# The Importance of Human Dimensions Research in Stream Restoration

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**1. Stream restoration success depends not only on ecological outcomes, but also on manager learning and public support.**
**2. Restoration managers, practitioners, and researchers in the Driftless region have huge amounts of knowledge about the human dimensions of stream restoration.**
**3. Some attempts have been made to synthesize angler perspectives on restoration practices and the major economic impacts of restored trout streams.**
**4. There is a need for more peer reviewed research into the human dimensions of stream restoration in the region.**
**5. Collaboration across states, with tribal nations, and between disciplines will be central to learning more about how to engage public stakeholders to support stream restoration outcomes.**

Restoration | Social Science | Stakeholders | Economics | Human Dimensions

In their landmark paper defining standards for ecologically successful restoration, Palmer, et al. (1) distinguished between three axes for evaluation of river restoration projects: ecological; learning; and stakeholder successes. Ecological success featured five characteristics: basis on a guiding image; measurable ecological improvement; improved resilience; absence of lasting harm; and publicly available pre- and post-assessment data. Meanwhile, learning success involved "advances in scientific knowledge and management practices that will benefit future restoration action," and stakeholder success referred to "human satisfaction with restoration outcome" (1). The most effective river restoration projects, they argued, meet all three axes of success.

These three axes are central to stream and river restoration in the Driftless Area, and such science reviews as presented in this Special Publication of the 11th Annual Driftless Area Symposium are attempts to meet at least two of these goals: gathering and synthesizing the best available science for restoration work in the Driftless (i.e., ecological success) and sharing that research among managers, researchers, and practitioners in the region (i.e., learning success). But the third axis—stakeholder success—may well be just as critical to Driftless Area restoration project outcomes and is largely understudied across stream restoration literature in the Driftless, nationally, and internationally.

Bernhardt, et al. (2) found a positive correlation between community involvement and ecological success in a nationwide study, while Druschke and Hychka (3) found that long-term public engagement played a central role in achieving aquatic restoration project successes in New England—even for projects that were focused primarily on ecological indicators of success. But, as Druschke and Hychka (3) detailed, "little research explores how to cultivate the sorts of quality public engagement experiences that might contribute to restoration success." And so, while natural resource agencies and organizations (e.g., Wisconsin Department of Natural Resources, Trout Unlimited, Natural Resources Conservation Service) work to restore Driftless Area streams for trout, and increasingly for non-game species, it is humans who conceive of projects, fund them, enact them, monitor them, and decide whether or not to support them. Likewise, it is humans who have an outsized impact on trout stream quality across the region based on fishing practices, land management practices, and agricultural practices. But, again, these human impacts, perspectives, and values are largely understudied.

**Fig. 1.** Paul Hayes educates participants on the 2018 TUDARE bus tour about the ongoing restoration project on Wisconsin's Weister Creek.

The bulk of this Special Publication is understandably and necessarily focused on physical and biological attributes of Driftless watersheds and science-based restoration practices that might support the restoration of dynamic streams in the Driftless in the face of climate change. But future projects will face major implementation challenges without better understanding of the human dimensions of stream restoration in our

## Statement of Interest

Trout angling offers major economic benefits to communities throughout the Driftless Area region, and there is evidence to suggest that degraded streams negatively impact both trout and trout anglers. More work is needed to consider the wider impacts of stream restoration, and to consider how fish, streams, and communities can benefit from these projects.

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Driftless context, in terms of both learning and stakeholder successes, focused on managers in the case of the former, and public stakeholders in the case of the latter. The remainder of this section, then, will focus on what we currently know about the human dimensions of stream restoration in the Driftless, and then point to directions for necessary further research.

