2010 Coordinating Committee Meeting · Minnesota Cooperative Fish and Wildlife Research Unit

2010 Coordinating Committee Meeting

12 October 2010

SUMMARY OF ACTIVITIES (2009 AND 2010 CALENDAR YEARS)

PUBLICATIONS

Peer reviewed

- Asmus, B., J. Magner, B. Vondracek, and J. Perry. 2009. Physical integrity: the missing link in biological monitoring and TMDLs. *Environmental Monitoring and Assessment* 159:443-463.
- Beck, M. W., L. K. Hatch, B. Vondracek, and R. D. Valley. 2010. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. *Ecological Indicators* 10:968–979.
- Blann, K.L., J. Anderson, G. Sands, and B. Vondracek. 2009. Effects of agricultural subsurface drainage on aquatic ecosystems: a review. *Critical Reviews in Environmental Science* and Technology 39:909-1001.
- Chizinski, C. J., B. Vondracek, C. Blinn, D. Atuke, E. Merten, N. Hemstad, R. M. Newman, N. Schlesser and K. Fredricks. 2010. The influence of partial timber harvesting in riparian buffers on macroinvertebrate and fish communities in small streams in Minnesota, USA. Forest Ecology and Management 259:1946-1958.
- Dolph C.L., A. Sheshukov, C.J. Chizinski, B. Vondracek, and B. Wilson. 2010. The Index of Biological Integrity and the bootstrap revisited: an example from Minnesota streams. *Ecological Indicators* 10:527–537.
- Fieberg, J., L. Cornicelli, D.C. Fulton, and M.D. Grund. 2010. Design and analysis of simple choice surveys for natural resource management. *Journal of Wildlife Management* 74:871-879.
- Henneman, C. and **D.E. Andersen**. 2009. Occupancy models of nesting-season habitat associations of red-shouldered hawks in central Minnesota. *Journal of Wildlife Management* 73:1316-1324.
- Merten, E.C., N.A. Hemstad, S.L. Eggert, L.B. Johnson, R.K. Kolka, R.M. Newman, and B. Vondracek. 2010. Relationship of sediment dynamics in moraine, headwater streams in northern Minnesota to forest harvest. *Ecology of Freshwater Fish* 19:63–73.
- Merten, E.C., N.A. Hemstad, R.K. Kolka, R.M. Newman, E.S. Verry, and B. Vondracek. 2010. Relationship of sediment dynamics in moraine, headwater streams in northern Minnesota to forest harvest. *Journal of the American Water Resources Association* 46:733-743.



Consultant's Report

- Reiter, M.E., D.E. Andersen, and C.W. Boal. 2008 (appeared in print in 2009). Species composition, distribution, and habitat associations of anurans in a subarctic tundra landscape near Cape Churchill, Manitoba, Canada. Canadian Field-Naturalist 122:129-137.
- Schramm, H.L., Jr., **B. Vondracek**, W.E. French, and P.D. Gerard. 2010. Factors associated with mortality of walleye and sauger caught in live-release tournaments. *North American Journal of Fisheries Management* 30:238-253.
- Schroeder, S.A. and D.C. Fulton. 2010. Land of 10,000 lakes and 2.3 million anglers: conflict, crowding, and coping among Minnesota anglers. *Journal of Leisure Research* 42: 291-316.
- Wan, H., C.J. Chizinski, C.L. Dolph, B. Vondracek and B. Wilson. 2010. The impact of rare taxa on measures of fish index of biotic integrity. *Ecological Indicators* 10:781-788.

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.
- 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.

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.
- 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*.
- Bruggeman, J.E., **D.E. Andersen**, and J.E. Woodford. *In Revision*. Bioregional monitoring for northern goshawks in the western Great Lakes region. *Journal of Raptor Research*.
- 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. *Wildlife Biology*.
- Dolph, C.L., D.D. Huff, C.J. Chizinski, and B. Vondracek. In Review. Implications of community concordance for assessing stream health at three nested spatial scales in Minnesota, USA. Freshwater Biology.
- Eells, L., R. Vondracek, and **B. Vondracek**. *In Press*. 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.
- 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.
- Huff, D.D., L.M. Miller, and **B. Vondracek**. *In Press*. 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 Press*. Entrapment of wood in Minnesota streams determined by a length ratio and weight. *Journal of Hydrological Processes*.
- Merten, E., J. Finlay, L. Johnson, R. Newman, H. Stefan, and **B. Vondracek**. *In Press*. Factors influencing wood mobilization in Minnesota streams. *Water Resources Research*.
- 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*.
- Nagle, F., T. Fuitak, K C. Nelson, and B. Vondracek. In Review. 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 Press* (*abstract*). Fall survival of American woodcock in the western Great Lakes region. *Proceedings of the 10th American Woodcock Symposium*.
- Raymond, K. L. and **B. Vondracek**. *In Review*. Relationships among rotational and conventional grazing systems, stream channels and macroinvertebrates. *Hydrobiologia*.

