Emulating Riverine Landscape Controls of Beaver in Stream Restoration

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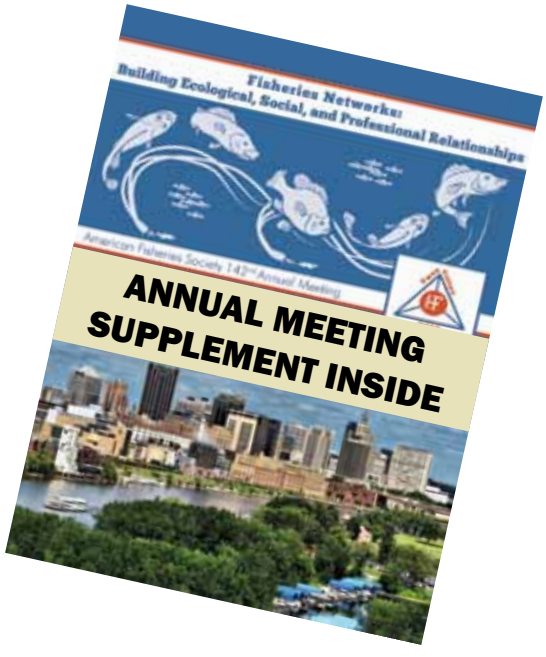

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	FS1001M "MUX"	IS1001 "ACN"	IS1001MCS
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Antenna Current	7.0 Ap-p	10.0 Ap-p	10.0 Ap-p
Auto-tuning	12 capacitors, electronically switched	10 capacitors, electronically switched	10 capacitors, electronically switched
Tags Read	134.2 FDX-B	134.2 FDX-B & HDX	134.2 FDX-B & HDX
Virtual Test Tag	Yes, digitally adjustable	Yes, digitally adjustable	Yes, digitally adjustable
Data Storage	1 x 128 KB: 5350 tags; 146 status reports	2 x 128 KB: 8900 tags; 151 status reports	2 x 128 KB: 15,600 tags; 151 status reports
Antenna Connections	6, multiplexed	1	12, multiplexed/synchronized
Communication Ports	1: RS232, DB-9	2 standard USB (Mini-B), CAN Bus. 2 optional Ethernet (RJ45) fibre optic	2 standard USB (Mini-B), CAN Bus. 2 optional Ethernet (RJ45) fibre optic
Synchronization Capability	No	Yes	Yes

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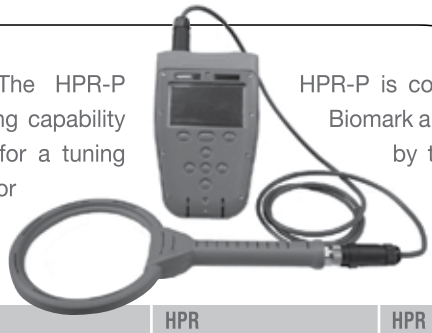

	FS2001	HPR	HPR Plus
Tags Read	125, 400, 134.2 FDX-B	134.2 FDX-B, HDX	134.2 FDX- B, HDX
Tag Memory Storage	4,400	1.6 million	1.6 million
Bluetooth	No	Yes	Yes
GPS	No	No	Yes
Comm. Port	RS232	USB	USB
Auto Tuning	No	No	Yes
Status Report	No	No	Yes
Noise Report	No	No	Yes
Water Proof	No	Yes	Yes
Display	Monochrome 1.5 x 5.8 CM	24 bit color 5.5 x 9.5 CM	24 bit color 5.5 x 9.5 CM

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246 Flow-choke structure with a simple contracted weir. Photo credit: Paul DeVries

Cover: *Castor canadensis*, Minette Layne

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Social Networks: Their Role in Fisheries

Bill Fisher, President

AFS President Fisher may be contacted at: wlf9@cornell.edu

The theme of the 2012 American Fisheries Society (AFS) Annual Meeting in Minneapolis–St. Paul, Minnesota, is "Fisheries Networks: Building Ecological, Social and Professional Relationships." This is the second of three articles about the theme and the plenary speakers who will address it. Dr. Barbara Knuth, the second plenary speaker, will be discussing social networks in fisheries. As many of you know, Barb is a Past President of AFS (2004–2005) and she presided over the very popular 135th Annual Meeting in Anchorage, Alaska. Currently, Barb is vice provost and dean of the Graduate School at Cornell University and professor of Natural Resource Policy.

Social network analysis has been applied to a variety of marine fisheries, including a small-scale lobster fishery in the Yucatan of Mexico, where scientists are examining how social networks correlate with the adaptive strategies of a group of fishermen who are experiencing resource scarcity.

Social networks play a crucial role in fisheries. Fishing occurs in heterogeneous aquatic environments, and capturing fish requires considerable information and involves much uncertainty. To improve their chances, fishermen use technology, instincts, and, perhaps most important, information from their social networks. Studies of marine fishermen show that they obtain two kinds of information in their social networks: current information on the location of fish stocks and long-term information about technical innovations and economic trends. At the National Oceanic and Atmospheric Administration (NOAA) Pacific Islands Fisheries Science Center, Human Dimensions Research Program, fisheries scientists are currently using social network analysis to evaluate the economic performance of Hawaii's longline fishery (NOAA 2012). Social network analysis has been applied to a variety of marine fisheries, including a small-scale lobster fishery in the Yucatan of Mexico, where scientists are examining how social networks correlate with the adaptive strategies of a group of fishermen who are experiencing resource scarcity (Lasseter 2008). Understanding social interactions among fishermen and how they adapt to changing environmental and resource conditions provides insights into their decision-making processes that can aid managers and policy makers.

For her plenary talk, Barb will address the importance of understanding social networks and how to cultivate them toward improving fisheries management capacity and fostering positive relationships among stakeholders, managers, and scientists. Her research focuses on the human dimensions of fisheries and wildlife management and policy, and she is known particularly for her work on risk perception, communication, and management associated with chemical contaminants in fish. She has served on National Academy of Sciences and Institute of Medicine committees, including those focused on improving the collection, management, and use of marine fisheries data and recreational fisheries survey methods, and on dioxins in the food supply. She currently serves on the Ocean Studies Board of the National Research Council and on the National Research Council Committee on the Effects of the *Deepwater Horizon* Oil Spill on Ecosystem Services in the Gulf of Mexico. She has served on numerous scientific panels and advisory boards, including the International Board of Technical Experts of the Great Lakes Fishery Commission and the Great Lakes Science Advisory Board of the International Joint Commission. In addition, Barb served as vice president of the executive board of the World Council of Fisheries Societies.

Barb's broad experience and perspectives will not only inform but challenge us to understand the importance of social networks in fisheries management. Next month, I will feature the third speaker, Dr. Bill Taylor, who will tie together ecological and social networks to build sustainable fisheries. This promises to be a great plenary session.

(For more on the plenary speakers and their topics, please visit the AFS annual meeting website: afs2012.org.)

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American Fisheries Society Past-President Appointed by Secretary of Interior

Secretary of the Interior Ken Salazar announced the appointments of 23 individuals to the Sport Fishing and Boating Partnership Council, an advisory panel created in 1993 to advise the secretary on nationally significant recreational fishing, boating, and aquatic resource conservation issues. American Fisheries Society (AFS) Past-President Frederick Harris will be one of the appointed to serve on the council for the upcoming two-year term. During its 19-year history, the council's advice and recommendations have played a major role in providing guidance to the U.S. Fish and Wildlife Service on its fisheries program and improving the efficiency of grant programs delivered through the Wildlife and Sport Fish Restoration Program. The council also played a leading role in the development of the National Fish Habitat Action Plan, a groundbreaking, partnership-driven strategy to restore fisheries and aquatic habitat across the nation. In 2012, the council is expected to undertake a major effort to lend assistance to the service's fisheries program in updating and revising its strategic vision and plan.

AFS Past-President Fred Harris

AFS Member Interviewed in a Web Series

Still from the film "Salmon Fishing in the Yemen" Photo credit: Laurie Sparham

Down to Earth, a Web series on environmental issues, interviewed AFS member Mike Kinnison (associate professor of evolutionary applications in the School of Biology and Ecology at the University of Maine) in the production "Could We Really Have 'Salmon Fishing in the Yemen'?" He stated that salmon do not do well in a tropical ocean and that a brand new river and ecosystem would have to be built for this to even happen. "It's almost like talking about terraforming on Mars." As well, he discusses the Penobscot River restoration and salmon and sturgeon research and conservation. It's a video worth watching.
http://youtu.be/-axyP9yK8p8

AFS Past-President at the Japanese Society of Fisheries Science

As AFS liaison, past-president Barbara Knuth attended the 2012 spring meeting of the Japanese Society of Fisheries Science (JSFS), held at the Tokyo–Shinagawa campus of the Tokyo University of Marine Science and Technology. She addressed the annual business meeting of the JSFS and provided a salutation at the banquet. The International Committee of the JSFS discussed opportunities to continue strengthening the ties between our societies, including active leadership roles within the World Council of Fisheries Societies. Taek Jeong Nam, president of the Korean Society of Fisheries and Aquatic Science, also attended the meeting. Shugo Watabe, University of Tokyo, was named president of the Japanese Society of Fisheries Science, and Shuichi Satoh, Tokyo University of Marine Science and Technology, became chair of the JSFS International Committee.

Dr. Taek Jeong Nam, president, Korean Society of Fisheries and Aquatic Science (and professor at Pukyong National University); Barbara Knuth, past-president of AFS (and vice provost and dean at Cornell University); Shuichi Satoh, chair of the International Committee Japanese Society of Fisheries Science (and professor at Tokyo University of Marine Science and Technology).

Dr. Taek Jeong Nam, President, Korean Society of Fisheries and Aquatic Science (and professor at Pukyong National University); Shugo Watabe, President, Japanese Society of Fisheries Science (and professor at The University of Tokyo); Barbara Knuth, past-president of AFS (and vice provost and dean at Cornell University); Wan Rong (professor, Ocean University of China).

AFS Proposes Conservation and Rehabilitation for the Klamath River Basin

AFS recently sent a letter to Interior Secretary Ken Salazar in support of the recent conservation and rehabilitation proposals for the Klamath River Basin. Highlights from the letter included the following:

- A brief discussion on the two settlement agreements in 2010 relating to the possible removal of four Klamath River dams owned and operated by PacifiCorp (Klamath Hydroelectric Settlement Agreement and the Klamath Basin Restoration Agreement).
- The AFS policy statement on dam removal, which, in brief, is that though dams and the reservoirs they create can provide important benefits (economic and social), there may come a time when the cost–benefit of a dam needs to be reevaluated.
- An examination of whether dam removal in the Klamath Basin is the best approach to restore fish habitat and populations, and an analysis of two action plans pertinent to the discussion.
- Data from four expert panel reports concerning the possible short- and long-term outcomes of dam removal on the Klamath River.
- An acknowledgment that with a project of this magnitude it would be virtually impossible to predict specific responses in number of fish, when fish will be available for harvest, or the rate of water quality improvement.
- A final statement indicating that AFS supports the goals and conceptual approach to ecosystem rehabilitation, including dam removal, outlined in the two settlement agreements.

Emulating Riverine Landscape Controls of Beaver in Stream Restoration

Paul DeVries

R2 Resource Consultants, Inc., 15250 NE 95th Street, Redmond, WA 98052. E-mail: pdevries@r2usa.com

Kevin L. Fetherston

R2 Resource Consultants, Inc., 15250 NE 95th Street, Redmond, WA 98052

Angelo Vitale

Fisheries Biologist, Coeur d'Alene Tribe Fisheries Department, 401 Annie Antelope Road, Plummer, ID 83851

Sue Madsen

Geomorphologist, Skagit Fisheries Enhancement Group, 407 Main Street, Suite 212, Mount Vernon, WA 98273

ABSTRACT: *Stream and floodplain restoration at the reach scale has ranged from expensive, heavy-handed modification of the channel and floodplain to simple, longer-term revegetation efforts. We have developed and implemented a simple approach that emulates the ecosystem engineering effects of beaver. This approach is less expensive and disruptive than typical large-scale engineering efforts and has the potential to restore both fish habitat and floodplain vegetation more rapidly than simply revegetating and waiting for the riparian zone to mature. The approach involves constructing log flow-choke structures that mimic the hydraulic function of a natural beaver dam during flooding. By placing these structures throughout a naturally entrenched stream reach at locations promoting increased frequency of flood connection with floodplain swales and relict channels, we set the stage to restore the riparian corridor and floodplain more quickly than could be achieved through revegetation alone. Monitoring shows that within just one to two years of implementation, beaver are building more persistent dams in close proximity to our structures, and we are seeing increased hydraulic connectivity with the floodplain. Our technique may therefore provide a cost-effective, natural process–based restoration tool with potential large-scale benefits.*

Emulación del control de paisajes fluviales ejercido por castores bajo un contexto de restauración ribereña

RESUMEN: *El gradiente de restauración ribereña y de planicies de inundación puede ir desde una importante modificación artificial de canales y llanuras inundables, hasta esfuerzos de reforestación a largo plazo. En este estudio se desarrolló e implementó un enfoque que emula los efectos a nivel de ecosistema que tienen las construcciones hechas por los castores. Este enfoque es menos costoso e invasivo que los típicos esfuerzos de ingeniería a gran escala, y tiene el potencial de poder restaurar tanto el hábitat de los peces como la vegetación de las planicies de inundación más rápidamente que la práctica de sólo reforestar y esperar a que el área ribereña madure por sí misma. Este enfoque consiste en la construcción de estructuras hechas a base de troncos que controlan el flujo de agua, emulando la función hidráulica de las presas construidas por los castores. La colocación de dichas estructuras en lugares donde el agua se confina de forma natural a lo largo de sitios que promueven la comunicación con canales tributarios y llanuras de inundación, representa la infraestructura que sirve para restaurar el corredor ribereño y las planicies de inundación más rápidamente que lo que pudiera lograrse sólo mediante la reforestación. Un seguimiento muestra que tras dos años de la implementación del enfoque, los castores están edificando presas más resistentes en sitios próximos a las estructuras, y se aprecia un incremento en la conectividad hidráulica con las llanuras de inundación. Esta técnica, por lo tanto, representa una herramienta de restauración de bajo costo y basada en un proceso natural con beneficios potenciales observables a gran escala.*

INTRODUCTION

Beaver (*Castor canadensis*) are ecosystem engineers that have important influences on riparian and aquatic habitats, river morphology and valley channel grade (Ruedemann and Schoonmaker 1938; Gurnell 1998; Westbrook et al. 2011). Their dams and impoundments can control the composition and density of riparian and wetland plants, quality and quantity of fish habitat, and fluvial erosion and sedimentation (Naiman et al. 1988; Pollock et al. 2007; Burchsted et al. 2010). Historic beaver trapping decimated many populations, and various management activities, such as maintaining culverts under roads and reclamation of land for grazing or development, resulted in the killing or relocation of beaver (Naiman et al. 1988). Clearing of riparian forests for grazing, timber harvest, and other purposes resulted in widespread loss of riparian forests and scrub–shrub wetland vegetation critical to establishment and maintenance of beaver populations. Beaver-generated off-channel water bodies provide significant juvenile salmonid rearing habitat, and their loss has had potentially profound effects on salmonid production (Murphy et al. 1989; Pollock et al. 2004; Rosell et al. 2005). More broadly, beaver are important for maintaining ecosystem richness at the landscape scale because they provide habitats for obligate wetland species that might otherwise not exist within the riparian zone (Wright et al. 2002; Rosell et al. 2005). Restoration efforts across the United States and Canada have recognized these important influences of beaver,

even when struggling with the need to balance restoration efforts with the potential nuisance effects of beaver dams (e.g., Finnegan and Marshall 1997; Wilson 2001).