## What We Know: Human Dimensions Research in the Driftless

Generally speaking, Driftless researchers, managers, and practitioners have huge amounts of knowledge about the human dimensions of stream restoration in the region (Fig. 1). The Wisconsin and Minnesota Departments of Natural Resources are well known for their deep history of trout stream habitat management, dating back a century. Work in the region was guided in large part by Ray White and Oscar Brynildson's (4) "Guidelines for Management of Trout Stream Habitat in Wisconsin," a groundbreaking text that contributed to learning successes by offering technical advice based in a philosophy of encouraging a river's natural processes. The history of recreational trout fishing in the Driftless, coupled with an early management orientation in the region, means that managers have been thinking—both explicitly and implicitly—about human aspects of stream restoration for decades.

Referring to work in the Driftless' Pecatonica Watershed, Steve Richter, director of conservation programs for The Nature Conservancy in Wisconsin, recently explained the importance of looking beyond the streambanks to human actors: "You can't just do stream restoration projects without looking at the practices in the adjacent fields. And you can't implement new practices in the field without having strong relationships with farmers and landowners. We took the time to develop strong relationships. That time spent in building relationships leads to bigger outcomes" (5). As Dieterman and Merten (6) recently suggested in their comprehensive history of trout management in southeastern Minnesota, "Effective and successful fisheries management requires information on the three primary components of a fishery: the biota (primarily fish), their habitat, and the benefits they provide to society (7)" (p. 16).

And yet, mirroring a national and international trend, there is a lack of published research into the human dimensions of stream restoration in the Driftless. As Dieterman and Snook (8) emphasized, while the Driftless region was an early leader in the biological evaluation of stream habitat projects and needs to continue that close biological evaluation with new habitat practices, "Perhaps more importantly, direct tangible benefits of habitat projects for anglers have been less frequently investigated" (8). They urged more specific, measurable project objectives, on both the biological and sociodemographic fronts. In the spirit of this Special Publication—which intends to offer "a review of the scopes of programs, projects, activities, and the underlying assumptions regarding scientific objectives to determine whether they are valid and credible," and to make explicit the links between restoration practices and science—I begin by reviewing the existing state of the science.

While, as mentioned above, there is a general lack of peer reviewed literature into the human dimensions of stream restoration in the Driftless, there are two clusters of research—angler preferences and economic impacts—that offer a good foundation for building a more robust archive of social science and social-ecological science in this realm. Both clusters are primarily driven by state managers and researchers in the Minnesota, Wisconsin, and Iowa Departments of Natural Resources, with contributions from Trout Unlimited and graduate students in the region.

**Fig. 2.** Trout lover Emma Lundberg shows off a brook trout in a Driftless stream. Credit: M. Mitro.

**Trout Angler Preferences in the Driftless.** Statewide surveys of angler preferences offer important insight into the possibilities for stream restoration (Fig. 2). While the Wisconsin Department of Natural Resources does not consistently survey anglers in the state, they have conducted several statewide surveys. Schroeder and Fulton (9) indicated that the Minnesota Department of Natural Resources conducts annual social surveys of angler attitudes; some data from those surveys are included in a variety of reports and manuscripts. Every five years, the Iowa Department of Natural Resources surveys 10,000 trout privilege purchasers, though results from those surveys do not seem to be publicly available.

In Minnesota statewide, anglers have consistently placed importance on habitat protection and restoration. A statewide survey of anglers who purchased licenses for the 2003 fishing season found "Over three-fourths of respondents felt that improving lake and stream habitat (91.3%) and protecting the land surrounding lakes and streams were important activities (83.2%)" (10). In southeastern Minnesota specifically, trout anglers linked stream health with agricultural induced erosion, with a majority of anglers indicating that livestock fencing, riparian vegetation, and rip-rap would be at least "very effective" (11). A decade later, a statewide survey of 2014 Minnesota fishing license holders ages 18 and over showed similar interest, with respondents rating "protecting the habitat in lakes and streams" as the most important management activity, and "restoring the habitat in lakes and streams also rating above "important" (4.2 out of 5) (12).