- Reiter, M.E. and **D.E. Andersen**. *In Review*. Arctic foxes, lemmings, and Canada goose nest survival at Cape Churchill, Manitoba. *Wilson Journal of Ornithology*.
- Reiter, M. E. and **D.E. Andersen**. *In Review*. Impacts of lesser snow goose-mediated habitat alteration on Canada goose nest density. *Avian Conservation and Ecology*.
- Reiter, M.E., **D.E. Andersen**, A.H. Raedeke, and D.R. Humburg. *In Revision*. Species interactions and habitat influence the range-wide distribution of breeding Canada geese in northern Manitoba. *Journal of Wildlife Management*.
- Schroeder, S. A. and **Fulton D.C.** *In Review*. Political action and philanthropy for lake protection: Do outdoor recreation participation and place attachment predict intention to conserve Minnesota lakes? *Society & Natural Resources*.
- Schroeder, S. A. and **Fulton, D.C.** *In Review.* Do outdoor recreation participation and place attachment relate to Minnesota lake home owners' attitudes about protecting their lake? *Environment & Behavior.*
- Schroeder, S. A. and **Fulton, D.C.** *In Review.* 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. *Journal of Environmental Psychology.*
- **Vondracek**, **B.**, H. L. Schramm, Jr., W E. French, and C. J. Chizinski. *In Revision*. Factors associated with initial mortality of walleye and sauger caught in live-release tournaments. *North American Journal of Fisheries Management*.
- Williams. M. A. and **B. Vondracek**. *In Review*. Spring distributions in Winona County, Minnesota, USA. *Carbonates and Evaporites*.

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*.
- 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*.
- Bruggeman, J.E., **D.E. Andersen**, and J.E. Woodford. *In Preparation*. Landscape-level models of goshawk breeding area attributes in the western Great Lakes region. *Journal of Raptor Research*.

- Bruggeman, J.E., **D.E. Andersen**, and J.E. Woodford. *In Preparation*. Population estimates of breeding goshawks in the western Great Lakes region based on occupancy surveys and home range size. *Journal of Wildlife Management*.
- Carlin, C., **D.C. Fulton**, and S.A. Schroeder. *In Preparation.* Using choice models to understanding walleye angler preferences in Minnesota. *North American Journal of Fisheries Management.*
- 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*. Applying 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*.
- Fulton, D.C., J. Bruskotter, H. Schramm, and B. Vondracek. In Preparation. Social acceptability of walleye mortality in live release tournaments in 5 midwestern states. North American Journal of Fisheries Management.
- **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*.
- 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*. Evidence of territoriality and inter-specific interactions from point-pattern analysis of subarctic-nesting geese. *Auk*.
- Rudberg, E., **D.C. Fulton**, and S.A. Schroeder. *In Preparation*. Understanding attitudes and beliefs concerning support for banning toxic shot. *Journal of Wildlife Management*.
- 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., **Fulton, D.C.**, Penning, W., DonCarlos. K. *In Preparation*. Using persuasive messages to encourage hunters to support a ban on lead shot. *Journal of Wildlife Management*.

- **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*.

TECHNICAL REPORTS

Final reports

- **Vondracek, B.**, D, C. Fulton, and H. L. Schramm. 2009. Mortality of walleye caught in live-release tournaments: assessment and determination of acceptable levels. Final report to the Minnesota Department of Natural Resources.
- 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.

Annual Reports

- Andersen, D.E., et al. 2009. Production of EPP Canada geese near Cape Churchill in 2009. Annual Report to the Mississippi Flyway Council. Minnesota Cooperative Fish and Wildlife Research Unit, St. Paul, Minnesota.
- Andersen, D.E., et al. 2010. Production of EPP Canada geese near Cape Churchill in 2010. 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. 2009. Mississippi Flyway Eastern Prairie Population (EPP) Canada goose monitoring. Annual Report to Wapusk National Park of Canada, Churchill, Manitoba, Canada.
- 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.
- 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.