A positive feedback cycle may exist where historic beaver trapping and removal of trees and shrubs used by beaver have resulted in local extirpation or significant reductions in beaver population size. In this event, neither beaver populations nor beaver-generated fish habitat will recover until riparian vegetation is restored (Pollock et al. 2004; Figure 1). Recovery of beaver-generated floodplain wetlands and their wet meadow, scrub–shrub, and forested plant communities is dependent upon the restoration of lost hydraulic linkages between the channel and its floodplain through annual flood pulses and a locally high water table (Westbrook et al. 2006). However, water availability may not be sufficient in some environments, including arid or semi-arid climates, entrenched and incised channels, and locations where soil characteristics restrict infiltration and water retention for spring plant growth. In such circumstances, beaver were likely the historic mechanism that supplied riparian vegetation with sufficient water to establish and maintain trees and shrubs. Importantly, this codependent mechanism is not adequately recognized or utilized in the stream restoration toolbox (Pollock et al. 2011).

"Plant-it-and-they-will-come" restoration strategies focus on restoring riparian vegetation with the assumption that beaver populations will reestablish when plant communities are capable of supporting them (Albert and Trimble 2000; Pollock et al. 2011; U.S. Forest Service 2011). However, successful beaver recolonization and riparian vegetation restoration may require long periods of time when the positive feedback mechanism (Figure 1) has been activated. We present a case study demonstrating this problem and the stream restoration method that we used to provide an ecosystem "kick-start" that emulates the mechanisms driving natural floodplain connectivity. We also

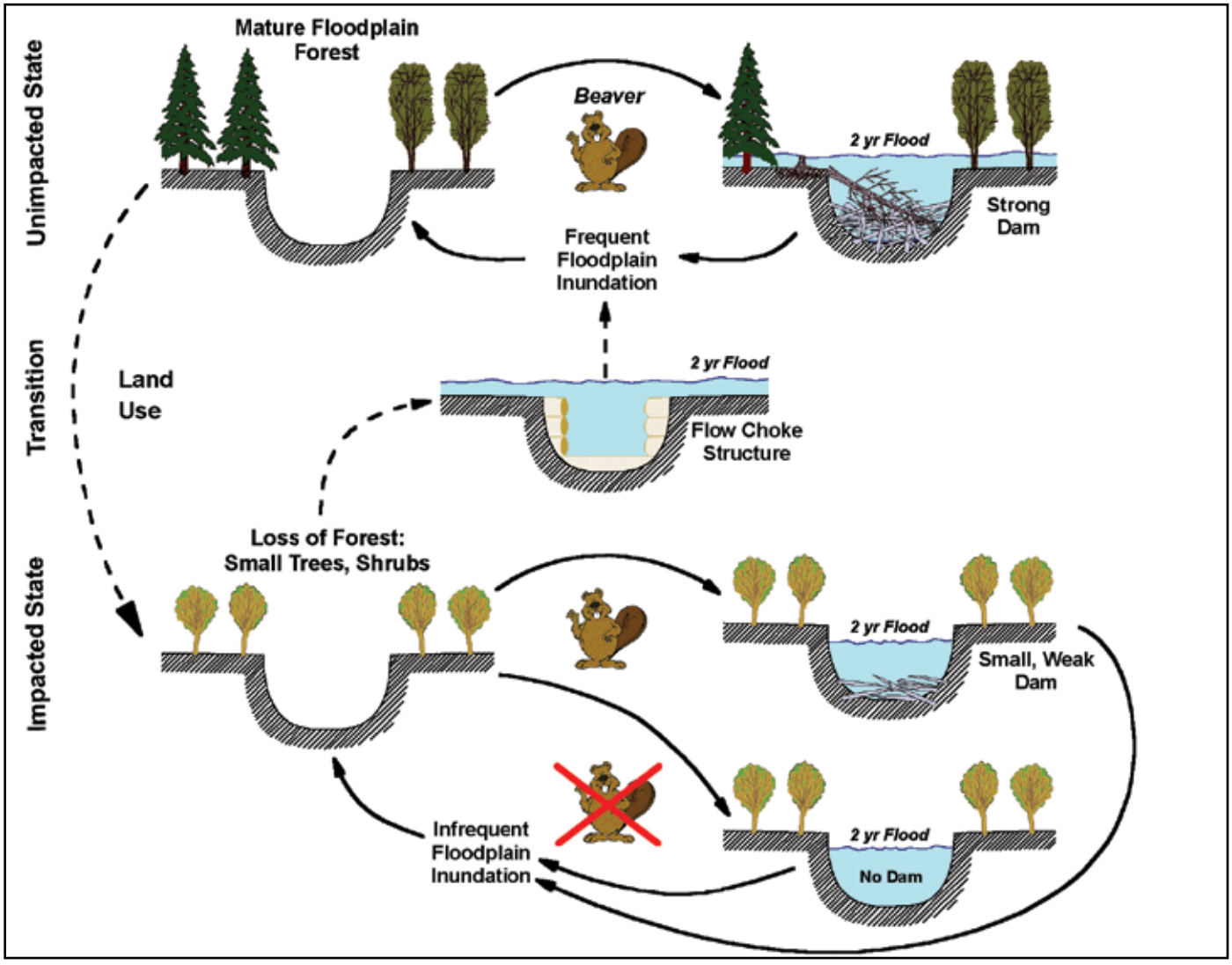

Figure 1. Conceptual model of the feedback cycle between beaver, flood levels, and floodplain forests in natural and impacted stream systems, illustrating how the structures discussed in this article can be used to restore the system. Dashed lines represent transition paths between natural and impacted states.

briefly discuss preliminary monitoring to assess the effectiveness of our method and guide future restoration designs. We believe that our simple approach has the potential to simultaneously restore riparian plant communities, along with fish and beaver habitat, and that it can do so in less time than replanting alone in many regions of Western North America.

THE RIVER AND RIPARIAN RESTORATION PROBLEM IN BENEWAH CREEK, IDAHO

Physical Setting

Benewah Creek drains to Benewah and Coeur d'Alene lakes in northwestern Idaho (Figure 2). The stream supports adfluvial and resident populations of westslope cutthroat trout (*Oncorhynchus clarkii*) and flows through several mountain meadow valleys that likely provided large quantities of high-quality spawning and rearing habitat in the past. However, extensive land clearing and grazing activities have resulted in bank erosion and widespread loss of riparian vegetation, leading to elevated water temperatures and fine sediment levels, loss of in-stream wood, and subsequent changes in channel morphology. These changes have in turn resulted in the loss of in-channel and riparian habitat and have likely contributed to fish population declines (Meehan 1991).

The channel is entrenched in many locations, and higher frequency floods during the critical spring snowmelt period no longer inundate the floodplain, resulting in a groundwater table during spring and summer that is approximately 1.2 m below the floodplain surface (June–August average, 2008–2010; Coeur d'Alene Tribe data). Reestablishment of riparian vegetation is hindered by insufficient water at or near the surface to support historic wetland wet meadow, scrub–shrub, and riparian gallery forests. Initial efforts to restore the riparian zone have therefore met with limited success, because the growth of plantings is inhibited by water availability in this semi-arid environment. In addition, impacts to the historic floodplain forest, which provided root cohesion to stream banks, has resulted in reduced stream bank stability and consequent lateral bank failures throughout the course of Benewah Creek. Until a mature native floodplain forest is established, aquatic habitat will remain degraded.

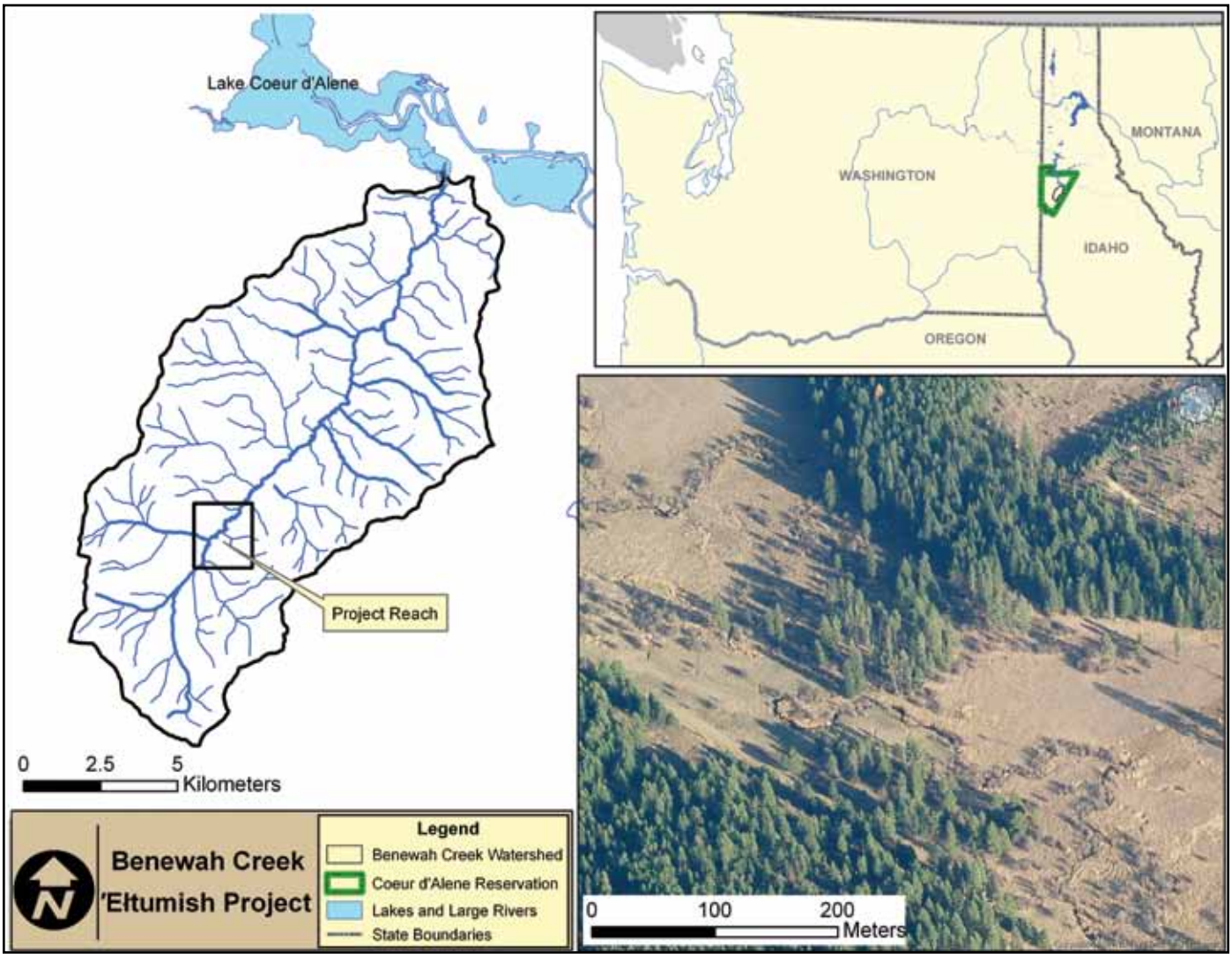

Figure 2. Map showing the location of the Benewah Creek Restoration Project near the community of Benewah, Idaho, and a representative view of the floodplain.

Assessing the Problem and Developing a Solution

We focused on developing channel, floodplain, and plant community restoration designs for an approximately 2.7-km entrenched reach of Benewah Creek flowing through a wide valley bottom with 0.4% gradient. Riparian vegetation is dominated by mountain alder (*Alnus incana*), black hawthorn (*Crataegus douglasii*), and reed canary grass (*Phalaris arundinacea*). Remnant willow (*Salix* spp.) communities and cottonwood gallery forests (*Populus balsamifera* spp. *trichocarpa*) are also found in the basin, but intensive grazing resulted in their general absence within the project reach. Bank erosion is also extensive in heavily grazed locations (Figure 3).

A plausible hypothesis was that beaver historically played an important role by constructing dams that raised water levels during spring runoff.