Protection and restoration of trout streams seems to play an important role in supporting and maintaining a strong population of trout anglers (Fig. 3). A recent Wisconsin survey of lapsed trout anglers (anglers who didn't purchase a trout stamp for three years after five consecutive years of purchase) found that quality of the trout fishery was an important factor in the trout angling lapse, and recognized that, coupled with

**Fig. 3.** A fly fisher enjoys a newly restored section of a Driftless stream.

external factors, habitat improvement projects can contribute to angler satisfaction (13). These findings are not divided by region, however, to get a sense of Driftless-specific responses. A statewide survey of active Wisconsin trout anglers showed that, statewide, 56% of trout anglers indicated a preference or requirement for a stream with restored habitat, while 74% would prefer not to or would never fish a degraded stream (14). Petchenik (14) hypothesized, "the imbalance between these two measures may be one of perception: anglers are more likely able to perceive poor stream habitat but may have more difficulty perceiving stream restoration, particularly if it is an angler's first experience at a stream" (p. 54). Use of live bait and years of angling experience were found to impact responses. A statewide survey of anglers who purchased Minnesota trout stamps and indicated they fished in southeastern Minnesota found that stream improvement projects most positively affected satisfaction with trout fishing in southeast Minnesota, with anglers supportive of trout stream easements, and fly anglers significantly more supportive of trout stream easements than lure and bait anglers (15). Anglers were supportive of trout stream easements newly in place, again with fly anglers more supportive (15). A recent comprehensive study of the economic impact of trout angling in the Driftless showed that 88.5% of respondents reported being aware of trout stream preservation and restoration efforts in the region, with almost 80% of that group reporting that past efforts prompted them to be more likely fish in the region and 72.7% indicating that future trout stream restoration efforts would make them more likely to fish in the region (16).

Minnesota anglers also seem fairly satisfied with state managers' work on habitat protection and restoration. Statewide respondents holding 2003 licenses indicated that the Minnesota Department of Natural Resources "performed well at improving lake and stream habitat (68.1%) and protecting the land surrounding lakes and streams (70.1%)" (10). A decade later, Schroeder (12) reported that "Respondents felt that the Minnesota Department of Natural Resources was doing well at protecting habitat in lakes and streams, protecting land surrounding lakes and streams, and educating people on how they can help protect lakes and streams" (12). Schroeder (12) recommended activities for future focus related to habitat management, including, "managing shoreline to protect fish spawning sites, restoring the habitat in lakes and streams, restoring land surrounding lakes and streams that have been damaged/developed, and educating people about lake and stream ecology/habitat" (p. v). Schroeder and Fulton's (9) recent work, based on a survey of Minnesota fishing license holders, reminded readers that management outcomes depend in large part on angler perceptions about those management decisions. Importantly, they found that acceptance of management decisions depended largely on impressions of voice and procedural fairness.

Managing increased fishing pressure—generally and in the wake of habitat restoration projects—will continue to be an issue for state managers. In Wisconsin's Kickapoo River Valley, a two-stage survey (intercept with mail follow-up) and series of focus group interviews conducted with trout anglers in 1994/1995 demonstrated respondent interest in improving fisheries management via management of future fishing pressure and the provision of larger fish, more fish, and greater species diversity on Valley streams (17). A 1999 follow-up to that survey showed that respondents were generally very satisfied with fisheries and river management practices in southwestern Wisconsin, though there continued to be

concern about future crowding (18). In southeast Minnesota, creel surveys were conducted during the 2013 season on 11 southeast Minnesota streams; habitat enhancement projects had occurred on three stream sites within the past eight years to allow for initial pre- and post-project evaluations, with a fourth site offering a control (8). Pre- and post-project comparisons revealed few differences in demographics, catch rates, participation, or satisfaction pre- and post-project, with the exception of Trout Run Creek, which saw a 200% increase in angler pressure post-project (8).

