellow, Department of Fisheries, Wildlife and Conservation Biology, October 2002-present.

Raintry Salk, Research Fellow, Department of Fisheries, Wildlife and Conservation Biology, July 2008-August 2009.

<u>Bruce Vondracek</u>

Christopher J. Chizinski, Research Fellow, Department of Fisheries, Wildlife and Conservation Biology, October 2007-June 2009.

Haibo Wan, Research Fellow, Department of Fisheries, Wildlife and Conservation Biology, January 2009-June 2009.

UNDERGRADUATE MENTORING

No undergraduate research projects supported in 2008

SERVICE

David E. Andersen

- Member, Eastern Prairie Population Canada Goose Committee of the Technical Section of the Mississippi Flyway Council
- Associate Editor, Proceedings of the 10th American Woodcock Symposium
- Chair, *Awards Nomination Committee*, The Raptor Research Foundation, Inc.
- Steering Committee Member, 2010 Midwest Fish and Wildlife Conference
- American Woodcock Information Needs Assessment Workshop participant, U.S. Fish and Wildlife Service

Manuscript Reviews (2008/2009)

Journal of Raptor Research (3) Journal of Wildlife Management (2) Auk (1) Condor (1) Ecological Applications (2)

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Proposal Reviews

National Science Foundation (1) Great Lakes Fish and Wildlife Restoration Act (1)

David C. Fulton

- President, Minnesota Chapter American Fisheries Society 2008-2009
- Member, Planning Committee, Pathways to Success: Integrating Human Dimensions into Fisheries and Wildlife Management, Conference October 2008.
- Organized symposium for Pathways to Success: Integrating Human Dimensions into Fisheries and Wildlife Management, Conference October 2008
- Organized symposium for North American Section Society for Conservation Biology-10th Biennial Conference on the Colorado Plateau October 2009.
- Associate Editor, Journal of Wildlife Management July 2009-Present

Manuscript Reviews (2008/2009)

Human Dimensions of Wildlife (2) Environmental Management (1) North American Journal of Fisheries Management (1) Journal of Wildlife Management (1) Society and Natural Resources (2)

Bruce Vondracek

- Minnesota Chapter of the Society for Conservation Biology, Vice President
- North American Benthological Society, member, Science and Policy Committee
- Minnesota Chapter of the American Fisheries Society, Scholarship Committee, chair
- Equal Opportunity Section of the American Fisheries Society, Travel Awards Committee, member
- North American Benthological Society, member, Environmental Stewardship Award Committee

Manuscript Reviews

Hydrobiologia (1) North American Journal of Fisheries Management (1 + second review) Journal of the North American Benthological Society (1) Aquatic Ecology (1 + second review) New Zealand Journal of Marine and Freshwater Research (1) Environmental Management (1) Fisheries Management and Ecology (1) North American Journal of Fisheries Management (1) Oikos (1)

Book Chapter

The Water Environment of Cities, Derek Booth and Brian Bledsoe, "Streams and urbanization: a hydro-geomorphic perspective on impacts, mitigation, and restoration".

RESEARCH PROJECTS

Ongoing projects

Alternative deer management strategies in Minnesota state parks 2005-2007

\$108,000. Funding: Minnesota DNR. Principal Investigator: David C. Fulton. Student: Lou Cornicelli (Ph.D., Natural Resource Science and Management, Environmental Science Policy and Management)

Status: Data collection completed for the first 3 seasons; dissertation near completion.

The Minnesota Department of Natural Resources (DNR) is conducting a research project to evaluate the effects of alternative harvest regulations on deer populations. The research is being conducted on selected permit areas and state parks. The regulations being tested include different methods of reducing harvest pressure on males while increasing harvest on females. The DNR is interested in ascertaining the level of acceptance Minnesota deer hunters have towards regulation changes. The purpose of this study is to determine hunter acceptance of several different management options. Specifically, hunters who participated in the special hunts will be asked about their hunting experience, number of animals seen and harvested, and their future intentions towards hunting. Hunters will be asked their attitudes toward all these different strategies and will also be asked how they feel about "party" hunting and if they are willing to change that as well. A total of 3,600 deer hunters were contacted via a mail survey after the conclusion of each fall deer season, including all 1,600 hunters who participated in the early antlerless season using a mail survey with up to 4 total contacts.

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

\$153,347. Funding: U.S. Fish and Wildlife Service (Webless Migratory Game Bird Research Program), Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, Woodcock Minnesota, Minnesota Cooperative Fish and Wildlife Research Unit. Principal Investigator: David E. Andersen. Student: Matt Nelson (M.S., Natural Resources Science and Management – Wildlife Ecology and Management)

Status: Graduate student started data collection and degree program in summer 2007 and is currently working on vegetation classification and delineation along survey routes in Wisconsin and Minnesota. Vegetation mapping verification underway and analyses for thesis begun.

Our overall objective is to better understand the relationship(s) between changes in counts of woodcock (*Scolopax minor*) on Singing-ground Surveys in Minnesota and Wisconsin and forest land cover. We proposed 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.

Bioregional monitoring for northern goshawks in the western Great Lakes \$120,000. Funding: U.S. Forest Service. Principal Investigator: David E. Andersen. Postdoc: Jason Bruggeman. \$3,000 supplement (Wisconsin Department of Natural Resources).

Status: Postdoctoral research associate began data summary and survey protocol development in 2007. Surveys conducted in Minnesota, Wisconsin, and Michigan in 2008. Final report submitted in 2009.

Relatively little is known regarding northern goshawk (*Accipiter gentilis*) abundance, distribution, and population trend in 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. In April 2007, a second stakeholder meeting was convened in northern Wisconsin, and we hired a postdoctoral research associate to begin data assessment and protocol development. A regional survey protocol was developed and provided to cooperators in September 2007. Additional funding was secured in early 2008 to conduct surveys in a portion of the region in spring and summer 2008, and these surveys were completed and resulting data were analyzed and submitted in a final report to project cooperators. Manuscripts in preparation.

Canada goose nesting ecology and habitat use in relation to snow geese at Cape Churchill, Manitoba (continued)

\$250,000. Funding: U.S. Geological Survey-Cooperative Research Units; Mississippi Flyway Council, EPP Canada Goose Committee of the Technical Section; the Wildlife Management Institute. Principal Investigator: David E. Andersen. Student: Matt Reiter (M.S. Wildlife Conservation, Ph.D. Wildlife Conservation).