- Nelson, M.R., D.E. Andersen, and J.R. Kelly. 2010. 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: 2009 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**. 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.
- 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

<u>David E. Andersen</u>

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

Demographic response of golden-winged warbler to habitat and management across a climate change gradient in the core of the species range. Funding: U.S. Fish and Wildlife Service - \$638,202

Summarizing data and developing conservation practices for eagle nesting and concentration areas in the Midwest Region Funding: U.S. Fish and Wildlife Service - \$53,257

David C. Fulton

Human dimensions studies in support of fish and wildlife decision-making Funding: Minnesota Department of Natural Resources - \$215,000

Field experiments to understand what encourages lake shore habitat restoration. Funding: Minnesota Department of Natural Resources - \$100,000

Understanding human behaviors concerning lake shoreline management. Funding: Minnesota Department of Natural Resources - \$130,000

<u>Bruce Vondracek</u>

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

Assessing the cumulative impacts to near-shore, in-water habitat. Funding: Minnesota Environmental Trust Fund as recommended by the Legislative Citizens Committee on Minnesota's Resources. \$300,000

Predicting and mitigating vulnerability of trout streams in Minnesota to global warming. Funding: Minnesota Environmental Trust Fund as recommended by the Legislative Citizens Committee on Minnesota's Resources. \$299,999

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.

Technical advisor for Woodcock 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 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.
- 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. 2009. (*Invited*). Distribution, abundance, and habitat use of red-shouldered hawks in central Minnesota. Managing forests in the Mille Lacs Uplands for biodiversity and high conservation values. Minnesota Department of Natural Resources, Onamia, Minnesota.
- Beck, M. W., B. Vondracek, and L. K. Hatch. 2010. Assessing the health of Minnesota's lakes using indices of biotic integrity. Joint Meeting of the Minnesota Chapters of the American Fisheries Society, Society for Conservation Biology, Society of American Foresters and The Wildlife Society, Nisswa, Minnesota.
- Beck, M. W., L. K. Hatch, B. Vondracek, and R. D. Valley. 2010. Development of a macrophyte-based index of biotic integrity for Minnesota lakes. 2010 International Congress for Conservation Biology, Edmonton, Alberta, Canada.
- Bergh, S.M. and D.E. Andersen. 2010. Factors affecting detection of American woodcock on Singing-ground Surveys. 2010 Joint Meeting of the Minnesota Chapters of The Wildlife Society, American Fisheries Society, Society of American Foresters, and the Society for Conservation Biology, Nisswa, Minnesota.
- Bergh, S.M. and D.E. Andersen. 2010. Estimation of the effective area surveyed for American woodcock on Singing-ground Surveys. 71st Midwest Fish and Wildlife Conference. Minneapolis, Minnesota.
- Bergh, S.M. and **D.E. Andersen**. 2010. Factors affecting detection of American woodcock on Singing-ground Surveys. 17th Annual Conference of The Wildlife Society, Snowbird, Utah.
- Bruggeman, J.E., **D.E. Andersen**, and J.E. Woodford. 2010. Northern goshawk monitoring in the western Great Lakes bioregion. 71st Midwest Fish and Wildlife Conference. Minneapolis, Minnesota.

- 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.
- Cornicelli, L. and **D. C. Fulton**. 2009. Change in satisfaction and participation among deer hunters in areas with special regulations. 15th Annual Meeting of The Wildlife Society. Monterey, California.
- 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., D. D. Huff, C. J. Chizinski, and B. Vondracek. 2010. Implications of concordance for assessing aquatic communities at three nested spatial scales in Minnesota, USA. Joint Meeting of the American Society of Limnology and Oceanography and the North American Benthological Society. Santa Fe, New Mexico.
- **Fulton, D.C.** 2009. *(Invited)*. Human-wildlife conflict: beyond biology. 23rd Annual Meeting of Society of Conservation Biology, Beijing, China.
- Fulton, D.C., Schroeder, S.A. and Rudberg, E. 2009. Factors influencing conservation of lakescapes. 10th Biennial Conference of Research on the Colorado Plateau/Society of Conservation Biology North American Section Meeting. Flagstaff, Arizona.
- Huff, D. D., L. M. Miller, C. J. Chizinski, and B. Vondracek. 2010. Outbreeding depression and genetic diversity in reintroduced populations of the slimy sculpin. Joint Meeting of the Minnesota Chapters of the American Fisheries Society, Society for Conservation Biology, Society of American Foresters and The Wildlife Society, Nisswa, Minnesota.
- 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.
- Huff, D. D., L. M. Miller, and B. Vondracek. 2009. Patterns of ancestry and genetic diversity in reintroduced populations of the slimy sculpin: Implications for conservation. 70th Midwest Fish and Wildlife Conference, Springfield, Illinois
- 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.
- Nelson, M.R. and **D.E. Andersen**. 2009. American woodcock Singing-ground Surveys in the western Great Lakes region: assessment of trends in woodcock counts, land cover types