In terms of preferred habitat, statewide in Minnesota, respondents indicated a preference for dense forest adjacent to streams and rivers, natural rocky banks, and rocky stream/river beds (12). This result may not hold true for the Driftless region, however. An earlier survey of trout angling in southeastern Minnesota detailed angler opinions regarding desired stream characteristics. Respondents preferred partial canopy cover and low brush on banks, with views of hills or bluffs, and respondents had a neutral response to the impact of pasture with animals (11). Respondents preferred "medium streams that are 10 – 25 feet wide, with a mix of both fast and slow water that is usually clear, even in times of high water" (11). In Wisconsin, data from the Department of Natural Resources' Driftless Area Master Plan survey indicated a preference for grass-lined banks over forested or pastured banks, but the survey was targeted only to individuals who signed up to receive updates about the Master Plan (19). A 2014 Wisconsin Department of Natural Resources Trout Angler Survey, meanwhile, indicated a preference for forested banks across the state. Approximately three respondents in ten statewide indicated they would never or would prefer not to fish a stream that was pastured or mowed (29%) or to fish a stream with an overgrown bank (30%) (14). Statewide, a thin majority of trout anglers needed or preferred forested stream banks (51%) and an equal percentage (51%) preferred not to or would never fish a stream where trees have been removed along the bank (14). Driftless-specific responses, however, offered directly by Petchenik indicated that while Driftless-specific sample size was limited, Driftless respondents to the statewide survey, unlike counterparts in the Master Plan survey, had more of a preference to fish on pastured or mowed stream banks and more indifference to forested stream banks compared with respondents from other parts of the state (14).

While the research was not specifically focused on stream management, a recent study of angler preferences for the Minnesota winter fishery showed that fly anglers tended to be specialized on a small group of streams, including branches of the Whitewater River, and that easy access was one of the common reasons driving angler preference (20). This point about angler access might influence future restoration design.

Much of what we know about trout angler preferences in the region comes from reports of state surveys of anglers. A notable methodological exception to that trend is work that emerged from five focus groups conducted in southeastern Minnesota to explore factors influencing riparian and watershed management among landowners in the area (21). Though the groups varied somewhat based on location and cultural aspects and concerns, emergent themes included strong interests in multi-generational stewardship, coupled with concerns about flooding, erosion, failed agricultural policy, corporatization of agriculture, chemical and livestock pollution, and increasing development (21). These interests suggest directions for future research in the region.

Another methodological exception is a pre- and post-project survey-based assessment of a conservation intervention in southeastern Minnesota's Wells Creek Watershed (22). While not angling-specific, a 1994 landowner survey gathered baseline data from southeastern Minnesota counties, allowing for comparison between the Wells Creek Watershed, other bluffland counties (Goodhue, Wabasha, Olmstead, Winona, Fillmore, and Houston), and other southeastern Minnesota counties (Rice, Steele, Dodge, Freeborn, and Mower). Conservation actions, including social and educational activities related to conservation actions, were introduced in the Wells Creek Watershed, and a 1999 survey was used to determine whether any noticeable differences emerged between the Wells Creek Watershed, neighboring counties, and other southeastern Minnesota counties. Results demonstrated very few changes in the perceptions and behaviors of landowners over the five-year span. The study noted that, "Changes that did occur tended to bring the responses of landowners in the bluffland and other southeastern Minnesota counties closer to those in Wells Creek—homogenizing views and actions," but respondents demonstrated some increasing concerns about increasing development (22). Concern with "quality of fish habitat" did not show significant change (22).