Status: Project funded and field work began in spring 2004. Field work was extended through 2006 due to a poor reproductive year in 2004, and completed in 2006. M.S. thesis completed in 2006. Ph.D. dissertation completed in 2009.

For over thirty years, the breeding grounds of Eastern Prairie Population (EPP) Canada geese (*Branta Canadensis*) 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 two 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 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. Field work was completed in summer 2006, and data analysis is currently underway. Matt Reiter defended his M.S. thesis in 2006 and his Ph.D. dissertation in 2009.

Ecological and genetic characteristics of slimy sculpin in southeast Minnesota streams \$141,500. Funding: Minnesota Department of Natural Resources. Principal Investigator: Bruce Vondracek. Students: David Huff (Ph.D., Conservation Biology-Fisheries and Aquatic Biology track) and Rebecca Bronk (M.S., Conservation Biology-Fisheries and Aquatic Biology track).

Status: Rebecca Bronk successfully defended 9 July 2008; David Huff's disseration underway.

The Departments of Natural Resources in Iowa, Minnesota, and Wisconsin have implemented "reintroduction" programs for sculpin (*Cottus* spp.) in streams in the Driftless Area Ecoregion of each state. The goal of these projects 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

(<u>http://www.dnr.state.mn.us/areas/fisheries/lanesboro/management.html</u>). This effort will 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. This study will investigate genetic characteristics, survival, prey availability, diet of slimy sculpin, and habitat of donor and recipient streams to determine characteristics of streams most amenable to establishing reintroduced populations and examine ecological exchangeability of sculpin.

Empowering water quality decisions: reducing uncertainty and bounding variability of stream ecosystem indicators

\$278,069. Funding: Minnesota Department of Natural Resources. Principal Investigator: Bruce Vondracek. Student: Christy Dolph (Ph.D., Water Resources Science Program)

Status: Funding began 1 June 2007, interim report submitted March 2008, M.S. Thesis defense April 2008, Ph.D. program began following successful completion of M.S.

Impaired waters and the Total Maximum Daily Load approach are central drivers to water quality management mandated by the Clean Water Act. Water quality and ecological integrity vary across a gradient of human disturbance, but assessing how ecological integrity is affected by human disturbance is complex and requires robust indicators of ecological health. Indicators are used to quantify stream ecosystem integrity; however, uncertainty and variability of those indicators are poorly understood. We will conduct research that will aid Minnesota regulatory agencies in reducing the uncertainty and variability of indicators of stream ecosystem integrity to allow managers to make decisions based on scientific knowledge and be more defensible than current decisions. We have three objectives;

(1) quantify the uncertainty surrounding stream health indicators,

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(2) evaluate the variability of indicators of stream health at different spatial scales, and (3) deconstruct stream health indices to understand which index metrics contribute most to uncertainty and variability at different spatial scales.

Our project will advance management of stream ecological resources by aiding accurate identification of impaired streams, using existing data to understand the history of stream ecosystem integrity, and increasing efficiency with which stream ecosystem integrity is assessed and monitored.

Factors affecting detection of American woodcock on Singing-ground Surveys

\$155,000. Funding: U.S. Fish and Wildlife Service (Migratory Bird Management Office). Principal Investigator: David E. Andersen. Student: Stefanie Bergh (M.S., Natural Resources Science and Management – Wildlife Ecology and Management)

Status: M.S. student selected in spring 2008 and pilot study conducted as part of ongoing work with private landowners in Pine County, Minnesota. Project cooperators meeting convened summer 2008, and first field season (2009) completed.

The Singing-ground Survey is the primary means by which American woodcock (*Scolopax minor*) population trends are monitored in North America. This study is designed to assess factors that influence detection of woodcock on this survey, and to estimate woodcock detectability, and what factors influence detectability. Objectives include:

- (1) Estimate detectability of woodcock using current sampling protocols, using repeated occupancy sampling of a subsample of routes, assessing detectability based on video or telemetry to refine conditions under which woodcock are detectable, double observer assessment of detectability and observer variability, and/or repeating survey routes to assess detection probability through time, and
- (2) Compare woodcock density along Singing-ground Survey routes with randomly located experimental routes in adjacent areas to directly assess whether counts on existing routes adequately represent the larger landscape.

Habitat use of post-fledging forest-nesting songbirds in northern hardwood-coniferous forests in northern Minnesota

\$225,000. U.S. Geological Survey (Science Support Initiative), U.S. Fish and Wildlife Service, U.S. Forest Service. Principal Investigator: David E. Andersen. Student: Henry Streby (Ph.D., Natural Resources Science and Management - Wildlife Ecology and Conservation).

Status: Pilot season (2005), 3 field seasons (2006, 2007, and 2008), and 1 post-study field season (2009) completed.

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 mistnetting, 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. Our objectives include;

(1) determine what species of forest-nesting birds (both adults and fledglings) use a range of habitats from early successional to mature forest during the post-fledging period, and (2) document post-fledging movements and habitat use of selected forest-nesting species in northern hardwood-coniferous forests in northern Minnesota.

In 2006, we monitored post-fledging habitat use of select forest-nesting songbirds with nest searching and radio telemetry, and increased (from 2005) sampling of early successional (clearcut) habitats associated with mature upland forest in the Chippewa National Forest in north-central Minnesota. We established 3 study locations, each containing substantial continuous mature mixed deciduous and conifer forest and clearcut habitats of at least 2 age ranges (1-5 and 6 - 10 years since harvest). In mature forest, we monitored nests of 3 target species: ovenbird (Seiurus aurocapillus), hermit thrush (*Catharus guttatus*), and wood thrush (*Hylocichla mustelina*) nests, and attached radio transmitters to ovenbird, wood thrush, and hermit thrush nestlings. We tracked ovenbird, wood thrush, and hermit thrush fledglings in habitat different from their nesting habitat on approximately 30 - 40% of days tracked. We sampled regenerating aspen (*Populus* spp.) clearcuts of 2 ages twice weekly using mist nets from early June through late August and captured approximately 1,200 - 1,500 birds annually. Hatch-year birds of species associated with nesting in mature forest habitats used different portions of 6-10year-old clearcuts similarly, while in younger clearcuts, they were captured more frequently farther from than near an edge. Lab analyses are currently being conducted on invertebrate samples and all project data have been collected.