along survey routes, and survey routes representation of the boarder landscape. 70th Midwest Fish and Wildlife Conference, Springfield, Illinois.

- Nelson, M.R. and **D.E. Andersen**. 2010. American Woodcock Singing-ground Surveys in the western Great Lakes region: assessment of woodcock counts, forest cover types along survey routes, and landscape cover type composition. 2010 Joint Meeting of the Minnesota Chapters of The Wildlife Society, American Fisheries Society, Society of American Foresters, and the Society for Conservation Biology, Nisswa, Minnesota.
- Nelson, M.R. and **D.E. Andersen**. 2010. American Woodcock Singing-ground Surveys in the western Great Lakes region: assessment of woodcock counts, forest cover types along survey routes, and landscape cover type composition. 71st Midwest Fish and Wildlife Conference. Minneapolis, Minnesota.
- 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. 23rd Annual Meeting of the Society of Conservation Biology, Beijing, China.
- 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.
- Streby, H.M. and D.E. Andersen. 2009. Nesting success does not equal reproductive success: a case study with songbirds. 70th Midwest Fish and Wildlife Conference, Springfield, Illinois.
- Streby, H.M. and **D.E. Andersen**. 2010. When is success not success? When it's songbird nesting success. Society for Integrative and Comparative Biology Annual Meeting. Seattle, Washington.
- Streby, H.M., J.P. Loegering, and D.E. Andersen. 2010. Golden-winged warbler demography: productivity and survival in northwest Minnesota in 2010. 71st Midwest Fish and Wildlife Conference. Minneapolis, Minnesota.

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.

TEACHING

David C. Fulton

Instructor

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 2009 **CBIO8201: Seminar- How to Excel in Graduate School** Conservation Biology Program, University of Minnesota

Fall 2009 FW8465 Fish Habitats and Restoration Department of Fisheries, Wildlife, and Conservation Biology

Invited lecture

Fall 2009 **GEO 8601: Introduction to Stream Restoration** Department of Geology (2 lectures)

STUDENT THESES AND AWARDS (2009/2010)

- Cornicelli, L. 2009. Integrating social considerations into managing deer in Minnesota. Ph.D. Dissertation, University of Minnesota. 243pp. (D.C. Fulton)
- Huff, D. D. 2010. Examining genetic diversity, outbreeding depression, and local adaptation in a native fish reintroduction program. Ph.D. Dissertation, University of Minnesota. 116pp. (B. Vondracek)
- 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

Stephanie Bergh. 2010. Best Student Presentation, 2010 Joint Meeting of the Minnesota Chapters of The Wildlife Society, American Fisheries Society, Society of American Foresters, and the Society for Conservation Biology, Nisswa, Minnesota.

Christine Dolph. 2010. EPA STAR Graduate Fellowship

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

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

David E. Andersen

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)

Dave Fronczak – M.S. Natural Resources Science and Management (Wildlife Ecology and Management)

David C. Fulton

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

Alexander Heeren – M.S., Natural Resources Science 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)

Bruce Vondracek

Marcus Beck – Ph.D., Conservation Biology (Fisheries and Aquatic Biology track) Jennifer Biederman – Ph.D. Conservation Biology (Fisheries and Aquatic Biology track) Bethany Blick – M.S., Water Resources Science 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

William French, Ph.D.-Conservation Biology (Fisheries and Aquatic Biology track) David Huff – Ph.D., Conservation Biology (Fisheries and Aquatic Biology track) Matt Kocian – M.S., Conservation Biology (Fisheries and Aquatic Biology track) Jennifer Keville, M.S.-Water Resources Science

Jessie Lepore, M.S.-Conservation Biology (Fisheries and Aquatic Biology track) 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.