A final methodological outlier comes from Epton and Fulton (23) related to controversial trout management efforts in southeastern Minnesota in the late 1990s. Concerns from the Minnesota Trout Association (MTA) and Trout Unlimited (TU) about results from a 1997 survey related to proposed trout regulation changes in southeastern Minnesota (24) led to the 1998 formation of a stakeholder committee facilitated by Minnesota Department of Natural Resources and the beginning of a public comment process. Participatory decision-making in the process was assessed according to sense of need, agreement on technical boundaries, perceptions of one's own power, and sense of urgency (23). While all stakeholders agreed on the need for the process, and all but one agreed on the technical boundaries, there was a great deal of disagreement about the perception of one's own power and sense of urgency(23). Participants reported mixed responses about their satisfaction with the process, including satisfaction with outcomes, personal commitment, and willingness to participate again (23). In terms of procedural justice, respondents mostly agreed that they had a high level of perception of voice and influence, but were much more mixed in terms of fairness of outcomes and procedural fairness (23). Responses about trust in authority, neutrality of authority, respect, pride in participation, and legitimacy of authority were mixed, as well (23). Epton and Fulton (23) recommended the development of future, meaningful opportunities for stakeholders to provide input into decision-making processes in ways that build trust and offer longer-term follow-through.

## Economic Impacts of Trout and Trout Restoration Efforts in the Driftless

There is a small but relatively thorough body of knowledge about the economic impacts of trout angling in the Driftless.

Over twenty years ago, Anderson and Marcouiller (17) noted the importance of trout angling as a rural economic engine in the Driftless region, including both direct and indirect

impacts, with research focused specifically on the Kickapoo River Valley. Through a two-stage intercept and mail survey and focus groups, mentioned above, the study found that half of trout anglers surveyed were nonlocal, and that visiting anglers spent almost $220,000 during the 1994 season, and contributed almost $500,000 to total gross output (17). The study pointed to past investments of nearly $330,000 (in 1994 dollars) on the Timber Coulee system and to the impacts of those restoration efforts on supporting increasing spending by out-of-town anglers in the area (17). A 1999 follow-up to that 1994 survey in the Kickapoo Valley demonstrated rapid growth in angling, with double the numbers of trout anglers from 1994 to 1999, including a three-to-one increase in nonlocal anglers, and an increase in total expenditures, including a 360% increase in nonlocal angler expenditures (18). Nonlocal anglers spent just over $1,000,000 in the region in 1999, with a total economic impact of $1.5 million.

In Minnesota, a 2000 statewide mail survey of Minnesota trout stamp holders focused on the economic and social benefits of coldwater angling. It demonstrated that the southeastern portion of the state accounted for 33.1% of all coldwater angling trips and 75% of stream fishing trips (25). Total direct sales due to stream anglers amounted to over $30 million for the year, with another $18 million in direct income, supporting over 632 full- and part-time jobs (25).

A comprehensive survey of Driftless-wide economic impacts of trout angling was conducted in 2016. 2,000 surveys were mailed to a representative sample of Wisconsin, Minnesota, and Iowa trout stamp holders who did not reside in a county fully contained in the Driftless (1.5% of the total population of estimated trout stamp holders in Wisconsin, Minnesota, and Iowa living outside the Driftless), as well as being made available online for mail survey recipients to encourage others to respond online. This yielded 310 useable responses, with Trout Unlimited Driftless Area Restoration Effort (TUDARE) providing expenditure information on restoration projects to complete the analyses. The study estimated the total economic impact of fishing to the Driftless Area in 2015 at $703,676,674.50, supporting 6,597 jobs in the region (16). The total effect of fishing in the Driftless Area in 2015, including both Driftless Area and non-Driftless Area angler spending is $1,627,186,794.79 (16).

## What We Need to Know: Recommendations for Future Research into the Human Dimensions of Stream Restoration in the Driftless

While the existing research detailed above focuses on angler perspectives and economic impacts, this work is not nearly as robust as it could be. Presumably, states have a plethora of long-term data from angler surveys that could be analyzed by researchers, and there are a variety of new questions that could be asked about angler perspectives and economic impacts across the region. Further, there are a variety of other questions to be asked of Driftless stream restoration projects and a variety of methodologies that could be adopted beyond angler surveys and valuation studies. This section closes with suggestions for future human dimensions research in the Driftless that could support Special Publication's goal to "contribute to providing increased resilience for stream ecosystems in a changing climate."