Human Dimensions Research Fellow

\$305,000 Funding: Minnesota Department of Natural Resources. Principal Investigator: David C. Fulton. Research Fellow: Susan Schroeder (Ph.D., Natural Resource Science and Management - Environmental Science Policy and Management)

Status: Ongoing; completed study on lead shot use, walleye angling in Minnesota and initiated study of youth hunters.

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

Synthesizing human dimensions information on Minnesota anglers to frame an outcomesbased management system for fishing in Minnesota

\$65,000. Funding: Minnesota Department of Natural Resources. Principal Investigator: David Fulton. Research Fellow: Raintry Salk.

Status: Manuscripts based on existing data are in draft form.

This study synthesizes existing information from Minnesota anglers' preference for activities, experiences and settings to develop an outcomes-based management framework in diverse fishing settings in Minnesota. This information will be used to design a statewide recreational fishery management and monitoring system for evaluating the quality of fishing experiences in Minnesota. This study will focus on analysis of existing data collected during the past 7 years from several angler surveys and the Electronic Licensing System database.

Understanding human behaviors concerning lake shoreline management

\$79,000 Funding: Minnesota Department of Natural Resources. Principal Investigator: David C. Fulton. Student: Ed Rudberg (Ph.D., Natural Resource Science and Management - Environmental Science Policy and Management)

Status: Visual field survey data collected and focus groups completed.

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.

Understanding the importance of weak-tie networks in complex human-environment systems: ecosocial feedback in multifunctional agriculture

\$925,000 (\$120,000 to BCV). Funding: National Science Foundation. Principal Investigator: Bruce Vondracek. Student: Kara Raymond (M.S., Water Resources Science Program)

Status: Kara Raymond successfully defended May 2009. Additional analysis underway.

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 will be 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. Weak-tie networks allow the shared perception of biophysical signals, communication, resource exchange, and collective action by individuals and groups to generate ecological benefits and increase the size and resource base of social networks. Work will occur in New York, Pennsylvania, and Wisconsin, areas that differ in adoption of rotational grazing (RG). The project will examine individual and group behavior and development of social networks, and assess the biophysical effects on terrestrial and aquatic systems at farm and landscape scales. Our portion of the project addresses stream channel characteristics and aquatic macroinvertebrate communities in relation to RG compared with continuously

grazed pastures. The proposed research will help identify both opportunities and barriers affecting development of a sustainable bioeconomy based on multifunctional agriculture.

New projects

Effects of imperfect detectability on inferences from monitoring

\$212,688. Funding: U.S Geological Survey, Northern Prairie Wildlife Research Center. Principal Investigator: David E. Andersen. Co-Principal Investigator: Doug Johnson.

Status: Research Work Order established and Ph.D. graduate student selected.

The value of bird monitoring has come under increasing scrutiny recently due to concerns about imperfect detectability. In particular, because the probability of detecting a bird in the area surveyed often is less than one, counts are indices of abundance, rather than actual estimates of abundance. Often the issue is cast in the equation,

$$E(C) = pN,$$

where E(C) is the expected count of some species made during a survey, N is the true number of that species in the surveyed area at the time of the survey, and p detectability—is the proportion of the true number that is recorded. In recent years many authors have emphasized that variation in C reflects not only variation in N but also variation in p. From that fact, they caution against drawing inferences about population changes from indices.

A variety of methods that attempt to adjust counts for imperfect detectability have been advanced, including distance sampling, multiple-observer sampling, and time-to-detection sampling. Surveys, especially of breeding birds, are constrained by limited time—both during the season and within a day, suitable weather conditions, the number and skills of observers, access to sites, and other factors. Gathering the information necessary to employ these techniques can take additional effort and thereby reduce the number of sites that can be surveyed. Further, the suitability of available adjustment methods in multispecies surveys has been questioned.

A critical question is the extent to which additional effort to employ these techniques is rewarded by improved results. Clearly, estimates of abundance will be affected by adjustments for detectability; what is not known are the consequences on estimates of population trajectories. The objective of the proposed study is to evaluate the influence of imperfect detectability on inferences about population changes. Results from this study could suggest that certain situations involving detectability seriously compromise conclusions drawn from a survey; in that case, appropriate adjustments may be strongly inconsequential errors in survey results; then the detectability adjustments may not be warranted.

The use of satellite telemetry to evaluate migration chronology and breeding, migratory, and wintering distribution of eastern population sandhill cranes \$324,316 Funding: U.S. Fish and Wildlife Service. Principal Investigator: David E. Andersen.

Status: Research Work Order established and preparations for capturing EP sandhill cranes and attaching satellite transmitters fall 2009 are underway.

The Eastern Population (EP) of sandhill cranes (*Grus canadensis*) is rapidly expanding in size and geographic range. The core of their breeding range occurs in Wisconsin, Michigan, and southern Ontario; however, the EP range has expanded in all directions as the population has grown. Little is known about the geographic extent of breeding, migration, and wintering ranges of EP cranes. In addition, little is known about migration chronology including when fall/spring migration commences or how long birds remain at staging areas.

Recently, tracking of cranes via satellite telemetry has successfully been used to better understand the breeding, migration, and wintering distribution as well as migration chronology for the Mid-Continent Population of sandhill cranes. A similar study is necessary for EP cranes not only to improve our understanding of migration ecology, but such information will be critical for evaluating the timing and location of population surveys.

The Mississippi and Atlantic Flyway Councils are currently in the process of developing a management plan for EP sandhill cranes that includes provisions for establishing a hunting season for EP cranes in states within these flyways. It is anticipated that some states will immediately request approval for hunting seasons once the plan is completed. Therefore, having an informed population monitoring survey is important for the future management of EP cranes. The results from this study will assist managers in making decisions about optimal survey timing and locations.

The objectives for this study are to employ satellite transmitters on a sample of EP sandhill cranes to:

(1) delineate the breeding and wintering distribution of EP sandhill cranes;

(2) delineate migratory corridors for EP sandhill cranes; and

(3) determine migration chronology.

Ongoing projects – Cooperating Faculty

Genetic determination of the boundary between northern and California spotted owls \$21,710. Funding: U.S. Fish and Wildlife Service. Principal Investigator: R.J. Gutiérrez.