Bruce Vondracek

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

Haibo Wan, Post Doctoral Researcher, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota. 6 January 2009-30 June 2009.

Haibo Wan, Research Fellow, Department of Forest Resources, July 2010-present

UNDERGRADUATE MENTORING

No undergraduate research projects supported in 2009-2010

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
- Associate Editor, Journal of Raptor Research

Manuscript Reviews (2009/2010)

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

Proposal Reviews

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

David C. Fulton

- Member, Planning Committee, Pathways to Success: Integrating Human Dimensions into Fisheries and Wildlife Management, Conference October 2010.
- 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 (2009/2010)

Human Dimensions of Wildlife (2) Environmental Management (1) Journal of Wildlife Management (6) Society and Natural Resources (2)

Bruce Vondracek

- 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 (2009/2010)

Environmental Management (2) Fisheries Management and Ecology (1) Forest Ecology and Management (1) Hydrobiologia (1) North American Journal of Fisheries Management (1)

Book Reviews

The Ecology and Historical Management of the Northern Pike in Minnesota, University of Minnesota Press.

RESEARCH PROJECTS

Ongoing projects

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, completed vegetation classification and delineation along survey routes in Wisconsin and Minnesota in 2009, defended his M.S. thesis in 2010, and is in the process of making final thesis revisions.

Our overall objective was 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. 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,

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- (3) Relate temporal changes in land cover types to woodcock counts,
- (4) Compare current cover type composition along routes to current 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. Operation data collection in 2010.

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.

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 field seasons (2009 and 2010) completed. Thesis preparation underway.

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. Ph.D. dissertation defended in 2010 and final revisions to dissertation in progress.

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 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, and hermit thrush nestlings. We tracked ovenbird, wood thrush, and hermit thrush nestlings. We tracked ovenbird, wood thrush, and hermit thrush nestlings 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 - 10-year-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.

Quality assessments and restoration potential of groundwater fed streams within the watersheds of Minnesota Valley National Wildlife Refuge

\$10,000 Funding: U.S. Fish and Wildlife Service Region 3 Quick Response Research Student: Veronica Bullock (M.S. Conservation Biology, Fisheries and Aquatic Biology track).

In 2005, the US Fish and Wildlife Service (USFWS) Minnesota Valley National Wildlife Refuge (Refuge) initiated a partnership with the Minnesota Department of Natural Resources (MNDNR), Trout Unlimited (TU) and several other organizations to evaluate the quality of a Refuge groundwater fed stream as suitable habitat for brook trout, a USFWS Region 3 Conservation Priority species. There are several groundwater fed streams within Refuge that are currently designated trout streams and several that may have the potential to support trout, due to their morphological condition and water quality parameters. Although many organizations have been interested in confirming the condition of these streams, there has not been a coordinated effort to determine whether these streams have suitable water quality and quantity to support trout and other aquatic organisms. The goal of this study is to collect information to determine the potential recovery of several streams located in the metro twin cities area. Specific objectives are to: (1) determine the stream health of seven urban streams located in lower Refuge, specifically in relation to water quality and habitat characteristics required by brook trout, (2) locate other groundwater streams in the watersheds of Refuge that may display suitable habitat to support a diverse and healthy assortment of biota including brook trout to compare with the seven study streams, and (3) work closely with concerned partners such as MNDNR, TU, Lower Minnesota River Watershed District, and the USFWS to conduct stream assessments and rank them in order of restoration potential. This project supports the MNDNR Stream Management Plans for streams entering the Refuge and the Lower Minnesota River Watershed Districts Management plan, which includes improving water quality in streams and wetlands throughout the District.

Scaleable indices of watershed health

\$188,000 Funding: Minnesota Department of Natural Resources.Student: Bethany Blick (M.S.-Water Resources Science Program) Research Fellow, Haibo Wan

Status: Funding began 15 June 2008; data collection and metric development is nearing completion.

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

Understanding human behaviors concerning lake shoreline management

\$230,000 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: Data have been collected and dissertation manuscripts are being prepared.

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. Information from the first phase of the study is being used to design field experiments to test the effectiveness of diverse communication and education strategies to increase shoreline restoration activity.

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. Student: Dave Fronczak (M.S., Natural Resources Science and Management – Wildlife Ecology and Management)

Status: Research Work Order established and first sample of EP sandhill cranes captured in late 2009 and early 2010. Additional project objectives identified and expanded to include survey evaluation in 2010.