We based our initial restoration designs on a prevailing hypothesis that the entrenched channel form was the result of incision caused by land use. This hypothesis was based in part on the observation that floodplain inundation is presently restricted to flows higher than the approximately 5-year return interval event, whereas a more typical alluvial channel would have been expected to overflow onto the floodplain at an approximately 1.5- to 2-year interval (Leopold et al. 1995). The corresponding level of incision was estimated to be approximately 1 m. Conventional solutions to this problem include (1) extensive earthwork construction of raised grade controls and riffles in the incised channel and/or (2) relocating the stream to relict or new channels. We settled initially on the second approach, using valley-wide floodplain stratigraphy to define the appropriate riffle control elevation for design. In doing so we hypothesized that if the channel had incised as suggested by flood hydrology, there would be stratigraphic layers of alluvial gravel in the adjacent floodplain located at elevations that were higher than in the present channel. The elevation of alluvial gravel deposits in relict channels would accordingly define the design thalweg elevation and new channel width needed to convey bank-full flow. Woody debris structures would be constructed in the channel to provide energy dissipation, bank protection, grade and channel meander control (if necessary), and fish habitat until a mature riparian plant community was restored.

To test this hypothesis, test pits were excavated at four relict channel locations distributed across the valley floor to determine the depth to historic alluvial gravel deposits. Three test pits were dug at each location, one at the relict channel centerline and one on the floodplain to each side of the relict channel. However, test pit results provided direct evidence of an alternative channel forming process, leading us to reconsider the historic mechanism whereby floods may have engaged the floodplain on an approximately annual basis. Floodplain stratigraphy did not indicate alluvial gravel deposits at elevations consistent with geologically recent (i.e., within the past 200 years) incision. Instead, test pit excavations consistently revealed a cobble-gravel layer at elevations comparable to those found in the current channel thalweg at cross-valley riffle and eroding stream bank locations. The soil profile above the cobble-gravel or silt clay loam layer was classified in soil maps as a relatively uniform, poorly draining silt loam originating from loess, volcanic ash, and alluvial deposits (Weisel 1980). The silt loam soil that was consistently found in all test pits and soil auger samples that we collected during wetland delineations indicated that the upper soil profile was formed predominantly through wind-borne deposition (i.e., loess). Two ash layers were consistently found below the surface in the test pits, representing deposition from the Mount St. Helens and Mount Mazama eruptions. Prominent alluvial deposits of silty sand were not found in any of the test pits above the gravel and silty clay loam mantle, indicating that valley soils were predominantly loess deposits and that relict channels may have been inactive for thousands of years. Charcoal fragments and dead roots were also found at depths between 0.1 and 1.3 m in all test pits, indicative of woody vegetation and fire occurring historically throughout the valley bottom. Finally, aerial photography indicated that channel location and sinuosity have not changed substantially in the reach since the 1930s.

Given these findings, we concluded that the project reach floodplain was not predominantly alluvial, the channel had likely not incised significantly, historic channel migration had occurred slowly, and the natural width : depth ratio was likely narrower than would be expected for a typical alluvial channel. In view of the relatively long return period of floods needed to inundate the current floodplain and the evidence of an extensive historic floodplain forest in poorly drained soil, some process other than alluvial channel mechanics must have supplied overbank water for woody vegetation growth and maintenance during spring runoff.

A plausible hypothesis was that beaver historically played an important role by constructing dams that raised water levels during spring runoff (Ruedemann and Schoonmaker 1938; Naiman et al. 1988; Rosell et al. 2005). The resulting flow obstructions would have provided a mechanism for floodplain connectivity, thereby promoting maintenance and growth of riparian vegetation (Figure 1; Westbrook et al. 2006). Following removal of the valley forest, beaver trapping, and 70+ years of cattle grazing, the effective flood level control provided by flow obstructions, along with the associated upstream gravel accumulations, was likely removed, resulting in less frequent and shorter duration inundation of the valley floor during spring runoff events. This may, in turn, have hindered recovery of the floodplain forest, thereby decreasing the availability of large wood. Indeed, the lack of large wood throughout the project reach may explain in part the high rates of annual dam turnover and the apparent overall instability of active beaver dam complexes that have been documented in recent surveys (Vitale and Firehammer 2011). Only 26% of dams surveyed were built with or upon stable materials such as large woody debris. Most were built using small alder pieces and were either substantially compromised or destroyed during ice breakup and peak flow periods that occurred during winter rain-on-snow events and spring runoff. Dams that persisted were generally located

Figure 3. Tall banks eroding in the project reach have a generally undifferentiated silt loam mantle over a gravel layer. Photo credit: Paul DeVries.

in areas with a relatively intact riparian forest and large wood present in the channel. Given these changes and observations, we felt that a means of increasing flood frequency and duration should be included in restoration planning to accelerate the recovery of woody floodplain vegetation. Assuming that these functions were historically supported by beaver dams, we then decided that a highly efficient solution may be to construct temporary structures that would emulate the hydraulic effects of beaver dams and to ensure that they would persist long enough for larger trees to become established that could subsequently be used by beaver (Figure 1).

EMULATING EFFECTS OF A BEAVER DAM TO PROVIDE AN ECOSYSTEM KICK-START

We began with an assessment of existing beaver dams in Benewah Creek, which are constructed primarily of small mountain alder pieces (generally the only material available) and are sited primarily at riffle crests, conceivably to minimize material needs and dam building effort. We then attempted to emulate the flow obstruction effects of beaver dams and natural wood jams by installing flow-choke structures constructed of large logs. The structures were designed to promote more frequent and extensive channel–floodplain connections during spring floods. It would also be cost effective compared with the more disruptive and expensive excavation methods used to construct raised bed riffles and new channels. For example, channel reconstruction (as described above) was completed at an average cost of US$260/m in downstream reaches. Installation of flow-choke structures cost about US$2,700 per structure, which equated to an estimated US$25/m to US$50/m for an equivalent level of flood flow engagement for a 0.4% stream gradient (time and materials).

Structures were sited primarily at locations where a raised backwater would increase the frequency with which key floodplain flow paths were connected during floods (Figure 4). In locating a structure, we used the Hydrologic Engineering Centers River Analysis System (HEC-RAS; U.S. Army Corps of Engineers) and compared the results with a light detection and ranging (LiDAR)-derived topographic contour map to project the upstream extent of the backwater effect at the estimated bank-full flow rate. This was also used to avoid impacts to private property where increased flooding might be perceived as a negative result. We are currently following this approach in stages, where the first structures were installed in the most obvious locations based on floodplain topography. The locations of additional structures will be based on monitoring of completed structures and flooding patterns, as well as the observed spacing of natural beaver dams. We noted in our surveys that 80% of the observed dams ranged between 15 and 90 m apart, with a median spacing of 52 m.

Because we were not able to identify an optimal structure design a priori, we experimented with two types of engineered flow-choke structures as a form of design hypothesis testing. Both designs used log "walls" with an appropriate hydraulic constriction to back up water to the floodplain level at approximately the target bank-full flow. The first, simpler design functioned by choking stream flow from the sides and directing weir flow over a sill log (Figure 5a). The second, more complex

design utilized both weir (over-) and orifice (through-) flow, with lateral as well as vertical constriction, and sufficient depth over the weir log to permit passage of ice jams and floating debris at the bank-full level (Figure 5b). The weir was designed to direct water flowing over it into the jet flowing out of the orifice situated underneath, thereby disrupting and dissipating energy during high flows. General weir and orifice flow equations were integrated in a spreadsheet to estimate total flow rate for a given width and depth of weir overflow and orifice through-flow (e.g., King et al. 1948). The spreadsheet was used to identify suitable combinations of width and depth of the orifice and weir specifications. All structures extended deep enough to account for predicted scour depths and extended far enough into the floodplain to preclude lateral erosion around the structure. Bank-full flows were constrained by the top logs to remain within the intended bank-full width. Rock was placed downstream as a scour countermeasure, to protect the integrity of the structure. The rock was sized to result in an acceptable scour pool depth. The scour pool provides energy dissipation, pool habitat, and a leaping pool for upstream trout passage. A deposit of finer gravel, sized to be comparable to stones occurring naturally in the river banks and bed, was placed on the bed of the upstream side of the structure to reduce turbulence of the approach flow, seal the structure against piping, and provide cutthroat trout spawning habitat. The resulting morphology resembled gravel deposits observed on the upstream side of natural logs in Benewah Creek.

The sill elevation of each orifice or weir was designed to emulate low-flow control elevations established by beaver dams present in the reach while avoiding conditions that may constrain upstream fish passage or cause excessive sedimentation problems. Median depths of existing dams in the reach were 0.35 m at the riffle crest and 0.98 m below the floodplain (Figure 6). These values served as natural, reference design criteria for specifying the sill control elevation and the depth of impounded gravel upstream. Should beavers seal up the structure using available materials, it was hypothesized based on the transient nature of similarly constructed, existing dams that they would break down during floods and not result in substantial additional impoundment depth or sedimentation over the near term until the natural cycle depicted in Figure 1 was restored. In addition, assuming that beaver dams built atop the structures would not survive spring floods, the head difference between the groundwater and stream channel during low-flow summer months would also not be reduced substantially from current conditions. This was viewed as important given that groundwater inputs at the site are crucial for maintaining favorable summer water temperatures in the absence of a riparian forest. Downstream, where the valley width is more confined and thus groundwater inflow rate is expected to be less, summer temperatures more frequently exceed an optimal growth criterion for trout (>17°C; Figure 7; see Bear et al. 2007). Once the riparian forest is reestablished, we hypothesize that additional ponding by stronger beaver dams will have less of an adverse effect on summer water temperatures.

Another important consideration is fish passage, which can be a problem at low flows over a flat log. Designing for a low-elevation sill and a scour pool allows fish to jump upstream over the log sill during low flow. A small V-notch can also be cut into the sill log where upstream passage is a concern during low summer flow. At other flow levels, the sill is designed to be low enough that fish can swim upstream through the opening. A sill elevation that is too high can be avoided by narrowing the orifice and weir openings to choke high flows. To date, none of our structures appear to have presented an upstream passage barrier.

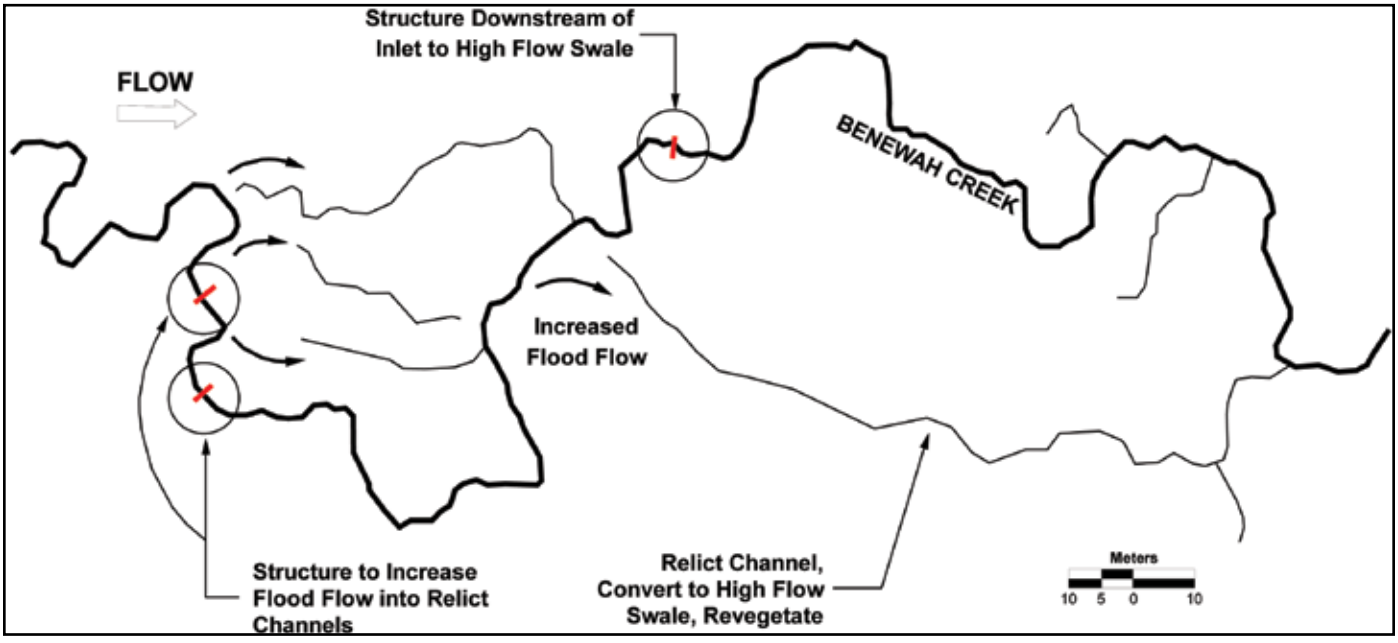

Figure 4. Locations of proposed flow-choke structures (red lines) relative to floodplain flow paths and floodplain restoration goals in Benewah Creek.

Figure 5. Two types of flow-choke structures were built: (a) with a simple contracted weir and (b) with a combined orifice and weir. Both structures impound water during high flow and are strong enough to withstand ice jams. Photo credits: Paul DeVries and Angelo Vitale.

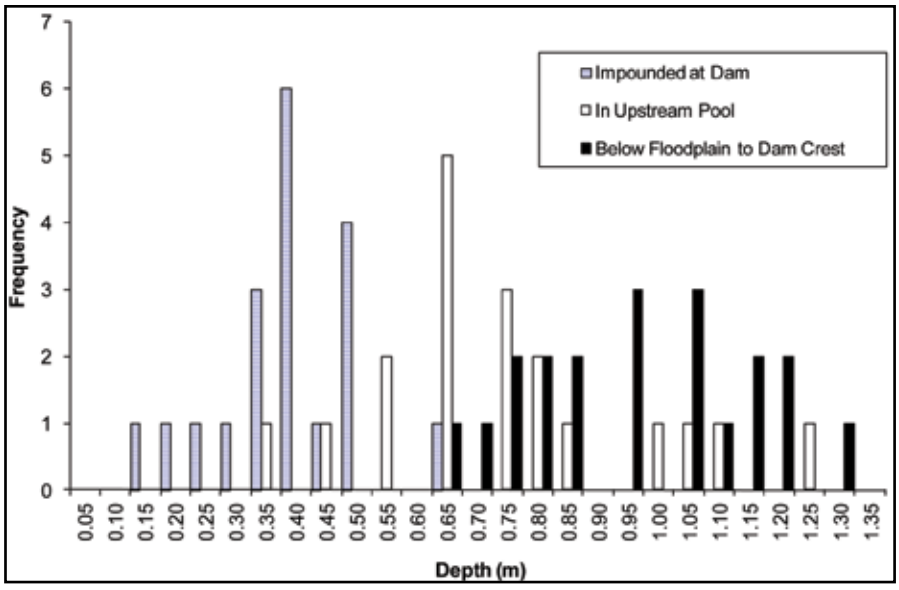

Figure 6. Frequency distributions of water depths at and in pools upstream of beaver dams in Benewah Creek and depths from the general floodplain elevation down to the dam crest. Data were obtained prior to restoration and provided design guidance for the structures.