Status: Agreement supporting this project processed and in place. First year of field (2007) work was not successful due to difficulty in accessing private land where most of the owls are found in this area. The primary private company's head biologist was unable to assist in facilitating access to private land because of a serious illness. We delayed data collection until 2008. In 2008, we were successful in gaining access to private land after 13 months of negotiation with landowners. However, timing of 2008 surveys was delayed because of these negotiations, which resulted in only one field trip to locate and capture birds. In addition, the unusual abundance and extent of wildfires in California during the summer of 2008 had a major impact on our ability to access areas for owl surveys. Thus far, we have captured 5 owls and need at least 10 more if located in the proper places to successfully complete the study.

Understanding the boundaries between populations of northern (*Strix occidentalis caurina*) and California spotted owls (*Strix occidentalis occidentalis*) is important for management and conservation of the species. Morphometric characteristics have proved unreliable in delineating subspecies, yet the subspecies boundaries have been placed

arbitrarily at the Pit River in northern California. We know the boundary between subspecies occurs somewhere in northern California based on previous DNA sampling 50 miles north and 40 miles south of the Pit River. Currently, there are no relevant samples from the area between Mt. Shasta and Mt. Lassen in north-central California that could be used to delineate the precise range boundary of the subspecies. The objectives of this project are to evaluate whether either a discrete boundary or a cline exists in the vicinity of the Pit River in northeastern California based on analysis of DNA and predictions of cline theory. We have captured 5 birds thus far, but will extend this project for another year to allow capture of owls in 2009. We believe the difficulties with access to private land have been overcome through a long process of multiple requests so we are optimistic about the successful completion of this project in 2009.

Long-term monitoring of colonial waterbird populations in the Great Lakes: improving the scientific basis for conservation and management

\$314,853. Funding: U.S. Fish and Wildlife Service. Principal Investigator: Francesca Cuthbert. Student: Lori Krider

Status: Project initiated in 2007. First and second field seasons completed.

The U.S. Fish and Wildlife Service and Canadian Wildlife Service have conducted three coordinated Great Lakes-wide surveys of breeding colonial waterbirds, incorporating a total count of all nests to estimate population sizes and distributions. Results from these efforts provided an important population inventory and documented significant population increases in some species and recent colonizations by American white pelicans and great black-backed gulls. Surveys also reported species with small populations and identified important breeding habitat for colonial waterbirds in the Great Lakes. These efforts provided the first comprehensive perspective on population trends over a 20-year period and included information on historically stable colony sites, species-specific habitat requirements and issues of conservation and management concern. However, because the survey is so labor intensive and expensive, it is conducted very infrequently (once every 10 years) and therefore has minimal value as a trend indicator. The 10-year interval between surveys does not allow rapid detection of changes in population trends and/or shifts in distribution, nor is it possible to evaluate population trends with high confidence from the limited data points produced.

In 2007, the 4th decadal survey effort was initiated and incorporates new, less laborintensive methodologies. The survey is being undertaken on a lake-by-lake basis, incorporating total counts of all birds on an individual water body within the same year. The goals of the project are to inventory (determine current distribution and abundance of) U.S. Great Lakes colonial waterbirds and identify sites that can be monitored, perhaps at 2-5 year intervals (depending on species), to enable trend detection and better inform management and conservation decisions. In the context of this large-scale inventory, the specific objectives of this research are to

(1) estimate regional population size, breeding colony size, and location of colonial waterbirds in the U.S. portion of the Great Lakes ecosystem and coordinate this effort with the Canadian Wildlife Service for a Great Lakes-wide estimate,

(2) evaluate inventory methodology by comparing population estimates obtained from the ground and aerial photos (both total and sample plots) to assess accuracy of both methods to estimate nesting pairs for multiple species,

(3) estimate and apply habitat-based detection rates for species at selected sites to improve survey accuracy,

(4) determine how numbers of breeding birds at select sites change over a season and compare these data to the traditional one-season count,

(5) compare results of this census to previous similar efforts in the Great Lakes to assess changes in population numbers and colony distributions, and

(6) identify the most important sites to monitor on a frequent basis in the future for detecting population trends by (a) utilizing and possibly refining the existing prioritization method, and (b) evaluating management and species-specific monitoring needs.

New projects – Cooperating Faculty

Identifying risks to migratory birds and bats from wind development

\$367,192. Funding: U.S. Fish and Wildlife Service. Principal Investigator: Jim Perry. Co-Principal Investigator: Doug Johnson.

Status: Research Work Order established and Ph.D. graduate student selected.

Wind energy development is occurring at a rapid pace and is expected to increase dramatically under the U.S. objective of producing 20 percent of the Nation's energy from wind by 2030. Although wind provides a renewable source of energy, concerns exist about the effects on wildlife, particularly migratory birds and bats. Migratory birds and any endangered bats are trust species of the federal government, and any "take" of such animals are of concern. The federal government has also made extensive investments in refuges, waterfowl productions areas, and wetland and grassland easements, primarily for the protection and production of migratory birds. It is important to understand the extent to which wildlife values associated with these investments may be compromised by wind energy development.

The goal of this study is to explore methods to assess risks to migratory birds and bats posed by wind energy development at a local level. Specific project objectives include: (1) Determine the relative likelihood of wind energy development in relation to federal wildlife management areas in the study area.

(2) Identify general migratory bird and bat resources in areas with both high likelihood of wind energy development and federal land management.

(3) Explore methods for determining, at a local scale, risks to migratory birds and bats that would be posed by wind energy development at a site.

Completed Research

Comparison of effects on stream habitat and fish nine years after harvest treatments

\$48,450. Funding: Minnesota Department of Natural Resources, U.S. Forest Service, and the National Council for Air and Stream Improvement. Principal Investigator: Bruce Vondracek. Co-Principal Investigator: Ray Newman. Student: Eric Merten (Ph.D., Water Resources Science)

A study "Evaluating riparian area dynamics, management alternatives and impacts of harvest practices" was initiated in 1997. We visited project study sites to collect data from the ninth year post-harvest time period in summer 2006. Our portion of a larger project with collaborators from the U. S. Forest Service and The Natural Resources Research Institute examined fish populations and stream channel characteristics.