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.

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, weaktie 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

Assessing the cumulative impacts to near-shore, in-water habitat

\$300,000 Funding: Environment and Natural Resources Trust Fund as recommended by the Legislative Citizens Committee on Minnesota's Resources. Students: Jennifer Keville and Jessie Lepore

Human structures related to shoreline development, such as docks, boatlifts, and other structures, and disturbance from recreational activity may have a cumulative impact on aquatic ecosystems. Near-shore areas (< 4.5 m deep) often contain most of the vegetation and are generally the spawning area for fish. Several studies have addressed the effects of incremental changes on lake ecosystems despite ongoing concerns about the rate and extent of near-shore, in-water habitat alterations, and expansion of in-lake structures. However, there is limited knowledge about the cumulative effects of human activities on aquatic habitat, water quality, and fish populations, which has hindered regulatory authorities and lake managers to guide landowners toward lower impact practices. We will assess the extent of near-shore vegetation, fish, and macroinvertebrates along a gradient of shoreline development and develop a framework to assess cumulative impacts on whole lake systems. We will use aerial photos and existing DNR data to estimate whole lake disturbances of ~100 lakes in the Northern Lakes and Forests Ecoregion. We will also conduct assessments of a

subset of lakes (~30) at the individual lot scale, to quantify impacts to vegetation and fish along a gradient of shoreline development and shoreline types. Finally, we will assess the biovolume, species, and areal coverage of aquatic macrophytes in 12 lakes (included in the 30 lake subset). We will use our research to develop a model to predict the cumulative impact of development on aquatic ecosystems, providing a tool to guide lake managers toward sustainable near-shore, in-water development.

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. Student: Beth Rigby (Ph.D., Natural Resources Science and Management – Wildlife Ecology and Management)

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.

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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 commended. Conversely, other types of variation in detectability might induce only inconsequential errors in survey results; then the detectability adjustments may not be warranted.

Human Dimensions Research Fellow

\$215,000 Funding: Minnesota Department of Natural Resources. Principal Investigator: David C. Fulton. Postdoctoral Research Associate: Susan Schroeder (Ph.D., Natural Resource Science and Management - Environmental Science Policy and Management)

Status: .The first year of projects have been identified

There is continued 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.

Predicting and mitigating vulnerability of trout streams

\$299,000 Funding: Environment and Natural Resources Trust Fund as recommended by the Legislative Citizens Committee on Minnesota's Resources. Students: Jennifer Biederman, William French, and Jane Louwsma

Trout require streams with excellent water quality that are fed by groundwaters, which keep streams cold in summer but ice-free in winter. The trout sport-fishing industry is vulnerable to global climate changes that can increase stream temperatures, alter the cold-adapted aquatic insects that form trout diets, and affect trout reproduction. Increasing air temperatures are predicted to increase the maximum water temperatures during summer, but also are very likely to dramatically change winter thermal conditions in trout streams. Our objectives are to: (1) investigate the role of stream bank vegetation and adjacent land use to minimize changes in stream temperatures in relation to climate change during summer; (2) determine winter diets and growth of trout populations; and (3) determine kinds, abundances, and timing of growth patterns of cold-adapted insects that are essential in winter diets of trout. We will work on 36 trout streams in the Driftless Area, using GIS coupled with habitat surveys for objective (1); seining and standard diet analysis techniques for objective (2); and rapid bioassessment protocols for objective (3). The project will identify and rank the streams most vulnerable to increases in summer high temperatures, and will identify cold-adapted insects that are most critical to trout diets and growth during winter. Trout fishing annually provides more than \$150 million dollars in direct expenditures to local economies in Minnesota and \$654 million through the Driftless Region (Trout Unlimited, 2008). With re-circulating dollars this represents more than one-billion dollars of economic stimulus to local economies. Our research will enable us to identify streams and food species that are most vulnerable to increasing temperatures, and translate scientific results into management strategies to protect and conserve this valuable industry.

Summarizing data and developing conservation practices for eagle nesting and concentration areas in the Midwest Region

\$21,710. Funding: U.S. Fish and Wildlife Service. Principal Investigator: David E. Andersen. Post-doctoral Researcher: Jason E. Bruggeman.

Status: Agreement supporting this project processed and in place.