**Fig. 4.** Angler fishing a Driftless Area stream flowing through a working pasture. Credit: D. Welter.

### A. Keep doing what we're doing....

- Continue research that explores angler perspectives on trout angling in the region.
- Continue research into economic impacts.

### B. And extend existing work....

- Consider the diverse uses of Driftless Area streams, with special focus on the intersecting needs and impacts of trout angling and livestock grazing.
- Improve access to state data that already exists, offering important new possibilities for analysis.
- Existing state surveys and experiential knowledge offer great insights into useful and productive questions that deserve follow-up. Research questions can and should flow from this existing pool of expertise: including state surveys and master plans, public comments, and grounded expertise. Dieterman and Merten (6), for instance, catalogued historical southeastern Minnesota creel surveys that could be mined for information. A 2013 roving-roving creel survey of 24 southeastern Minnesota trout stream areas urged additional human dimension surveys to identify factors contributing to retention and recruitment of new anglers, young anglers (<16 years old), female anglers, and bait anglers (8), while a comprehensive comparison of pre- and post-habitat improvement project creel surveys concluded with a recommendation for future creel surveys focused on a smaller number of stream sites, suggesting, "the compilation of existing data in this report should thus serve to provide more robust data for evaluations of future habitat projects implemented at the other seven stream sites" (8).
- Increase the amount of research focused on the impacts of specific restoration projects following the example of Dieterman and Snook (8), which noted the funding and sample size challenges of assessing sociodemographic and fishery-related benefits on particular streams, but offered

a comprehensive study design for approaching quantitative research related to angler perceptions pre- and post-habitat project implementation.

- Consider using existing public comments from management plans and meetings as a source of data for management related research, as well as to guide future research questions. A 1996 survey of southeastern Minnesota trout anglers related to a proposed change in fishing regulations, for instance, includes 15 pages of colorful narrative feedback about trout management that raises issues about access, philosophies of stocking, and elitism, among other issues (24).

- There is great potential for mixed methods and qualitative explorations into the human dimensions of stream restoration in the Driftless. Existing research remains in the realm of numbers: with basic survey data and economic calculations. Those quantitative data are important—and can be especially useful for supporting arguments (politically and fiscally) for stream restoration projects. But, given the deep history and passion of anglers, land managers, and restoration practitioners—and the often-contentious nature of managing this singular and multifunctional landscape—those passions and controversies don't always translate well to quantitative data.

- Likewise, there is a need to build human dimensions explorations of stream restoration in the region in conversation with the vast font of science-based knowledge about Driftless hydrology, geomorphology, and biology. This integrative, social-ecological approach will be essential to managing these streams into an increasingly uncertain future.

### C. Focus on adaptive management....

- Consider how human dimensions research and public engagement can support learning successes in adaptive management. There is a need for research that focuses on management expertise and practice.

### D. Increase the amount of peer reviewed literature....

- There is a need for an increase in peer reviewed literature about all aspects of the human dimensions of stream restoration in the Driftless. Driftless managers have a huge amount of knowledge about the social and managerial aspects of restoration, in addition to their physical and biological knowledge. Extending the peer review process outside of state agencies would add to the robustness and availability of those data.

### E. Build collaborations for richer human dimensions research....

- While much is understood about Trout Unlimited member perspectives on trout angling and stream restoration, there is a need to engage with and study populations outside the Trout Unlimited umbrella.

- Continued collaborations with staff from tribal nations, including the Ho-Chunk Nation, could contribute to a multifacted understanding of the past, present, and future of stream ecosystems in the Driftless.

- Engaged, participatory research methods can yield important data, while also serving to engage broad communities in stream restoration and management. Statewide surveys offer useful insights, but understanding the human dimensions of stream restoration in the Driftless poses two paired challenges: 1) Driftless-specific data are not always available in state surveys; and 2) state surveys only provide insights in state-specific areas of the Driftless. Coordinating survey efforts across states to provide a multi-state understanding of the region would be especially useful.

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