Creek chub abundance was the only fish response that had a significant site-level treatment effect at the "within" reaches. No fish community variables showed a significant site-level treatment effect at the "downstream" reaches, although creek chub abundance was marginally significant. Most fish community variables indicated significant basin-scale year effects when all reaches were assessed. The significant variables were index of biological integrity (IBI) score, total fish abundance, species richness, brook trout (Salvelinus fontinalis) abundance, brook stickleback (Culaea inconstans) abundance, central mudminnow (Umbra limi) abundance, creek chub (Semotilus atromaculatus) abundance, finescale dace (Phoxinus neogaeus) abundance, and fathead minnow (Pimephales promelas) abundance. IBI scores indicated a significant decline in 2006 and brook trout abundance declined each year of the study. Canopy coverage and overhanging vegetation showed significant site-level treatment effects at the "within" reaches, but no other responses were significant. Most stream characteristics variables showed significant basin-scale year effects across all reaches. The significant variables were canopy coverage, unstable banks, boulder pockets, embeddedness, percent fine substrates, percent riffle, depth of refusal, and residual pool depth. Canopy coverage declined each year from 1997-2000 but recovered by 2006. Unstable banks increased each year from 1997-2000 but recovered by 2006. Percent fine substrates increased from 1997-2000 and remained elevated in 2006.

This study will serve as the basis for longer term assessment of the effects of riparian harvest and provide information about the ecology of forest streams and will be used directly by the Minnesota Forest Resources Council to develop forest management policy in Minnesota.

Development of an ecological assessment method for Minnesota lakes

\$78,000. Funding: Minnesota Department of Natural Resources. Principal Investigator: Bruce Vondracek. Student: Marcus Beck (M.S. and Ph.D., Conservation Biology - Fisheries and Aquatic Biology)

The Minnesota Pollution Control Agency has encouraged the Department of Natural Resources to identify and develop two lake health indicators that could be used to assess whether Minnesota lakes are impaired as part of the Minnesota Legislature's Clean Water Legacy Initiative to facilitate the implementation of the Total Maximum Daily Load process mandated by the Clean Water Act. Our goal was to evaluate which indictors of lake health should be used for assessing the ecological integrity of lakes in Minnesota, focusing on an indicator that will complement the fish index of biological integrity (fish IBI) that has developed. Our objectives were to

(1) review the existing indicators of lake health that have been used in temperate lakes,
 (2) use existing data within Minnesota to evaluate the applicability and robustness of existing measures of lake health,

(3) prioritize approaches across the gradient of Minnesota lake types and identify data gaps, and

(4) identify an approach to complement the fish IBI method, and recommend a general framework for its use in Minnesota.

Several studies have successfully adapted the IBI for use in lakes using fish and macrophyte communities. Recent research dedicated to the development of the lake IBI using macroinvertebrates, plankton, and periphyton as biocriteria have had less success, though there are exceptions to the general trend. Despite the apparent inability of these communities to act as consistent indicators of lake condition, researchers should not be

discouraged from examining the feasibility of these communities for lake IBI development. Communities that are highly variable may be the best indicators of immediate environmental changes, and accordingly could facilitate early detection and rapid response to disturbance. Macroinvertebrates, plankton, or periphyton may be the best indicators of immediate changes within a lake's watershed.

A macrophyte-based IBI was developed for Minnesota lakes to assess the ability of aquatic plant communities to indicate environmental condition. The index was developed using quantitative point intercept vegetation surveys for 97 lakes that represent a range of limnological and watershed characteristics. We followed an approach similar to that used in Wisconsin to develop the aquatic macrophyte community index (AMCI). Regional adaptation of the AMCI required the identification of species representative of macrophyte communities in Minnesota. Metrics and scaling methods were also substantially modified to produce a more empirically robust index. Regression analyses indicated that IBI scores reflected statewide differences in lake trophic state, agricultural, urban, and forested land uses, and county population density. Variance partitioning analyses using multiple regression models indicated a unique response of the IBI to anthropogenic impacts separate from a response to natural lake characteristics. The IBI was minimally affected by differences in sample point density as indicated by Monte Carlo analyses of reduced sampling effort. Our analysis indicates that a macrophyte IBI calibrated for Minnesota lakes could be useful for identifying differences in environmental condition attributed to anthropogenic disturbance gradients.

Effects of riparian forest harvest on instream habitat and fish and invertebrate communities

\$428,878. Funding: Minnesota Department of Natural Resources, Legislative Committee for Minnesota Resources, and Water Resources Center. Principal Investigator: Bruce Vondracek. Co-Principal Investigator: Raymond M. Newman. Students: Dickson Atuke (Ph.D., Conservation Biology – Fisheries and Aquatic Biology) and Nicholas Schlesser (M.S., Conservation Biology – Fisheries and Aquatic Biology)

This project examined the effectiveness of guidelines to protect forested riparian areas at a site level. Guidelines developed in Minnesota in 1999 recommended timber harvest in riparian areas. This project was part of a larger effort with the U. S. Forest Service and the Natural Resources Research Institute. Our interdisciplinary team evaluated effects of riparian forest harvest on water quality, fish, invertebrates, and stream morphology across three riparian harvest treatments (none, low, and intermediate) in association with unharvested (riparian and upland) control sites and sites with no harvest in the riparian zone adjacent to upland clearcuts. Our time frame was 1 year of pre-harvest (2003) and 3 years of post-harvest (2004-2006). We found significant variation among years in habitat scores and macroinvertebrate assemblages and differences within and among sites in fish species composition and abundance. This study serves as the basis for longer term assessment of the effects of riparian harvest and provides information about the ecology of forest streams that will be used by the Minnesota Forest Resources Council to develop forest management policy in Minnesota.

Empowering water quality decisions: reducing uncertainty and bounding variability of stream ecosystem indicators

\$278,069. Funding: Minnesota Department of Natural Resources. Principal Investigator: Bruce Vondracek. Student: Christy Dolph (Ph.D., Water Resources Science Program)

Impaired waters and the Total Maximum Daily Load approach are central drivers to water quality management mandated by the Clean Water Act. Water quality and ecological integrity vary across a gradient of human disturbance, but assessing how ecological integrity is affected by human disturbance is complex and requires robust indicators of ecological health. Indicators are used to quantify stream ecosystem integrity; however, uncertainty and variability of those indicators are poorly understood. We conducted research to aid Minnesota regulatory agencies in reducing the uncertainty and variability of indicators of stream ecosystem integrity to allow managers to make decisions based on scientific knowledge and be more defensible than current decisions. We had two objectives;

(1) Quantify precision and sensitivity of index of biological integrity (IBI) scores and component metrics of the IBI. This objective included quantifying the response of IBI scores to random sampling error, developing confidence intervals for IBI and metric scores, and determining which metrics contribute most strongly to overall IBI variability and

(2) Evaluate IBI variability at the stream reach, assessment unit, and major watershed scales.