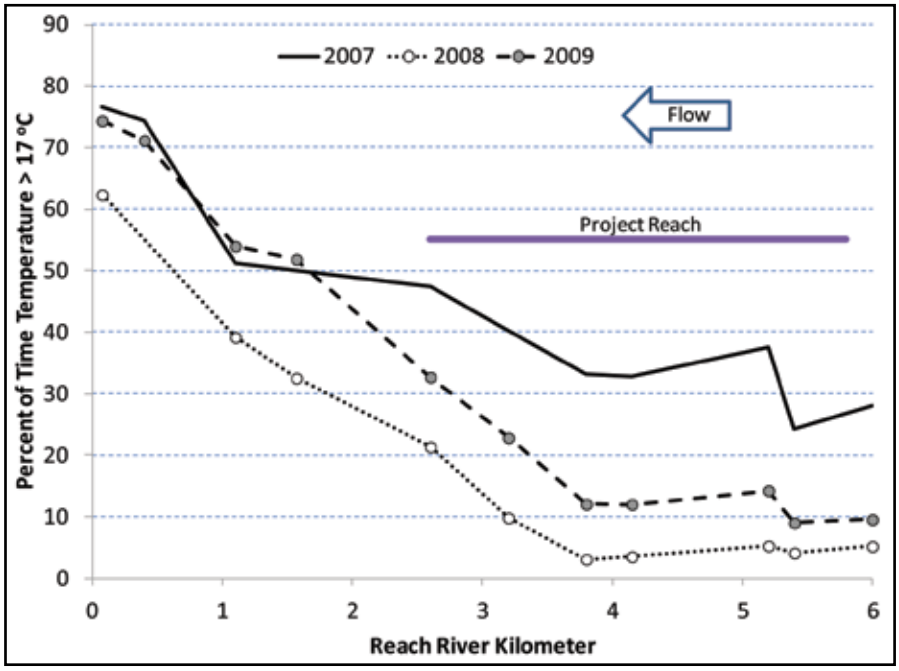

Figure 7. The frequency with which water temperatures exceed that needed for optimal growth of cutthroat trout (>17 °C; Bear et al. 2007) during July and August, the warmest part of the year in upper Benewah Creek.

We also utilized a passive approach by placing two to four large logs in the channel to provide a more durable foundation that beavers could use in dam construction (i.e., "beaver assist structures"). This was based on observations that the most persistent, existing dams throughout the Benewah Creek stream corridor are built with mountain alder integrated with remnant in-channel large wood. MacCracken and Lebovitz (2005) found that this technique can work when the channel is unconfined with a wide floodplain, there are no logjams nearby, and deep pools and banks suitable for beaver dens are nearby. Individual logs were placed across the channel bottom at riffle crest locations between the engineered structures and wedged between small boles driven vertically into the substrate. Fresh black cottonwood and Aspen cuttings were also placed along the stream banks above the log structures to encourage beavers to complete dam construction (Muller-Schwarze and Sun 2003).

PROJECT PERFORMANCE

A key strength of our design is that it is an experimental approach to emulating the effects of beaver dams on channel and floodplain processes. Accordingly, we are monitoring the hydrologic and hydraulic performance of the flow-choke structures, beaver assist structures, and local floodplain wetland response to assess whether we have succeeded in emulating the geomorphic and ecological effects of beaver dams, and to provide us with empirical data to guide future design revisions. For example, we noted after the second year of monitoring that downstream scour protection is more critical for the orifice–weir combination structure than for the simple weir. The flow patterns are more complex for the combination structure, where the weir overflow nappe appears to interact with the orifice jet to create more turbulence near the bed than was anticipated. The simple weir structure has been found to have smaller scour depths downstream that are more consistent with predictions based on hydraulic engineering literature.

We note that the choke structures were not designed to increase summer pool habitat. This is important because natural beaver dams can increase the surface area and depth of pool habitat in Benewah Creek. Our surveys indicate, however, that most dam building activity occurs later in the summer, suggesting that trout may not benefit from increased thermal refugia and habitat cover during the warmest mid-summer periods (e.g., Ebersole et al. 2003; Firehammer et al. 2010). The loss of unstable dams during high flows and ice breakup may also contribute to poor overwinter survival in mainstem habitats because both juvenile and adult cutthroat trout are known to use deep pools as winter refugia in small stream systems (Brown and Mackay 1995; Jakober et al. 1998; Harper and Farag 2004; Lindstrom and Hubert 2004). Our observations to date indicate that persistence of natural dams and the benefits they provide to trout (i.e., summer and winter pool habitat) are greater when located within the high-flow inundation zone created by our engineered structures.

Importantly, from the riparian floodplain restoration perspective, we have documented overbank flows across the valley bottom at discharges equal to the approximately 1.5-year return interval flood in the vicinity of our structures. Other reaches without stable beaver dams require much higher discharge for overbank flow. Thus, we are already seeing intended results, where floodplain flow path swales and relict channels are more frequently engaged and those that have been replanted are already showing good growth. The Coeur d'Alene Tribe Fisheries Department will continue to monitor the project and report results in the future.

SUMMARY

Natural beaver activity can be an efficient tool to restore stream channels when abundant food and dam building materials are available (e.g., Ruedemann and Schoonmaker 1938; Olson and Hubert 1994; Albert and Trimble 2000). However, our approach can be applied in streams where riparian resources are insufficient to support beaver reintroduction. Installing structures that emulate the hydraulic effects of beaver dams should facilitate accelerated recovery of natural channel and riparian forest in reaches where a positive feedback mechanism exists between beaver activity, flood frequency and extent, and riparian tree growth. This technique can potentially be used in any stream disconnected from its floodplain where vegetation restoration is desired in conjunction with either beaver reintroduction or beaver nuisance control strategies. Notably, this method may allow more rapid and cost-effective restoration of dynamic riverine, floodplain, and wetland ecosystems than basic replanting efforts. Furthermore, by not substantially raising the low-flow water surface elevation, it should have a minor or negligible effect on groundwater inflow rates and can therefore help to maintain cool summer water temperatures for trout until the riparian canopy is restored. Our approach is simple and relatively inexpensive and should greatly accelerate restoration of riparian habitats and the organisms that depend on them.

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Case Studies in Fisheries Conservation and Management:
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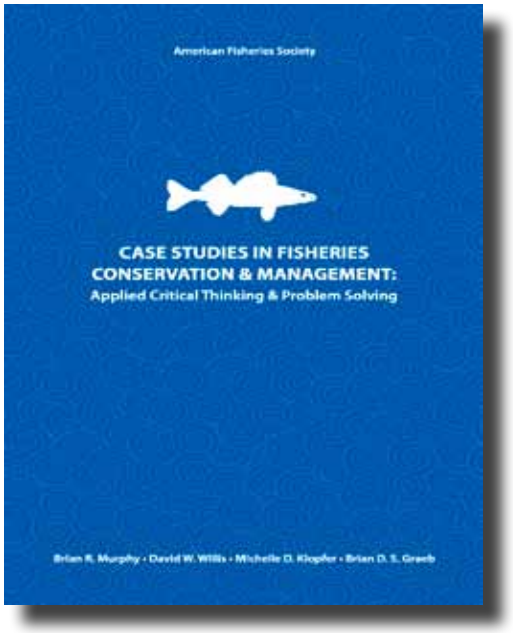

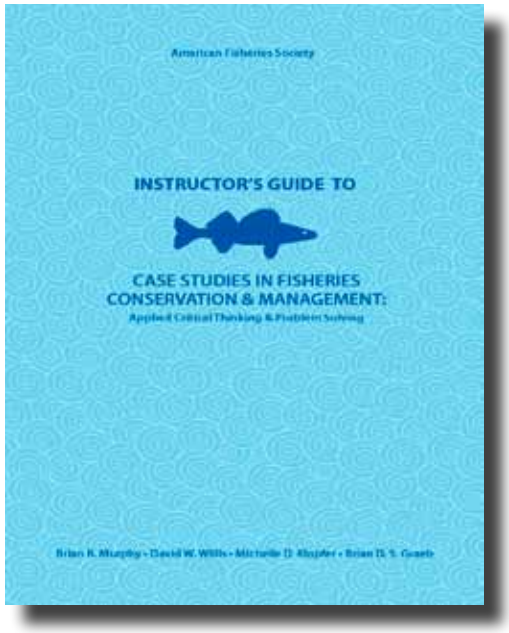

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A Comparison of Stipends, Health Insurance, and Tuition Remission Policies at Fisheries and Wildlife Graduate Programs throughout the United States

Luke D. Schultz

Department of Wildlife and Fisheries Sciences, South Dakota State University, Box 2140B NPS 138, Brookings, SD 57007-1696. Current address: Oregon Cooperative Fishery Research Unit, Oregon State University, Corvallis, OR 97331

Justin A. VanDeHey

Department of Natural Resource Management, South Dakota State University, Box 2140B NPS 138, Brookings, SD 57007-1696. Current address: Wisconsin Cooperative Fishery Research Unit, University of Wisconsin–Stevens Point, 800 Reserve Street, Stevens Point, WI 54481-3897. E-mail: Justin.vandehey@uwsp.edu

ABSTRACT: *Many factors should be considered before selecting a graduate program to attend. Graduate education can be expensive, so financial and health care benefits offered by a department or college should be considered when selecting a graduate program. A majority of fisheries graduate students recently surveyed believed that financial aspects should be an important consideration in selecting a graduate program. Therefore, our objective was to estimate the range of stipends, tuition remission, and health care benefits provided to students in graduate programs that offer training in wildlife and fisheries disciplines across the United States. Thirty-one out of 70 schools (44%) from across the United States responded to our online survey. Doctoral and master's student stipends were highly variable among programs and appointments (research v. teaching assistants). Over half of the universities offered full tuition remission (67%), and of those that did not, most (97 %) offered at least partial tuition remission. On-campus health care was the most common health care benefit offered to graduate students. Though traditional factors for selecting a graduate school (such as desirability of graduate research topic/question, program reputation, and suitability of the advisor) may override financial considerations, financial benefits may be a critical component when choosing a graduate program.*

Comparación de estipendios, seguros médicos y políticas de exención de colegiatura en las facultades de ciencias en los Estados Unidos de Norteamérica, relacionadas a las pesquerías y vida silvestre

RESUMEN: *Varios factores debieran considerarse antes de seleccionar una facultad de ciencias a la que se quiere ingresar. La educación superior y de posgrado puede ser cara, de manera que los beneficios económicos y de salud que ofrece una facultad o colegio son factores que debieran sopesarse al momento de hacer una elección. La mayoría de los estudiantes de pesquerías, recientemente entrevistados, creen que los aspectos de orden financiero debieran ser un factor determinante para seleccionar una facultad o escuela de nivel superior. Por lo tanto el objetivo de la presente contribución fue estimar el rango de estipendios, exención de colegiaturas y seguros de gastos médicos que se otorgan en las escuelas de nivel superior que ofrecen estudios sobre vida silvestre y disciplinas pesqueras en los Estados Unidos de Norteamérica (EEUU). De las 70 escuelas encuestadas a lo largo de los EEUU, respondieron sólo 31 (44%). Los estipendios otorgados a los estudiantes de maestría y doctorado fueron altamente variables tanto entre facultades como entre nombramientos (investigador asistente versus docente). Más de la mitad de las facultades (67%) ofrecen exención total de colegiaturas, y de entre las que no ofrecen esta prestación, la mayoría (97%) ofrece al menos una exención parcial. Los seguros médicos, válidos dentro de las instalaciones de las facultades, constituyeron los planes de salud más comunes que se otorgan a los estudiantes. Si bien los factores más comunes que se toman en cuenta para elegir una carrera profesional (propensión hacia cierto tópico o pregunta de investigación, la reputación de la facultad y el perfil del tutor académico) pudieran rebasar las consideraciones de orden financiero, los beneficios económicos pueden ser un componente crítico en la elección de una facultad o escuela de educación superior.*

Okay, so you are a senior finishing your bachelor's degree in a natural resources–based field. This is an exciting time—you are taking classes that interest you, perhaps attending a couple of scientific meetings, and interning with a faculty member or a state or federal agency to gain work experience. You have been diligently studying and working to improve your grade point average. For the first time in your life it finally seems as if all those years of schooling are worth it. Then one day after class your professor calls you aside and asks, "Have you ever thought about going to graduate school?" For many students in natural resources, biology, or fisheries and wildlife sciences programs, at one point or another this topic will certainly arise. The decision regarding whether or not (or when) to attend graduate school—and, perhaps more important, where—should not be taken lightly (Reed 1971). Although the above hypotheti-

cal situation applies to prospective graduate students who are currently attending school, similar considerations affect those who have temporarily been out of school and may be looking to pursue graduate studies to further their careers.