Although bald eagles and golden eagles were delisted pursuant to the Endangered Species Act in 2007, they remain protected from harassment and disturbance under the Bald and Golden Eagle Protection Act (Eagle Act). The Eagle Act defines Important Eagle Use Areas as, "an eagle nest, foraging area, or communal roost site that eagles rely on for breeding, sheltering, or feeding, and the landscape features surrounding such nest, foraging area, or roost site that are essential for the continued viability of the site for breeding, feeding, or sheltering eagles" (50 CFR §22.3).

Foraging, communal roosting, and wintering areas (here-after called "concentration areas") are often harder to locate and protect than nests, but may be equally important to the survival of the species. Consequently, a violation of the Eagle Act can occur if human activity at or near these concentration areas agitates eagles to the extent it causes a loss of productivity, injury, or death.

Adequate protection of eagle nesting and concentration areas is contingent upon accurate location data; however, there is currently no database of eagle concentration areas. Much information regarding eagle concentration areas is known but disparate in consistency and quality; locations may be known to one party but not shared with another. Additionally, the frequency of updating nest location and nest productivity data varies among parties. Databases of nest locations are frequently managed by state agencies and not readily shared between states. Significant amount of information on eagle concentration areas, nest disturbance, and disturbance minimization measures is in the form of "gray" literature including unpublished graduate theses, technical reports, annual monitoring reports, etc. These data need to be compiled and summarized so biologists may benefit from this information. For efficient and meaningful protection of eagles, gaps in information need to be filled and existing knowledge compiled, summarized and shared. With these improvements, the Fish and Wildlife Service can make conservation decisions grounded in scientific rationale. These conservation decisions need to be compiled into a set of Advanced Conservation Practices (ACPs), which will be tailored to various industries (wind, electric) to ensure eagle management and population growth. ACPs are scientifically-supportable measures approved by the Fish and Wildlife Service that represent the best-available techniques to reduce eagle disturbance and/or ongoing mortalities to a level where remaining take is unavoidable.

Resource use of arctic peregrine falcons along the Colville River, Alaska

\$205,000. Funding: U.S. Bureau of Land Management. Principal Investigators: David E. Andersen and Patricia L. Kennedy (Oregon State University). Student: not yet selected.

Status: Intra-agency agreement to support this project in place. Research Work Order being prepared and initial advertisement for a student.

The Colville River Special Area (CRSA) was designated in 1977 to protect nesting and foraging habitat of the then-endangered arctic peregrine falcon (*Falco peregrinus tundrius*). The CRSA is approximately 2.44 million acres, and provides nesting habitat

for approximately one-fourth of Alaska's arctic peregrine falcon population. To afford additional protections to the arctic peregrine falcon, the Record of Decision (ROD) from the 2004 Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) for the Northwest planning unit of the NPR-A and the final ROD for the Northeast planning unit required a management plan for the arctic peregrine falcon in the CRSA to be developed and put into effect prior to any lease sales. The Colville River Special Area Management Plan (CRSAMP) was completed in July 2008 (Bureau of Land Management 2008 Colville River Special Area Management Plan) and specifically addresses the need for additional measures to protect arctic peregrine falcon nesting habitat and the need for research to determine the characteristics of peregrine falcon nesting habitat in the CRSA.

One objective of the CRSAMP was to: Improve knowledge about the ecology, life history, and behavior of arctic peregrine falcons to help decision makers and managers make informed decisions on proposals that could have an impact on falcons. To address that information need, we propose to (1) summarize and evaluate existing CRSA peregrine nesting data to assess nesting habitat use and related productivity, and (2) implement additional data collection efforts focused on assessing nesting area occupancy related to habitat and other factors associated with productivity.

Ongoing 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. Student: Kevin Heist.

Status: Research Work Order established and Ph.D. graduate student selected. The study was designed over the winter of 2009-2010, and the initial field season was completed in spring 2010.

Wind energy development is occurring at a rapid pace and is expected to increase dramatically under the U.S. objective of producing 20% 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.

Field sites were selected for the first field season (spring 2010) at 1) wind farms where fatality searches were being conducted (independently of this study), and 2) locations of

varying distances from physiographic and landscape features that may influence bird and bat abundance during migration, including riparian corridors and grasslands under federal and state protection. The first season of data collection was completed, with nightly recordings from 19 sites in northern Iowa and southern Minnesota. Recording began again in August, 2010 at the 19 original sites and 12 additional sites in northern Texas and central and western Minnesota. Sites include private farmland, state parks and wildlife management areas, and federal waterfowl production areas and wildlife refuges.