A review of the scientific literature for indicators of stream health include: 1) understanding how structural indicators of stream health correspond to stream function; 2) developing better screening tools to identify reference condition; 3) evaluating how information from different types of stream health indicators can be used in complementary ways; 4) developing ways to link changes in biotic community composition to specific stressors; and 5) understanding seasonal variation in stream health indicators.

A bootstrap analysis indicated that fish IBIs may vary by as much as 40 points due to random sampling error alone. 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, suggesting that random sampling variability is not sufficient to change the impairment status in the majority of replicate samples for stream sites in Minnesota. For sites with IBI scores near the impairment threshold, random sampling variability is more likely to affect status determination, and more than one field sample may be needed to verify impairment status.

We suggest that sampling variability in IBI scores is related in part to the number of fish in a collection. We found that field samples containing at least 160 fish could be interpreted with a reasonable degree of confidence. Obtaining a sample this large for all sites would likely require increasing either the standard length over which a stream reach is sampled, or increasing the sampling intensity (i.e., conducting multiple sampling passes of the same stream reach). Sampling variability in IBI scores is related to stream drainage area

A comparison of the effects of different scoring methods on IBI variability indicates that a continuous scoring method may reduce the amount of bias in IBI scores.

Rare taxa contribute critical information to fish community metrics based on taxa richness. Failure to capture a single rare taxon will have slight effect on individual metrics or total IBI score. Failure to capture multiple rare taxa at a study site may have a substantial effect on individual metrics or total IBI score.

We used multivariate analysis to identify which environmental variables best discriminated assemblages found in reference streams across the state. The variables which best discriminated reference invertebrate assemblages included: calendar day, watershed area, stream gradient, latitude, ecoregion, and year in which streams were sampled. The variables that best discriminated fish assemblages across the state were: average annual precipitation, watershed area, latitude, longitude, mean thalweg depth, ecoregion. The variables that best discriminated a combined fish and macroinvertebrate assemblage were: average annual air temperature, watershed area, stream gradient, latitude, ecoregion, and year streams were sampled. Multivariate models developed at the statewide scale for macroinvertebrate, fish, and a combined assemblage (macroinvertebrates + fish) are able to accurately predict the number of taxa expected at reference sites.

When the ratio of observed to expected (O/E) taxa derived from multivariate models is used as an index to evaluate stream health, we found that O/E scores and IBI scores are in concordance for very high quality and very low quality sites, but may differ for intermediately disturbed sites. A combined assemblage model appears to integrate information from both fish and macroinvertebrate communities, and may be more sensitive to high levels of disturbance than models based on either macroinvertebrates or fish alone.

The metric contribution analysis indicates that the *Headwater-Tolerant* and *%Piscivore* are among the metrics that contribute most to the sensitivity of IBI total score, whereas the *Benthic insect, Sensitive taxa* and *Total Taxa* are among the metrics that contribute least to the sensitivity of IBI total score.

Our project will advance management of stream ecological resources by aiding accurate identification of impaired streams, using existing data to understand the history of stream ecosystem integrity, and increasing efficiency with which stream ecosystem integrity is assessed and monitored.

Evaluating riparian timber harvesting guidelines: phase 3

\$400,000 (\$121,900 to BV) Funding: Legislative Citizens Committee on Minnesota Resources. Principal Investigator: Bruce Vondracek. Student: Eric Merten (Ph.D.-Water Resources Science Program) and Postdoctoral Researcher: Christopher Chizinski.

Riparian guidelines have been the most controversial of the seven 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 riparian guidelines, and sustaining Minnesota's forest resources. Specific objectives were to (1) 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 that had a low and intermediate treatment,

(2) begin to combine and synthesize data from the multiple study components through a "meta-analysis," and

(3) provide information to natural resource professionals about riparian zone management.

We evaluated the effects of riparian harvest on stream ecosystem functioning using measures of invertebrate biomass, in-stream habitat, and food web analyses and (2) evaluated the effects of harvest treatments through time on both the terrestrial (birds, trees and understory woody and herbaceous species) and aquatic habitat components as well as changes of terrestrial and aquatic communities (fish and invertebrate) in a meta-analysis.

Fine sediment increased in the streambed throughout the Pokegema basin. Throughout the study area, the proportion of unstable banks increased for several years post-harvest, coinciding with an increase in fine sediment. Increased unstable banks may have been caused by forest harvest equipment, increased windthrow and exposure of rootwads, or increased discharge and bank scour. Fine sediment in the channels did not recover by summer 2007, even though canopy cover and unstable banks had returned to 1997 levels. We also noted a significant decrease 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) over the study period. Abundance of brook stickleback (*Culaea inconstans*) also decreased over time (r = -0.70) while creek chub (*Semotilus*) *atromaculatus*) abundance increased (r = 0.79), although neither trend was significant. Summer air temperatures increased in the Pokegema basin during the study period. Across the basin, abundances of most species were negatively related to mean summer air temperature. Lower index of biotic integrity scores were significantly related to warmer temperatures ($r^2 = 0.56$), as were lower abundances for brook trout ($r^2 = 0.53$), northern redbelly date ($r^2 = 0.85$), and brook sticklebacks ($r^2 = 0.62$). Fish variables were not significantly related to fine substrates in the streambed, large wood, or total spring precipitation at the basin scale. Based on stream temperatures measured at the end of the study period, thinned riparian treatments caused the stream to warm significantly more than riparian buffer treatments. However, stream warming in unharvested control treatments was not significantly different from other treatments (i.e., riparian buffer or thinned riparian).