Throughout our tenure as graduate students we were fortunate to interact with many students from different programs in numerous geographic locations with varying viewpoints and reasons for attending graduate school. One resounding theme we encountered was that students are passionate about science and the organisms and ecosystems with which they work. However, the reasons that students chose to attend graduate school at their specific university were highly variable. A few common reasons included having an advisor or a research topic they really enjoyed, finding a geographic area that fit their personal interests, having amenities suitable for their families, and getting paid to attend school. Certainly these are important considerations. Fortunately, there are several good resources available for prospective graduate students to help them identify and evaluate potential schools and advisors (Allen 1993; Zale 2006; O'Connor 2012) and to get accepted into graduate school (Fischer and King 1998; Zale 2006). We recommend that prospective students consult these published resources, as well as ask questions and seek advice from academic advisors, employers, colleagues, and current or recent graduate students when evaluating potential programs and/or research topics. Essentially we are advocating that students consider these multiple factors and develop a personal rating system to help them make this important decision. For example, based on our own experiences and discussions with faculty members and graduate students from various universities, we developed a hypothetical list of questions for prospective graduate students to consider prior to committing to a given graduate program (Table 1). We recognize that all students are individuals and that everyone has his or her own ideals as to which factors are most and least important. This is why no preassigned weights are made in Table 1. We recommend that students use a similar template to develop their own pro–con rating system based on personal importance.

One facet that is often overlooked relates to the financial aspects of graduate school. Though financial considerations should probably not be the primary reason one selects a graduate school, finances are still important. Therefore, our objectives were to (1) determine students' viewpoints related to financial aspects of graduate school and (2) to estimate the range of stipends, tuition remission, and health care benefits provided to graduate students in wildlife and fisheries programs or similarly based fields across the United States. Though these methods do not assess temporal trends or address the numerous and varied potential sources of funding in graduate stipends and benefits, we hope that our analyses provide useful information

TABLE 1. List of some potential questions used to develop a pro–con-based decision for whether or not a prospective student should attend a given graduate program. Though this list is not all-inclusive, it provides a framework of typical questions to be considered by prospective graduate students. We recommend that potential students evaluate the relative impact of each of these (and other) questions prior to committing to a graduate program.

Question	Importance weight
Do you like the research topic?	?
Do you like the advisor?	?
Do you like the university (e.g., setting, location, reputation)?	?
Is funding available for your graduate program (e.g., TA/RA assistantships)?	?
What are the teaching and/or research requirements associated with your funding?	?
Does the research topic involve field/lab work you desire? Don't desire?	?
Is the stipend adequate (e.g., does it cover the cost of living, etc.)?	?
Are you comfortable spending 2–5 years (or more) at the school's location?	?
Is health insurance offered?	?
What level of tuition remission is offered?	?
Are the required equipment and lab and office space available?	?
Have the advisor's previous students been successful in publishing?	?
Have the advisor's previous students been successful in obtaining employment?	?
Are the other graduate students and faculty members collegial?	?
Will you have financial support to attend workshops and scientific meetings?	?
Do previous students have positive things to say about the advisor/university?	?
Are you provided with beneficial networking opportunities for future employment?	?
Will you have input on the study design or implementation?	?
Does the university have affiliations with professional societies?	?
Are there alternative schools or employment options?	?
Are you familiar with the program's requirements (written and unwritten)?	?
Does the university offer desired courses?	?

to prospective graduate students currently considering suitable graduate programs, as well as provide baseline data for future assessments of this nature.

METHODS

To determine the opinions and beliefs of current and recent graduate students related to financial aspects of graduate school and to garner further information regarding why students chose a specific graduate program, we surveyed the student subsection of the American Fisheries Society (AFS). The survey was conducted using SurveyMonkey (SurveyMonkey.com), and an e-mail with the survey link was sent to all students currently listed as a member of the AFS student subunit. The first question asked students to list the top three reasons they selected their graduate school. Upon completion of the survey we separated these responses into 12 categories to reduce redundancy among responses. The last six questions focused on determining students' viewpoints related to financial aspects of graduate school (Table 2). Questions 2 through 4 used a Likert scale (1–5), question 5 was multiple choice, question 6 was multiple choice, and question 7 was a simple yes or no response.

Several iterations of the survey were tested and refined prior to distributing it to potential participants to assess patterns in graduate student incomes and benefits. The survey included three sections (Table 3). The first section aimed to quantify salaries for graduate research assistants (GRAs) and graduate teaching assistants (GTAs) at both the master's (M.S.) and doctoral (Ph.D.) levels. Because numerous programs did not have fixed graduate student stipend policies, we asked survey participants to provide the mean and overall range of stipends for all applicable categories (i.e., M.S. GRA, M.S. GTA, Ph.D. GRA, Ph.D. GTA). The second section addressed tuition remission policies. Specifically, we wanted to know whether departments or colleges offered full, partial, or no tuition remission. In the absence of full tuition remission, we were interested in what percentage of remaining tuition was paid by the student and whether the department or college offered in-state tuition rates. For this section we again asked survey participants to provide the mean and range of these values if they differed among appointments. The final section of our survey addressed the level of graduate student health care coverage provided by the college or department. Realizing that numerous options exist for health care plans, we focused on three very generalized types.

TABLE 2. List of questions and potential responses asked of current and recent graduate students to address motivating factors in selecting a graduate school and the influence of financial aspects in the decision. Total survey respondents = 363.

Question	Response type
1. Please list the three most important factors involved in your decision to attend your chosen graduate school.	Open response
Multiple-choice questions (Please select one answer from the following list.)	
2. Prior to selecting a graduate school, the graduate stipend offered to you was a _____ factor for your selection of a graduate program.	1 = Least important, 2 = Somewhat important, 3 = Neutral, 4 = Important, 5 = Very important
3. Prior to selecting a graduate school, the benefits (tuition remission, in-state tuition rates, health care) offered to you were _____ factors in your selection of a graduate program.	1 = Least important, 2 = Somewhat important, 3 = Neutral, 4 = Important, 5 = Very important
4. I would have chosen to attend this graduate program regardless of the graduate stipend.	1 = Not true at all, 2 = Somewhat untrue, 3 = Neutral, 4 = Somewhat true, 5 = Very true
5. I would have chosen to attend this graduate program regardless of the benefits.	1 = Not true at all, 2 = Somewhat untrue, 3 = Neutral, 4 = Somewhat true, 5 = Very true
6. Now that you are in graduate school, do you wish you had considered financial aspects and/or benefits more?	Yes, I would have considered these more. Yes, but I am happy with the benefits available. No, I am happy with the benefits available. No, these aspects are not important to me.
7. Do you believe that prospective graduate students should research the financial (stipends, health care, tuition remission) policies at graduate programs before selecting one?	Yes or no

TABLE 3. List of questions sent to 70 graduate programs that provide training in wildlife and/or fisheries across the United States to assess graduate student stipends, tuition remission policies, and health care coverage. Response rate for each question is included.

Question	Response rate %
Graduate stipends	
1. What was the mean 2009 (calendar) gross yearly stipend (and range) for graduate students (RA and TA) in your department?	44
Tuition remission	
1. Does your department offer in-state tuition to graduate students?	43
2. What is the tuition wavier policy (%) in your department for graduate students?	43
Health care	
1. What type of health coverage is offered to graduate students in your department?	43

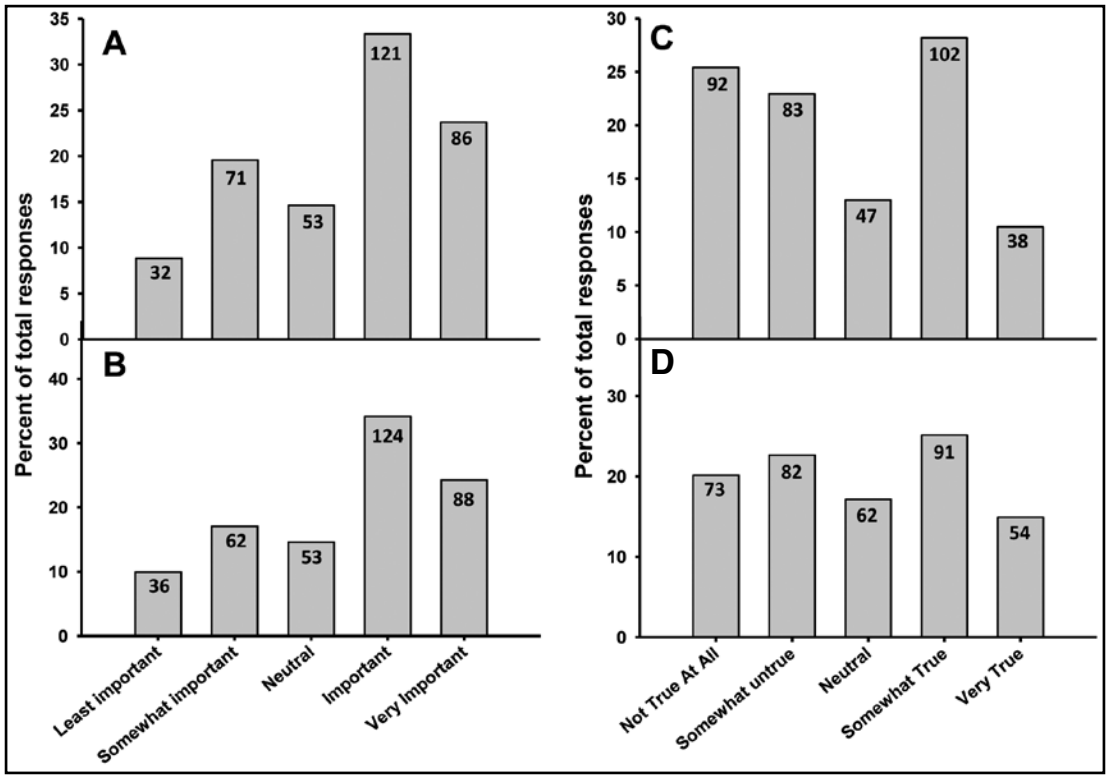

Figure 1. Percentage of total responses of fisheries graduate students for questions 2 through 5 on the student survey. Question 2 (A) "Prior to selecting a graduate school, the graduate stipend offered to you was a ___ factor for your selection of a graduate program"; question 3 (B) "Prior to selecting a graduate school, the benefits (tuition remission, in-state tuition rates, health care) were ___ factors considered in my selection"; question 4 (C) "I would have chosen to attend this graduate program regardless of the graduate stipend"; and question 5 (D) "I would have chosen to attend this graduate program regardless of the benefits." Number on each bar represents the number of responses.

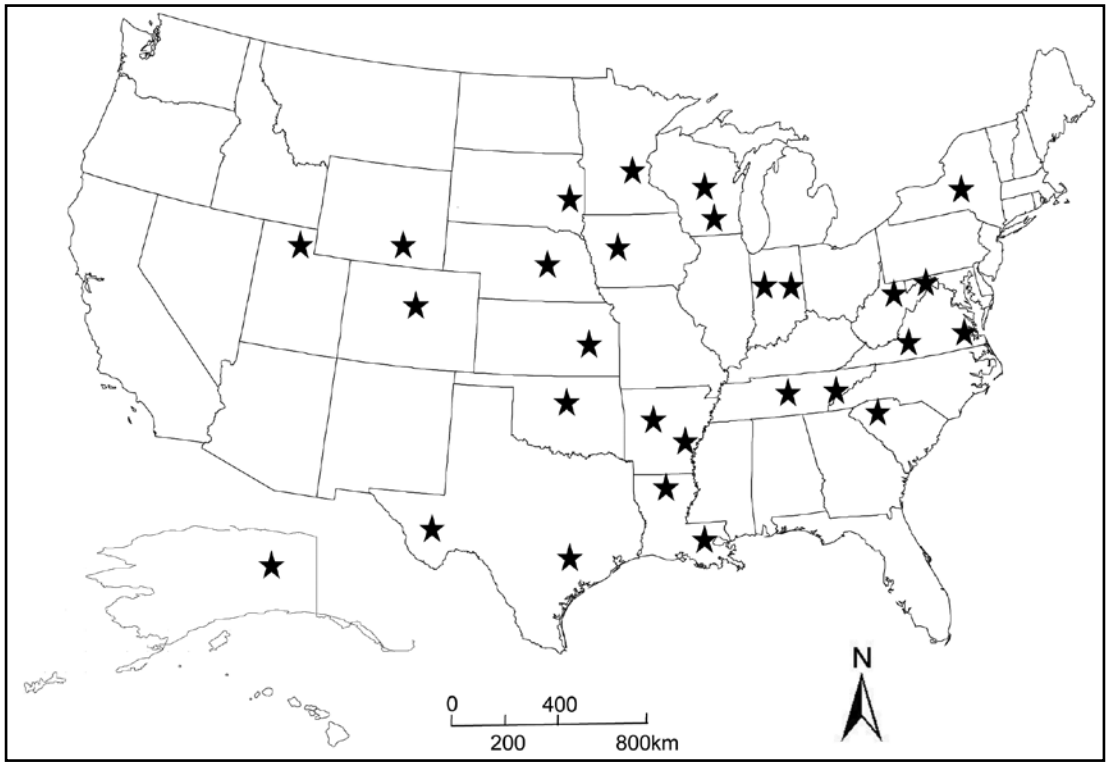

Figure 2. United States map with locations (black stars) of university survey participants. Of the 31 survey respondents, 3 did not provide a university affiliation.

We ranked these types in general terms from most to least amount of coverage available. First was a state employee health insurance system, where coverage is available to the student and premiums are deducted from student paychecks similar to a state or federal employee health plan. These types of insurance plans typically have lower copays for exams and prescriptions. The second type was major medical insurance, which consists of a health care plan with high deductibles and copays. These plans are typically only used in case of an emergency, a surgery, or other large out-of-pocket expenses. Finally, the third type was campus health care, where care is provided to students through the university. These plans are similar to major medical insurance, but instead of obtaining a policy through an insurance agent plans are provided by and partially subsidized through the university for students. Typically these plans provide health care for no or reduced upfront cost; however, students typically pay indirectly for these benefits through student fees that are required with their tuition. If a program had a health care plan that did not fit into any of these categories, we asked survey participants to briefly describe their plan.