Ultrasonic (bat) recordings from spring 2010 were processed and analyzed. Bat calls were recorded regularly at all 19 recorders, and a total of over 7,000 bat passes were recorded. Activity was clearly heightened near forest edges in wetter regions relative to other sites. Acoustic data from spring 2010 is currently being processed and analyzed.

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. All field seasons completed. Final report due February 2011.

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

Determining the olfactory sensitivity of Asian carp (*Hypophthalichthys* spp.) to putative hormonal sex pheromones

\$94,604 Funding: U.S. Geological Survey (Ed Little, Columbia River Lab). Principal Investigator: Peter Sorensen. Post Doctoral Researcher: Hangkyo Lim

All species of carp that have been studied to date (common carp, crucian carp, goldfish) have been found to rely heavily upon species-specific hormonally-derived sex pheromones (chemical cues that pass between members of the same species) to mediate reproductive interactions. This study hypothesizes that Asian carps function in similar manners and use novel, limited sets of hormonal metabolites as sex pheromones as well. It examines this hypothesis by measuring electrophysiological responses from their olfactory systems (electro-olfactogram or EOG) to a range of over 100 hormonal products to determine if any are detected with extraordinary sensitivity (picomolar) and specificity. The project started in September 2010. We are now raising juvenile bighead carp to a size that they can be tested and have established the EOG technique using goldfish as a surrogate. Steroid mixtures will be tested on bighead carp by the end of November 2010.

Completed Research

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)

The Minnesota Department of Natural Resources (DNR) supported 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 included different methods of reducing harvest pressure on males while increasing harvest on females. The DNR was interested in ascertaining the level of acceptance Minnesota deer hunters have towards regulation changes. The purpose of this study was 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 were 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 special park hunts and a random sample of 2,000 hunters who participated in the early antlerless season using a mail survey with up to 4 total contacts. The project served as a dissertation for L. J. Cornicelli. The dissertation was successfully defended November 2009, and peer-review manuscripts are in preparation.

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.

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 dissertation 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

(http://www.dnr.state.mn.us/areas/fisheries/lanesboro/management.html). 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)

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.

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 orvzivorus) 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.

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)

This project provided funding for a research fellow to collect human dimensions data in support of several key programmatic areas for fisheries and wildlife. This information has proven important to agency decision-making for waterfowl, small game, and a variety of fisheries management programs. In addition, the project supported completion of a PhD dissertation.

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 evaluated 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.

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 drafting and being prepared for review.

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.

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.

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. Sample collection completed in 2009 and 2010 and final report submitted in 2010.

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.

Source population assignment of Isle Royale and Minnesota North Shore brook trout

\$7,264. Funding: U.S. Fish and Wildlife Service. Principal Investigator: Loren M. Miller. Student: Jacob Hennig (Undergraduate Research Assistant).

The U. S. Fish and Wildlife Service Ashland, WI, office contributed to a research project on coaster brook trout genetics. Rehabilitation efforts for coaster brook trout in Lake Superior have included stocking fish from various broodstocks, including two strains from Isle Royale derived from populations in Tobin Harbor and Siskiwit Bay. In one part of our research, we genetically screened 45 wild adults captured at Tobin Harbor for gamete collection and determined they were not strays from other populations, which could alter the genetic diversity of the broodstock. In a second part of our study, we examined the impact of coaster brook trout stocking on natural populations along Minnesota's North Shore of Lake Superior. The Minnesota Department of Natural Resources (MNDNR) has documented a slight increase in larger brook trout in recent years at some North Shore streams. These large individuals may result from recent restrictive changes in regulations allowing fish to get older and grow larger, or from straying of potentially faster-growing hatchery fish from coaster brook trout strains. Using microsatellite DNA markers, we evaluated potential coaster hatchery strain ancestry in brook trout sampled in 20 MN North Shore streams and Grand Portage streams. All 31 fish from Grand Portage streams assigned to hatchery strains. Of 302 fish from MN North Shore streams, approximately 16% had hatchery strain ancestry but coaster hatchery fish did not account for most of the larger fish. These results will contribute to determining which management strategies are effective or necessary to increase the number of large brook trout in Lake Superior tributaries. The results were reported to the USFWS and MNDNR and will be incorporated into a presentation at the 2010 Midwest Fish and Wildlife Conference and a subsequent peer-reviewed manuscript.