The ranks of the invertebrate functional groups were dominated by collectors (filterers and gatherers) prior to harvest and this continued after harvest in both studies. We observed interannual variation in macroinvertebrate community, but few effects related to harvest treatments. Interannual variation was evident in the fish communities, but we detected small changes in the stream fish communities associated with partially harvested riparian management zones. In both studies, turnover of the fish community in the intermediate harvest treatment was the largest where the brook stickleback and central mudminnow (*Umbra limi*), two relatively tolerant fish species, increased.

Although avian community metrics (abundance, diversity, and richness) did not indicate significant treatment affects, 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*). Multivariate analysis (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.

We suggest that riparian harvest along reaches ≤ 200 m in length on both sides of the stream that that maintaining a basal area ≥ 11.5 m²/ha, or riparian harvest on one side of the stream that retains ≥ 8.1 m² ha⁻¹ may be adequate to maintain instream habitat and invertebrate and fish communities and may mitigate changes in the avian community in low gradient streams in the Midwest.

Features of the Farm Bill that influence breeding birds

\$27,553. Funding: U.S. Geological Survey, Northern Prairie Wildlife Research Center. Principal Investigator: David E. Andersen. Co-Principal Investigator: Doug Johnson. Research Associate: Maiken Winter

Information collected in this study has the potential to help guide future directions of Farm Bill and other conservation programs by addressing critical questions related to how breeding birds are influenced by a variety of factors. The goal of the work described here was to exploit extant data to address those questions. Specific objectives were to: (1) determine how densities of breeding birds in Conservation Reserve Program (CRP) fields are influenced by vegetational metrics, such as the ratio of forbs to grasses; and (2) determine how densities of breeding birds in CRP fields are influenced by the relative composition of native versus introduced species; and to determine how densities of breeding birds are influenced by the fraction of a CRP field that is wetland.

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 were 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 Tringa semipalmata, sharp-tailed sparrow Ammodramus spp.); 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 will be more valuable in the western portion of the Great Plains. In contrast, introduced plantings should be valuable in the eastern regions as long as the fields are allowed to develop litter extensive enough to provide shelter and nesting places.

Mortality of walleye caught in live-release tournaments: assessment, reduction, and determination of acceptable levels

\$259,144. Funding: Minnesota Department of Natural Resources. Principal Investigator: Bruce Vondracek. Co-Principal Investigator: David Fulton. Students: John Loomis (M.S., Conservation Biology - Fisheries and Aquatic Biology) and Jeremy Bruskotter (Ph.D., Natural Resource Science and Management).

Previous assessments of walleye (*Sander vitreus*) tournaments suggest mortality ranges from 0-98%, but these assessments either did not evaluate a range of environmental or fishing-related variables or did not use consistent methodology that allowed reliable determination of variables associated with mortality. Our goal was to synthesize recently completed studies that evaluated mortality of walleye by estimating: (1) initial, prerelease, and post-release mortality during 14 live-release walleye tournaments in five midwestern states in 2006-2007; (2) post-release mortality under simulated tournament conditions in relation to temperature; and (3) levels of mortality acceptable to tournament (n = 511) and licensed anglers (n = 1,649) using a mail survey.

Mortality at tournaments was < 25% when water temperatures were $< 16^{\circ}$ 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 livewell with temperatures $> 22^{\circ}$ C. In the simulated tournament trials, we found more than 64% of walleye survived simulated tournament procedures at or below 18°C, but survival decreased above 18°C. Survival exceeded 70% when DO was > 5 mg/L at 18°C but decreased to 0% when dissolved oxygen concentration was 2 mg/L at the same temperature. Glucose concentrations were lower at 16°C than at 8 and 12°C in simulated tournament conditions. Mean blood glucose concentrations significantly increased for the fish subjected to angling activity relative to baseline and for the 8-h confinement relative to angling activity, potentially indicating a mobilization of metabolic energy reserves. Plasma chloride concentrations were higher at 16°C than 8 and 12°C, but mean plasma chloride concentration for post-release walleye was significantly lower than reference fish. Plasma osmolality concentrations were higher at 16°C than 8 and 12°C, and mean plasma osmolality concentrations were significantly higher for the post-simulation relative to the post-release assessment. Survival of walleye during the blood chemistry experiment was lowest at 8°C, intermediate at 12°C, and highest at 16°C, which may be related to the differences in blood chemistry variables we measured across these temperatures.

Median acceptable initial mortality was 5.0% and median acceptable total mortality was 10.0% for licensed walleye anglers. Tournament anglers indicated 10% initial and 12% total mortality were acceptable. Licensed anglers estimated actual survival for live-release tournaments held in cool weather would be 70-80% or 50-70% in warm weather, whereas tournament anglers estimated 90% survival in cool water and 75% for warm water. A majority of anglers (\geq 55%) agreed state agencies should prohibit live-release tournaments during warm weather, but tournament anglers indicated that management agencies should only prohibit tournaments on a case-by-case basis.

Resource managers could use values we measured for mortality at the tournaments and the estimates of mortality from logistic regressions as tools in a permitting process for

live-release tournaments when water temperature would likely contribute to high mortality.

Predicting large wood transport and effects on stream geomorphology in northern Minnesota streams

\$64,000. Funding: Minnesota Department of Natural Resources. Principal Investigator: Bruce Vondracek. Student: Eric Merten (Ph.D., Water Resources Science)

Large wood performs many important ecosystem functions in streams, including diversifying instream flow environments (e.g., plunge pools, and backwater habitat), creating overhead cover for fish, and providing a stable substrate for invertebrates and periphyton. Few instream studies of large wood dynamics have been completed in the Midwest, rather the majority of studies have been from mountainous areas with steeper gradients and narrower floodplains. We elavuated individual logs to investigate instream wood dynamics in streams flowing through second-growth forest to improve our understanding of instream wood processes in the Midwest. We related mobilization and retention of individual pieces to geomorphic conditions and piece characteristics. We hypothesized that shorter, smaller, and more buoyant pieces will be mobilized more readily than large dense pieces, and that channels that are steeper, wider, and more entrenched will retain less wood than narrow, shallow, nonentrenched channels. Information gained from this study will be used to improve riparian management policies, wood removal regulations, and stream restoration practices.