The survey was sent via a Web link to the listed contact (usually department head, chair, or dean) for the 59 full and associate members of the National Association of University Fish and Wildlife Programs in the 2009–2010 directory. To increase sample size and gain a more diverse sampling of programs, we sent the survey to 11 additional graduate programs that provided contact information in the 2007 National Wildlife Federation Conservation Directory. The National Association of University Fish and Wildlife Programs and National Wildlife Federation directories listed contact information for graduate programs that provide training in wildlife and fisheries and include numerous degree programs (e.g., wildlife and fisheries, natural resources, biology). Following the initial contact attempt, a reminder e-mail was used to increase the response rates of those surveyed (Salant and Dillman 1994). The Web link was available for 90 days to allow survey participants time to complete the survey. For the purpose of anonymity, all reported results were not linked to any given university or location.

RESULTS

We received a total of 363 total responses to the student survey, although not every student answered all questions. The top five reasons students selected a graduate school (in order of importance) included the following: project (201), department (188), location (179), advisor (178), and assistantship offered (169). Other frequent responses included career advancement (62), cost of graduate school (32), and acceptance (20). No other responses were recorded more than 14 times (<1.5%). When asked whether stipends and benefits were a factor in selecting a graduate program, 56% and 58%, respectively, indicated that these were important or very important (Figure 1). When asked whether they would have chosen to attend the program regardless of the stipends or benefits, more students responded that they would not (not true at all or somewhat untrue) than those who said they would (somewhat true or very true; Figure 1). When students were asked whether, in hindsight, they wished they had considered benefits, 54% of respondents said "no," and 46% said "yes." However, only 6% of students responded, "No, these aspects are not important to me." The majority of no responses were the first option, "No, I am happy with the benefits available at this program." Finally, when asked whether current students thought that prospective graduate students should consider financial aspects when selecting a graduate school, 96% of respondents said "yes."

We received a total of 31 responses to our online survey from natural resource departments across the United States (Table 3), although not every respondent answered all survey questions. Survey respondents represented a broad geographic and demographic (program size, degrees offered) sampling of graduate programs. Graduate stipends were variable across programs, between appointments (GTA v. GRA), and between M.S. and Ph.D. students. Median annual stipends were variable, ranging from $7,000 to $44,600, depending upon appointment and location (Table 4). In general, GRA positions tended to pay slightly higher than GTA positions, and Ph.D. stipends were higher than M.S. stipends (Table 4).

TABLE 4. Median annual stipends (US$) for graduate student appointments at responding universities throughout the United States. N = number of survey respondents, GRA = graduate research assistant, GTA = graduate teaching assistant, M.S. = master's level, Ph.D. = doctoral level.

Appointment	*N*	Median stipend ($)	Range of stipends ($)
M.S. GRA	31	16,506	7,000 to 36,700
M.S. GTA	25	15,504	7,000 to 36,700
Ph.D. GRA	24	19,400	12,528 to 44,600
Ph.D. GTA	21	18,270	9,333 to 44,600

TABLE 5. Health care coverage provided to graduate students at 31 natural resources programs in the United States.

Health care option	% of respondents
State employee	26.67
Major medical	16.67
On-campus	40.00
None	10.00
Other	6.66

Tuition remission and health care benefits for graduate students also varied across graduate programs. Of the 31 survey participants, 30 provided information on tuition remission. Full tuition remission was provided to graduate students at 66.7% (20 of 30) of responding programs. Of the 10 respondents that did not offer full tuition remission, in-state tuition rates were offered to students at 90% of these locations (9 of 10). Of the programs that did not offer full tuition remission, some programs covered a fixed percentage (e.g., 67%) of tuition costs, others paid a fixed dollar amount per semester, and others still offered no tuition remission at all.

Of the 30 survey participants who provided information on graduate student health care coverage, the most common type provided was campus health care, with 63% of survey participants listing it as at least one option available to students and 40% of programs listing this as the primary coverage option (Table 5). The next most common primary health care coverage option was the state employee plan (the highest level of care), available at 27% of survey participants' programs. Major medical coverage was reported by 16.7%, and 10% of survey participants reported no health care coverage. Additionally, coverage provided at some programs was variable for each individual student, with no fixed policy. However, in general, both tuition remission and health care coverage were similar across M.S./Ph.D. students and GRAs/GTAs within a given department or college. For example, if a program offered full tuition remission for their Ph.D. students, they generally also offered full tuition remission for their M.S. students regardless of whether they were on a GRA or GTA appointment.

DISCUSSION

Based on our student opinion survey it is apparent that students select graduate schools based on several main factors, including the research project or topic, characteristics of the department or program, location, future advisor, and the assistantship offered. These results were supported by subsequent responses (questions 2 and 3) and current or past graduate students overwhelmingly believed that prospective graduate students should research the financial aspects of graduate school prior to selecting a program of study (question 7).

Results of the survey indicated that the stipend and benefit packages offered to graduate students were highly variable among departments and colleges that responded. Some of the variability in graduate stipends reflected in this study was possibly due to differences in cost of living in various locations. Similarly, graduate student health care plans were often different between schools and may have reflected socioeconomic factors between locations. For example, many programs classify graduate students as state employees, and as state employees they are subject to changes in their salary or benefits instituted by state government.

Because there is such variability—and based on the overwhelming responses of current and past graduate students—we recommend that prospective graduate students research and consider financial factors before accepting a position as a new graduate student. First, it is important to realize that graduate school is a full-time job. As a graduate student, you likely will not have time—or may not even be allowed—to work a second job. After reviewing the financing options available for graduate school, you may need to consider applying for loans to cover school and living expenses, and your findings may help dictate the type and size of loan you may need. The combination of stipend, insurance, and tuition remission should also be considered in light of the cost of living at a particular location. Though some universities offer higher stipends, they may not cover as much tuition or have a complete insurance policy or vice versa. A few thousand dollars on a higher stipend may quickly be negated by tuition rates or the purchase of a health insurance policy. Emergency health care costs may result in further debt.

Although many programs offered some form of on-campus medical care or insurance, prospective students should assess these components with a keen eye. Many programs offer campus health care for free. Remember the old adage, "There's no such thing as a free lunch." Typically, universities offset free health care costs with student fees. In addition to campus health care, fees cover a variety of expenses such as athletic events, intramurals, library costs, and other university programs. As the student, if you have to pay any student fees, you are likely indirectly paying for your on-campus health care. Because our survey did not explicitly assess fee coverage for graduate students, we cannot offer specific findings but rather advise prospective students to be aware of these hidden expenses. Another aspect to consider regarding insurance is whether you are still covered under a parent's health care policy. Many health insurance policies allow full-time students to be covered under their parents' health insurance plan until the age of 25 or 26. If so, then perhaps this issue is not important for you. Although likely expensive, students may have to consider the option of purchasing health care coverage through independent providers.

Though our survey results and list of considerations provide students with information to help make an educated decision when selecting a graduate school, there are limitations to our study and items we that did not address. First, our student survey only encompassed graduate students who were members of the AFS and may not represent issues encountered by other graduate students. However, you are not required to be in a strictly "fisheries-related program" to be a member of AFS, so it is likely that students from natural resource and biology programs also responded. Second, responses to our nationwide survey of departments and universities did not come from every state or include every major wildlife and fisheries graduate program in the United States. Other universities not included in this study may have their own suite of benefits available to graduate students. However, we did provide a random sample from a broad geographic range of schools and program sizes. One other topic our survey did not address was the option for students to obtain fellowships or funding through grant writing. Some universities offer graduate fellowships, and some faculty members encourage students to help secure their own

funding. These are unique, beneficial opportunities for students (i.e., learning grantsmanship); however, these opportunities should be researched and discussed openly among prospective students and their potential advisors.

The choice of whether or not to attend graduate school and where to attend is a critical one. Although we strongly advocate that students consider non-financial aspects of a particular graduate program, the financial aspects will likely influence the decision made. By providing prospective students with knowledge regarding the financial aspects of graduate school—and the proper questions to consider asking—we hope that our findings may help more students select a graduate school that best fits their needs and lead them to a more productive graduate experience.

ACKNOWLEDGMENTS

We thank the Department of Natural Resource Management faculty members at South Dakota State University (SDSU) for providing useful feedback during the development of our survey. We would also like to thank fellow graduate students at SDSU and across the country for helpful and insightful discussions for this undertaking. We thank Dave Willis, Melissa Wuellner, Joshua Raabe, Mark Kaemingk, and four anonymous reviewers for insightful comments of a previous version of this article.

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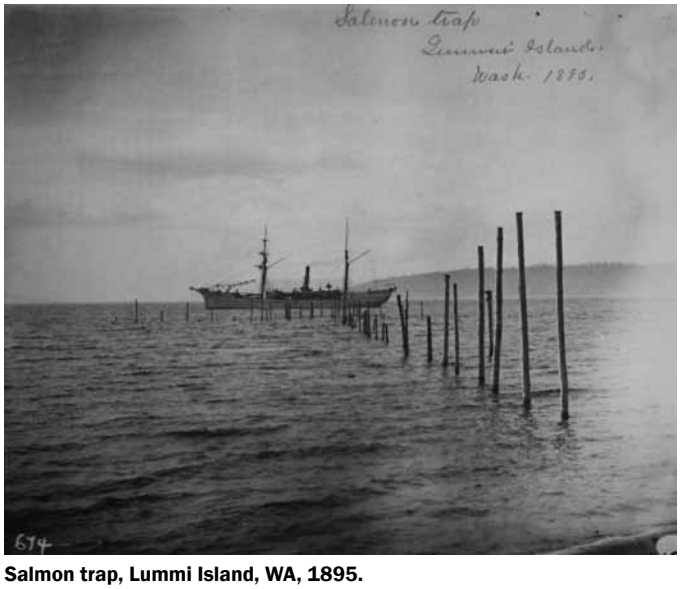
Physiology and Fish Culture Sections

The Physiology Section and Fish Culture Section would like to announce a special triennial symposium, "Physiological Insights towards Improving Fish Culture III," at Aquaculture 2013, cosponsored by the World Aquaculture Society, National Shellfish Association, and American Fisheries Society (AFS) Fish Culture Section, to be held in Nashville, Tennessee, from February 20 to February 25. The special two-day symposium will cover topics in growth and nutrition, health and disease, stress and environmental challenges, and reproduction and development, featuring plenary, invited, and contributed presentations. The goals of the symposium are to provide a forum for fish physiologists and aquaculturists to exchange scientific ideas, establish research collaborations, and work to improve finfish production using recent developments in basic and applied research. They anticipate that abstracts for Aquaculture 2013 (www.was.org) will be due in September 2012.

Adult broodstock cobia being sampled at the Florida research facility. (Rachycentron canadum) Rosenstiel School of Marine and Atmospheric Science. Photo credit: NOAA / Jorge Alarcon - Dr. Daniel Benetti

Fisheries History Section: A Brief Visit to the Internet



Salmon trap, Lummi Island, WA, 1895.
Photo credit: Gulf of Maine Cod Project, NOAA National Marine Sanctuaries; Courtesy of National Archives

> *Along the Pacific Coast the streams running into the sea receive their annual migrations of spawning salmon that ascend the streams to spawn and die. Superficially this appears to be a prodigal waste on the part of nature. A closer observation, however, reveals an intricate balance of related parts. The bodies of the spawned out salmon are either consumed directly as food by young salmon and trout or start a food cycle as they decompose that indirectly provides food for them. (Lauren R. Donaldson and Fred J. Foster,* Progressive Fish Culturist*, No. 19, June 1936)*

Reading the above in a copy of the *Progressive Fish Culturist* at D.C. Booth made me a little curious. I was under the impression that this thought was a relatively recent one. Turning to the Internet, I found a 1995 article by Willson and Halupka, *Anadromous Fish as Keystone Species in Vertebrate Communities*. That article cited a 1975 article by Richey, *Effects of Kokanee Salmon Decomposition on the Ecology of a Subalpine Stream*. Without a subscription to the *Journal of the Fisheries Research Board of Canada*, I was blocked from the article itself. Turning to the archives at D.C. Booth, I found two issues from 1975, neither one the correct one. The Internet next yielded *Distribution of Organics from Salmon Decomposition* (Goering and Brickell 1972). It was not available online and not apparent in our cataloged archives. The archives are not completely cataloged, nor do catalog records list every title. With amazement at the Internet, I left the gap from 1936 to 1972 for a later time.

~ Randi Sue Smith

Bioengineering Section: Evaluation of Fish Injury and Mortality Associated with Hydrokinetic Turbines

Welka UPG hydrokinetic turbine installed in the Alden flume and evaluated with rainbow trout and largemouth bass. Photo credit: Alden Research Laboratory, Inc.

Considerable efforts have been underway to develop hydrokinetic energy resources in tidal and riverine environments throughout North America. With this development comes concern for potential impacts to fish and other aquatic organisms. A primary issue of interest to resource and regulatory agencies is the potential for fish to be injured or killed if they encounter hydrokinetic turbines. To address this issue, the Electric Power Research Institute teamed with Alden Research Laboratory, Inc., to develop information and data that can be used to assess the potential for proposed projects to adversely affect fish. For these efforts, EPRI was awarded a grant by the U.S. Department of Energy to (1) review existing information on injury mechanisms associated with fish passage through conventional hydro turbines and the relevance and applicability of this information to fish passage through hydrokinetic turbines; (2) conduct flume studies examining fish interactions with two hydrokinetic turbine designs to determine injury and survival rates and to assess behavioral reactions and avoidance; and (3) apply a theoretical model for predicting blade strike probability and mortality to hydrokinetic turbines. Flume testing was conducted with a spherical Darreius-type (cross-flow) turbine and an axial-flow propeller turbine. Survival and injury for selected species and size groups was estimated for each turbine operating at two approach velocities. Survival rates were greater than 98% for rainbow trout tested with the Darreius-type turbine and greater than 99% for trout and largemouth bass tested with the axial-flow unit. Injury and scale loss rates of turbine-exposed fish were low for tests with both turbines and generally comparable to control fish. Video observations from survival tests demonstrated active avoidance of turbine passage by a large proportion of fish even though they were released about 25 cm upstream of the turbine blade sweep. The information and data developed from this research effort has resulted in a better understanding of the interactions between fish and hydrokinetic turbines for two general design types (vertical cross-flow and ducted axial flow). However, because the results are generally applicable to the presence of a single turbine, more analysis is needed to assess the potential for multiple units to lead to greater mortality rates or impacts on fish movements and migrations. Additionally, future research should focus on expanding the existing data by developing better estimates of encounter and avoidance probabilities. Published reports for these studies can be downloaded at http://www.epri.com.

~ Stephen Amaral

Fish Health Section

Staff transporting fish by stretcher at the Florida Keys research laboratory. Rosenstiel School of Marine and Atmospheric Science
Photo credit: NOAA / Brian O'Hanlon - Joe Ayvazian

You are most cordially invited to attend the AFS–Fish Health Section (FHS) meeting from July 31 to August 3, 2012, in La Crosse, Wisconsin. The meeting begins with a social/registration the evening of July 31, followed by two full days of papers on August 1 – 2 and a continuing education course on August 3. The meeting is cosponsored by the U.S. Fish and Wildlife Service (USFWS) La Crosse Fish Health Center, Wisconsin Department of Natural Resources, Wisconsin Veterinary Diagnostic Lab, U.S. Geological Survey Upper Midwest Environmental Sciences Center, Great Lakes Fish Health Committee, and Wisconsin Department of Agriculture, Trade and Consumer Protection. In an effort to reduce everyone's carbon footprint for attending this meeting to a size 3 (narrow), we have synchronized watches with the following groups who will hold their annual meetings on July 30 and/or 31. These meetings provide a fantastic segue for the FHS meeting, which begins on the evening of July 31. The Great Lakes Fish Health Committee meets 8 AM to 5 PM on July 30 and 8 AM to noon on July 31. The Drug Approval Workshop meets from 8 AM to 5 PM on July 31 and will provide attendees with updates on the approval status of aquaculture drugs and an opportunity to discuss and identify new or unmet fish disease control needs with other fish health professionals, fish culturists, and drug researchers, sponsors, and regulators. In addition, the AFS-FHS will kick off its meeting with a special session on topics related to new fish drug approvals on August 1 from 8 a.m. to noon. The Workshop for Veterinarians on Fish Regulatory Medicine (sponsored by U.S. Department of Agriculture–Animal and Plant Health Inspection Service [APHIS] and the Wisconsin Department of Agriculture Trade and Consumer Protection) meets July 31. All of this is happening at the beautiful Radisson Hotel in downtown La Crosse, located on the parkway and banks of the mighty Mississippi River. The hotel has generously provided single room rates of $70 (a king-size bed) and double room rates of $100 (two queen-size beds) per night.

~ Andrew E. Goodwin

Baitfish Certified Free of Aquatic Nuisance Species and Important Diseases: The Future Is Now

A bucket full of bait mullet caught by net casting
Photo credit: NOAA / William B. Folsom, NMFS

The use of live bait for fishing has a rich cultural history in the United States. The farmed and wild baitfish industries provide livelihoods for thousands of people, including harvesters, farmers, shippers, wholesalers, and bait retailers. Sport fishers who utilize live baitfish spend millions of dollars on fishing tackle, fishing licenses, hotels, and other equipment and services. Baitfish are an important tradition and critical to the livelihoods of thousands of Americans.

The capture and use of wild baitfish has been practiced in North America since long before the first Europeans arrived and significant numbers of farmed baitfish have been produced in the United States since shortly after World War II. An April 13, 1941, a press release from the USFWS encouraged the farming of baitfish "to reserve the natural food supply for native game fish" and to "provide anglers with better-conditioned bait." The USFWS even provided guidance to baitfish farmers through the 1939 "Circular 28: Propagation of Bait and Forage Fish." There are now baitfish farms in the United States that are well into their fourth generation of family ownership.

Despite their long history, the wild and farm-raised baitfish industries have recently been challenged by concerns that live baitfish, and baitfish shipments, might serve as vectors to spread diseases or aquatic nuisance species (ANS) to new watersheds. Regulators have responded to those concerns by imposing new rules and limitations on baitfish movements and by increasing scrutiny of baitfish shipments. These changes have been of great concern to those with livelihoods dependent on the baitfish industry. One segment of that industry, producers of farm-raised baitfish in Arkansas, has responded by working with the Arkansas Agriculture Department to develop a stringent inspection and certification program that provides formal assurances that baitfish produced under the program are free of ANS and important diseases.

In 2005, the Arkansas State Legislature responded to industry requests and passed a bill directing the Agriculture Department to oversee a bait and ornamental fish certification program. The specific requirements for that program were developed in collaboration between the Agriculture Department, the Arkansas Bait and Ornamental Fish Growers Association, and aquaculture and fish health scientists from the University of Arkansas at Pine Bluff. The goal of the program was to develop stringent requirements that meet internationally recognized criteria and that are based on independent third-party verification of compliance. In 2007 the final regulations were formalized and the first farms were enrolled.

Farms that participate in the Arkansas Certification Program must do the following: (1) conduct semi-annual disease inspections with sampling overseen by a U.S. Department of Agriculture–APHIS certified veterinarian and testing conducted in a laboratory that uses APHIS-approved protocols, (2) follow stringent biosecurity requirements including culture-only well water and no importation of fish that do not meet full program standards for disease freedom, (3) submit to on-farm inspections for ANS species by state inspectors, and (4) allow state inspectors to examine farm records to verify compliance. Costs to the producer include payments to the veterinarian, to the testing laboratory, and an annual fee to the state. Farms that meet program requirements for at least two consecutive years are eligible for certification and may ship fish using serially numbered, tamper-evident, shipment-specific certificates provided by the state. Program pathogens include the viral pathogens of national concern. The program also certifies freedom from 13 major ANS species including fish (Asian carps, snakeheads, sticklebacks, rudd, and orfe), plants (hydrilla, Eurasian milfoil, and others), and mollusks, including zebra and quagga mussels and New Zealand mud snails.

The Arkansas Bait and Ornamental Fish Certification Program is stringent, third-party verified, and expensive for producers, but more than 95% of Arkansas baitfish are produced under this voluntary program. It is successful because it was developed through a collaboration of industry, scientists, and regulators and because farmers clearly see economic benefits that offset the risk and financial costs involved in program participation. These benefits include market advantages gained by the producer's ability to provide meaningful assurances of safety to customers and regulators and a greatly reduced probability of disease or ANS impacts on their farms.

~ Andrew E. Goodwin

NEW AFS MEMBERS

Richard Allibone
Deanna Anglin
Patrick Appel
Heather Baird
Nolan Bett
Russell Black
Shannon Boys
Richard Burrows
Matt Cahoon
Carina Caldeira
Brandon Chasco
Lauren Cleeves
John Cooney
Andrew Cushing
Jeremiah Davis
Matthew DeAngelo
Scott Deeds
Andrew DeWitt
Brie Elking
Mandy Erickson
Anthony Fernando
Michael Fortin
Andrew Futerman
Dan Garren
Swagat Ghosh
Victoria Gibbs
Ruslan Grigoriev
Ryan Handeland
Nicole Harris
Jason Harris
Rezvan Hatami
Earl Heath
Laura Heironimus
Erika Holland-Fritsch
Michael Hughes
Satya Kansal
Sara Kappus
Elise Kelley
Alexis Kho
Christina Killourhy
Benjamin Kissinger
Casey Knight
Breanna Korsman
Tommy Larouche
Bruce Lauber
Sarah Leis
Megan Lloyst
Mark Luttenton
Maureen Lynch
Ayman Mabrouk
Kristen Maize
Louise Mauldin
Shaun Miller
Jaime Mills
Anne Morgan
Daniel Morodvanschi
Robbie Mulberger
Joel Mulder
Max Murray
Denver Nelson
Adam O'Dell
Elizabeth Parvis
Kestrel Perez
William Pine
Milton Qualttlebaum
Michael Rafferty
Andrey Reshetnikov
Nathaniel Rigolino
Jason Ross
Kathryn Ruddick
Brendan Runde
Ryan Ryswyk
Cory Sandow
Scott Schon
Steven Seiler
April Silva
Luis Silva
Sara Smith
Dongwha Sohn
Natalie Sopinka
Isaac Standish
Ronald Steg
James Stephenson
Cheree Steward
Laura Stichert
Andrew Swenson
Steven Teo
Mark Tupper
Page Vick
Craig Walker
Jeremy Webster
Alan Webster
Micah Wells
David Whitehair
Nicholas Whitney
Daniel Willard
Garth Wyatt
Joshua Zacharias

A 75th Anniversary Must-Do

Brian L. Bohnsack
U.S. Fish and Wildlife Service, Arlington, VA 22192. E-mail: brian_bohnsack@fws.gov

Ronald J. Essig
Wildlife and Sport Fish Restoration Program–Northeast Region, U.S. Fish and Wildlife Service, Hadley, MA

Robert L. Curry
North Carolina Wildlife Resources Commission, Raleigh, NC

Douglas D. Nygren
Kansas Department of Wildlife, Parks and Tourism, Pratt, KS

Attendees at the American Fisheries Society (AFS) 2012 annual meeting (afs2012.org) have the special opportunity to join in the year-long celebration of one of the cornerstones of America's conservation, the Sport Fish Restoration (SFR) Program. The SFR Program is being celebrated along with its predecessor user-pay, user-benefit program, the Wildlife Restoration Program, which is 75 years old this year. A day-long symposium featuring some of the nation's most influential leaders with the SFR Program has been sponsored and arranged jointly by the Fisheries Administration and Fisheries Management sections. You may know the SFR Program by one of its other names; for example, the Dingell-Johnson or Wallop-Breaux program. Regardless of which name you know it by, this symposium will provide you with the chance to better understand the program, its history, the critical role it has played in shaping fisheries management and conservation in the United States, its provision of recreational fishing opportunities, and its future directions.

The SFR Program is arguably the most important fisheries conservation program in the United States, and perhaps the world, and celebrated its 50th anniversary in 2000 (Loftus and Tyler 2000). The sections have worked hard to develop a symposium that highlights its historical, current, and future importance to fisheries management, to AFS, and to the overall conservation effort in the United States. The SFR Program has provided a total of $7.3 billion through grants to state fish and wildlife agencies for their sport fisheries programs since 1950 (Figure 1).Current SFR Program revenues exceed $625 million annually from excise taxes on fishing equipment, import duties, interest, motorboat fuel taxes, and small-engine fuel taxes. State agencies have used SFR Program funds for a wide variety of projects. The Fisheries Administration Section annually selects projects in the categories of research and survey, development, and aquatic resource education to receive their "Outstanding Sport Fish Restoration Projects of the Year." Previous recipients of these awards in recent years will give presentations and discuss their work as the main focus of the symposium.

The SFR Program's reach is far ranging, and a comprehensive study of its ramifications would undoubtedly identify only a few AFS members in the United States who have not been affected by it in some fashion. For example, attendees will learn how the SFR Program has enhanced and furthered the fisheries science discipline. It has funded salaries of countless state fisheries biologists, particularly in field positions early in their careers. Many state agencies have used SFR Program funds to contract with universities for needed research and therefore assisted in training future fisheries professionals. Symposium attendees will also learn about how AFS used SFR Program funds to produce textbooks like *Inland Fisheries Management* (Kohler and Hubert 1993), and *Angler Survey Methods and Their Applications in Fisheries Management* (Pollock and Brown 1994), and to support many special symposia in the 1980s and 1990s that ultimately resulted in AFS publications still in use today.

SFR Program funding is critical for state fisheries conservation programs (Ross and Loomis 1999). Most important, its permanent-indefinite funding appropriation eliminates the need for annual congressional funding approval. This has ensured the long-term stability and predictability of funding that has been critical for program success. SFR Program regulations prohibit the diversion of fishing license sales revenue for purposes other than administration of the state fish and wildlife agency (Bohnsack and Sousa 2000). This has offered key protection for these license revenues that are a backbone of state agency funding

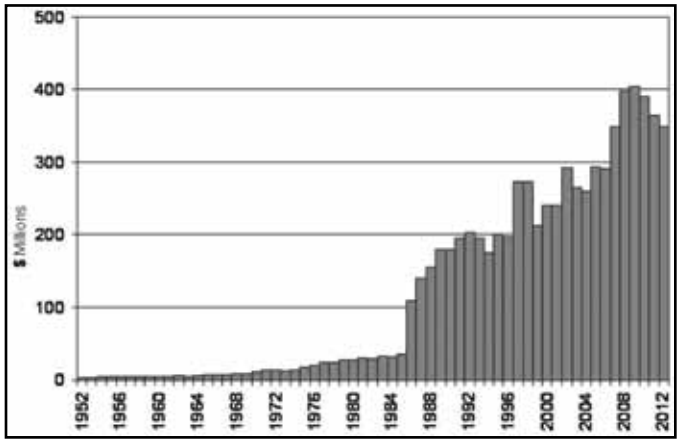


Figure 1. Dingell-Johnson Sport Fish Restoration funding to state fish and wildlife agencies, fiscal years 1952–2012.

and are often used as the 25% non-federal match required for SFR funding.

Many fisheries professionals likely do not realize that the SFR Program is just one of several important conservation and recreation programs that receive funding from the Sport Fish Restoration and Boating Trust Fund. In fact, the trust fund provides funding for seven different conservation and recreation grant programs administered by three different federal agencies, including the U.S. Fish and Wildlife Service, U.S. Coast Guard, and U.S. Army Corps of Engineers. Wetlands conservation and restoration, recreational boaters' sewage disposal, boating safety and enforcement, and infrastructure for transient boaters are also efforts that receive funding from the Trust Fund. Symposium speakers will provide updates on the status of these ancillary programs for a basic understanding that is essential for biologists who are working in the increasingly more complicated arena of natural resources management.