The characteristics and locations of 865 undisturbed wood pieces (> 0.05 m in diameter and > 1 m in length) were documented in nine streams along the shore of Lake Superior in Minnesota in summer 2007 and in fall 2007 after an overbank stormflow event to determine the factors that influence mobilization of stationary wood pieces in natural streams. Hydraulic conditions in the streams from June to November 2007 were determined using calibrated hydraulic simulation models. Overall, the best-supported model (p < 0.001, Nagelkerke's $r^2 = 0.39$) indicated that wood mobilization under natural conditions is a complex function of both mechanical factors [burial, ratio of piece length to effective stream width (length ratio), bracing, rootwad presence, draft ratio] and hydraulic factors (effective depth, downstream force ratio).

Data on entrapment were collected for a wide range of natural wood pieces (n = 344), stream geomorphology, and hydraulic conditions in nine streams along the north shore of Lake Superior in Minnesota. Locations of pieces were determined in summer 2007 and again following an overbank stormflow event in fall 2007. The ratio of piece length to effective stream width (length ratio) and the weight of the pieces were determined to be of primary importance to wood entrapment using multiple logistic regression.

This study can inform stream modifications to discourage entrapment at road crossings or other infrastructure by determining the effective stream width required to pass particular wood pieces. Conversely, these results could also be used to determine conditions that encourage entrapment where wood is valued for ecological functions.

Stream classification for TMDL assessment using a dimensionless, reference reach approach

\$898,592. Funding: US Environmental Protection Agency and Minnesota Pollution Control Agency. Principal Investigators: Bruce Vondracek, James A. Perry, Bruce Wilson, John Nieber. Student: Brenda Asmus (M.S., Water Resources Science)

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) is developing a regional stream classification system to facilitate Total Maximum Daily Load (TMDL) assessment of impaired waters in Minnesota. The classification will use 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 in six stream basins,

(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. An independent data set will be used for validating dimensionless curves.

We found 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. 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. 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.

This approach is well suited to affect changes in land use and other watershed practices to address nonpoint source pollution. The classification system will be used by the MPCA to prioritize TMDL programs.

Completed Research – Cooperating faculty

Ammonia, nitrite and nitrate toxicity to the Topeka shiner (*Notropis topeka*) \$56,638. U.S. Fish and Wildlife Service. Principal Investigator: Ira Adelman. Staff: Jessica Koehle, Luke Kusilek

Concentrations of nitrogen chemicals in Topeka shiner Critical Habitat may be of sufficient magnitude to either directly or indirectly adversely affect native minnows. However, the specific concentrations at which the various nitrogen forms adversely affect the Topeka shiner compared to other native minnows are not known because chemical toxicity data are lacking for this endangered species. Regulatory agencies often need species-specific sensitivities of the Topeka shiner to different nitrogen forms. To date, information that is available for closely related species such as other native shiners or minnows that may or may not represent the sensitivity of the Topeka shiner is being used, but this information may not be protective of Topeka shiners. Therefore, this project was conducted to determine the concentrations of ammonia, nitrite, and nitrate that cause adverse affects on survival, growth and development of Topeka shiners.

A series of toxicity tests were conducted, in accordance with ASTM guidelines in which Topeka shiners and fathead minnows were exposed to three toxicants (ammonia, nitrite, and nitrate) as separate tests. Results from these tests were used to indicate 'safe' concentrations of the chemicals for Topeka shiners.

Estimating detectability rates for colonial waterbirds in the U.S. Great Lakes

\$22,290. U.S. Fish and Wildlife Service. Principal Investigator: Francesca Cuthbert. Staff: Linda Wires.

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 second 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 next binational survey (2007-09), a workshop was convened at LaCrosse, Wisconsin (as part of the 2000 Annual Meeting of the Waterbird Society) with USFWS Region 3 funding to identify ways to improve the accuracy of the Great Lakes survey and ability to detect colonial waterbird population trends. As a result of the workshop, we submitted a report to USFWS with the following recommendations for research/pilot studies:

- a) determine detection rates to assess accuracy of total nest counts
- b) develop and test species-specific census strategies for improving our ability to detect trends in Great Lakes colonial waterbird populations
- c) develop and test sampling designs for large colonies and compare their accuracy with total nest counts
- d) investigate the feasibility of censusing certain species/colonies using aerial photography.

This agreement provides funding to develop and evaluate methods to be used in the 2007 Binational Great Lakes Waterbird Survey to improve the accuracy of this effort. This work plan will focus on one of the recommendations developed at the 2000 LaCrosse workshop: estimation of nest detection rates.

We determined detection rates for double-crested cormorants (*Phalacrocorax auritus*), Caspian terns (*Hydroprogne caspia*), ring-billed gulls (*Larus delawarensis*), herring gulls (*Larus argentatus*), great blue herons (*Ardea herodias*), and black-crowned night-herons (*Nycticorax nycticorax*). In general, the most important variable was habitat. Birds nesting on the ground in little or no vegetation were detected at higher rates than those in trees or birds on the ground in dense vegetation. We have also determined under which conditions we can use aerial photographs to obtain accurate estimates of colonial nesting species. Ground nesters are easier to locate, identify, and count than tree nesters. The best estimates (as compared to ground counts) are obtained using photos to count cormorants because their black plumage contrasts well against lighter substrates. Estimates are more accurate for ground versus tree-nesting birds.

Estimation and evaluation of demographic parameters required for recovery of the endangered Great Lakes piping plover population

\$26,125. U.S. Geological Survey, Science Support Initiative. Principal Investigator: Francesca Cuthbert. Student: Erin Roche (Ph.D., Conservation Biology)

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 < 31 breeding pairs in Michigan by 1979. By 1986, when the Great Lakes population was listed as federally endangered under the Endangered Species Act, only 17 pairs remained. In 2000, a population viability analysis of all piping plover populations projected the Great Lakes population would decline to eventual extirpation. 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 re-evaluation of the demographic parameters necessary for population recovery.

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.

Results suggest that under current best-case scenarios the Great Lakes population will require a fledging success rate of ~ 2.5 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. 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 conservation managers of imperiled populations to better assess target vital rates and potential management strategies *in lieu* of current population trends.

An evaluation of storm-water management in a watershed of the Minnesota Valley National Wildlife Refuge

\$72,823 U.S. Fish and Wildlife Service, Region 3. Principal Investigator: Bruce Wilson. Student: Brian Ash (M.S., Biosystems and Agricultural Engineering).

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 stations was reduced to 5. 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 we were 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 Better Assessment Science Integrating Point and Nonpoint Sources (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 one-inch and 6.5% for the six-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 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.