In this day of political strife and discord, key components of the SFR Program have needed reauthorization by Congress, most notably the fuels tax transfer provisions. AFS has been an important supporter of the SFR Program and works with other groups to ensure its reauthorization. The Sections have arranged for a keynote speaker who helped to develop and gain approval for the influential Wallop-Breaux amendment which was ratified as part of Public Law 98-369 and which dramatically increased the SFR program's funding. Other speakers will provide fishing industry and outdoor media perspectives on the SFR Program, as well as discuss the current status of its reauthorization and the longer term challenges that future reauthorizations will likely pose.

You are encouraged to stop in and participate in this symposium. It will help you gain a better appreciation of SFR Program contributions to U.S. fisheries' past, present, and future.

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Usage of "Sex" and "Gender"

Derek H. Ogle

Professor of Mathematical Sciences and Natural Resources, Northland College, Ashland, WI 54806.
E-mail: dogle@northland.edu

Kevin F. Schanning

Professor of Sociology, Northland College, Ashland, WI 54806

The word "gender" is a stem of the Latin term "genus," which means "kind" or "sort." Early on, gender served as a synonym for "sex" (Haig 2004). However, in the 1970s, the definition of gender evolved to provide a clear distinction from the meaning of sex (Money and Ehrhardt 1972). The World Health Organization (2011) now provides very clear definitions of sex as "the biological and physiological characteristics that define men and women" and gender as "the socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for men and women." Thus, sex is a biological distinction focused on reproductive organs and genetic makeup, whereas gender distinctions are defined or constructed by a culture or society and, thus, are subject to change as societal norms change (McCammon et al. 2007; Kramer 2010).

Given modern definitions, sex and gender are not synonyms and they should not continue to be used interchangeably in fisheries publications. Gender is used correctly when in reference to Latin names (i.e., a grammatical use). Outside of grammatical uses, gender would be used correctly only "to refer to social or cultural characteristics of males and females" (Sabin 2001:294). This use would likely be in reference to fishers rather than fish, because fishers are components of societies.

We searched for gender in the main text (i.e., excluding references) of all issues of all American Fisheries Society journals (except *Fisheries*), *the Canadian Journal of Fisheries and Aquatic Sciences* (CJFAS), and *Fisheries Research* (FR) published before 2011 to assess the use of the word gender in fisheries-related scientific publications. Gender was used incorrectly in 308 of the 311 (99%) articles reviewed and was used correctly only once in a nongrammatical usage; that is, "… social and gender roles have been redefined to permit a wider participation of women in village fishing activities …" (Kronen 2004:123). Typical examples in which gender was used incorrectly included the following:

"… gender was determined by visually examining the gonads." (Allen et al. 2003:846)

"Gender was determined by examination for the presence of testes or ovaries during surgery." (Kuhn et al. 2008:362)

"Abdominal palpation and/or gamete extrusion was used to determine gender …" (Noltie 1990:175)

"… skewed female:male gender ratios on the spawning grounds …" (Larsen et al. 2010:565)

"… gender-specific mean age was 4.1 years for males …" (Harris et al. 2007:1537)

"Dummy variables were used for gender (1 = male, 0 = female), …" (Thunberg and Fulcher 2006:641)

"The ability to accurately determine the sex of individual fish in a nonlethal manner is useful because it precludes the need to sacrifice fish when gender represents a variable of interest to fishery scientists." (Isermann 2010:352)

The incorrect usage of gender is not confined to journal articles; a recent introductory wildlife and fisheries textbook (Willis et al. 2009) contains sections entitled "Determination of Gender," "Use of Gender Information," and "Implications of Age, Growth, and Gender Information." In all of these examples, the author was referring to the biological sex of the fish.

The use of gender instead of sex in fisheries publications appears to be a relatively recent phenomenon. We used dummy variable regression (Fox 1997) to examine the annual rate of change in the percentage of articles incorrectly using gender in *Transactions of the American Fisheries Society* (TAFS), *North American Journal of Fisheries Management* (NAJFM), CJFAS, and FR since the year gender was first used in each journal. The number of articles with gender in the main text remained very low until approximately 1990 for all publications except for FR, in which the use of gender remained low until approximately 2000. Since those years, the percentage of articles with gender has remained constant for CJFAS ($P = 0.2093$) but increased ($P < 0.00005$) at the same ($P = 0.1655$) annual rate of between 0.14% and 0.23% per year for NAJFM, TAFS, and FR. By 2010, between 2.7% and 3.9% of articles published in NAJFM, TAFS, CJFAS, and FR used gender in the main text.

Why has gender been used in place of sex in fisheries publications? Two possible reasons include (1) a misplaced form of political correctness resulting in an attempt to avoid the word sex or (2) an attempt to provide variability in the writing. We attempted to quantify these possible reasons by computing the proportion of times gender was used out of all of the times gender and sex were used in each article. The misuse was then classified as "avoiding using 'sex'" if this proportion was greater than 0.8, as "providing a variety of speech" if this

proportion was between 0.2 and 0.8, and as "can't tell" if this proportion was less than 0.2. Excluding the can't tell situations, usage was approximately evenly distributed between the two reasons (50.4% avoiding using "sex"). Unfortunately, these results do not provide a conclusive reason for why gender has been used in place of sex.

Given that gender has roots as a synonym for sex, some authors and editors might argue that the usages of gender that we have identified as incorrect are indeed correct. However, we feel that this argument is spurious because sex would be both correct and unambiguous in these situations. Thus, the continued misuse of gender in the work of fisheries professionals can lead to a lack of clarity, misperceptions, and, because the usage is usually incorrect (according to modern definitions) or unneeded, an erosion of respect for our work. For these reasons, we urge all fisheries professionals to use the word sex rather than gender when sex—that is, biological differences—is meant. The word sex should be used in nearly all writings and presentations by fisheries professionals and students and, thus, we as writers, reviewers, and readers should work to eradicate the misuse of gender from our work.

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Georgia Chapter Holds 20th Anniversary Meeting in Macon

Joey Slaughter, Past-President of the American Fisheries Society Georgia Chapter

The Georgia Chapter of the American Fisheries Society (AFS) held its 2012 annual meeting and celebrated its 20th anniversary as a chapter from February 7 – 9. The meeting was attended by nearly 100 fisheries professionals from around the state, representing state and federal agencies, academia, private consulting, extension, and industry. The meeting program included 30 talks on topics ranging from stream restoration to mussel diversity and trophy largemouth bass management to lionfish toxicology. Among those talks were 14 student presentations, which are always a bright point in the annual program.

During our annual awards banquet, several members were recognized for their service to the chapter and to the profession. Nicole Rankin of the U.S. Fish and Wildlife Service was presented with a Chapter Distinguished Service Award for her hard work revitalizing and maintaining the Georgia Chapter's Website despite a mid-year relocation to South Carolina. Josh Tannehill and Chris Harper, both from the Georgia Department of Natural Resources, were recognized as co-Fisheries Worker of the Year recipients. Josh, a regional fisheries technician, and Chris, a state hatchery manager, have showed a tremendous commitment to protection and conservation of fish and aquatic resources within the state of Georgia in the past year. Charles West, a Department of Natural Resources regional technician from Waycross, was presented with the 2012 Career Contributions Award, recognizing a lifetime of commitment and service to the betterment of our fish and aquatic resources.

The chapter also recognized its students for outstanding research and presentation at the annual meeting. The best student paper award for 2012 was awarded to Brittany Trushel of the University of Georgia (UGA) for her paper, "Influence of Multi-scale Factors on Fish Structural Indices in Freshwater Impoundments: Implication for Successful Fisheries Management." Andrew Taylor from UGA took second place with his review, "Shoal Bass Tag Retention and Spawning Aggregation Abundance in the Lower Flint River, GA." Third place went to Mike Bednarski from UGA for his presentation, "Influences of Drought on Shortnose Sturgeon in the Altamaha River, GA."

The 2012 Georgia Chapter meeting was a tremendous success due entirely to the contributions of our active members. Preparations have already begun for an even better 2013 meeting (location to be determined), and the chapter is looking forward to an opportunity to bid for hosting the 2015 Southern Division mid-year meeting. For more information on the Georgia Chapter, visit www.gaafs.org.

AFS members discuss the future. Photo credit: Rebecca Brown

Awards Committee Chair Steven Patrick presents Charles West with the Georgia Chapter's Career Contributions Award.
Photo credit: Rebecca Brown

Cecil Jennings and Julie Creamer. Photo credit: Rebecca Brown

Incoming President Tim Barrett recognizes Chris Harper with a Georgia Fishery Worker of the Year Award. Photo credit: Rebecca Brown

Georgia Chapter members enthralled in a presentation during the technical session. Photo credit: Rebecca Brown

Steven Patrick recognizes Josh Tannehill with a Georgia Fishery Worker of the Year Award. Photo credit: Rebecca Brown

Georgia Chapter's 20th anniversary commemorative logo.

Virginia Chapter Holds its 22nd Annual Meeting in Blacksburg

William B. Kittrell, Jr., Former Interim Secretary, Virginia Chapter, American Fisheries Society

The Virginia Chapter of the American Fisheries Society (AFS) held its 22nd annual meeting at Virginia Tech in Blacksburg, Virginia, from January 31 to February 2, 2012. The meeting was held in conjunction with the Virginia Tech Chapter's annual meeting. Attending the joint meeting were 112 registered participants, including 61 fisheries professionals and 51 students. Two continuing education workshops were offered at minimal cost on January 31. The first workshop, "Introduction to GIS for Fisheries Scientists," was taught by Shannon White and Tiz Mogollon, both of whom are graduate students at Virginia Tech. Robert Humston (Washington and Lee University) and Vic DiCenzo (Virginia Department of Game and Inland Fisheries) served as instructors for the second workshop, entitled "Statistics for Fisheries Research." Meeting participants enjoyed an all-you-can-eat fish fry and social hosted by the Virginia Chapter at the German Club on the Virginia Tech campus Tuesday evening.

The technical presentations began on Wednesday morning and continued throughout the day in Fralin Auditorium with a poster session late in the afternoon in the Atrium. The 2012 annual business meeting was held Wednesday afternoon just before another all-you-can-eat buffet and social hosted by the Virginia Tech Chapter in downtown Blacksburg. The Virginia Chapter hosted a raffle that generated approximately $700 for student scholarships and other worthy endeavors. Technical presentations continued Thursday morning, and the meeting concluded at noon on Thursday. A total of 21 technical presentations were given, with an additional four posters presented Wednesday evening.

The annual business meeting was held on February 1 with President Bob Andrews presiding. Bryan Murphy (Southern Division president) updated the chapter on the division's plan of work for the upcoming year. The Robert Jenkins Undergraduate Scholarship was awarded to Patrick Snelling of Virginia Tech. The Ross Graduate Research Scholarship went to Shannon White of Virginia Tech. Brandon Peoples and Cory Dunn tied for best student papers, and both were given a monetary award. Shelton Miles received the Natural Resource Conservationist Award for his work on the Staunton River. This award is given every year to an outstanding citizen conservationist in Virginia. The Eugene W. Surber Award was given to John Schmerfeld with the U.S. Fish and Wildlife Service in honor of his national resource damage assessment work. Vic DiCenzo was installed as president, and Bob Andrews will now serve as past-president. John Copeland and Mike Isel were installed as the new president-elect and secretary, respectively. Dawn Kirk will serve as chapter treasurer, and Robert Humston continues as newsletter editor.

From the Archives

The pompano (*Trachinotuscarolinus*). Although a fish of Southern waters, the excellence of the pompano for the table places it at the head, not only oftheestuary fishes, but of all known members of the finny tribe. It is incomparable with any other. While in the restaurants of New Orleans and Mobile it is the fish beyond compare, it is worth a trip to Southern Florida to realize the delectable, luscious savor of a freshly caught and broiled pompano. The salmon, white-fish, and shad alike pale before its super excellence. A broiled pompano's head is a bonne-bouche to eat and dream of for a life-time. See Rome and die, eat pompano and live!

J.A. Henshall (1884): Comparative Excellence of Food Fishes, *Transactions of the American Fisheries Society*, 13:1, 115-122.

John Schmerfeld (right) receives the Eugene W. Surber Professional Service Award from Bob Andrews.

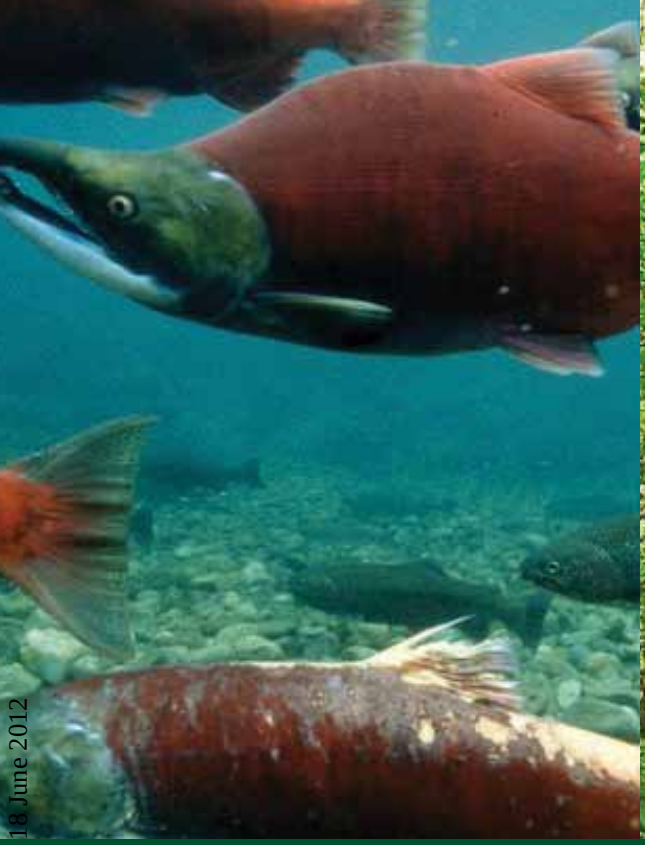
Attentive students participating in the continuing education workshop entitled "Introduction to GIS for Fisheries Scientists."

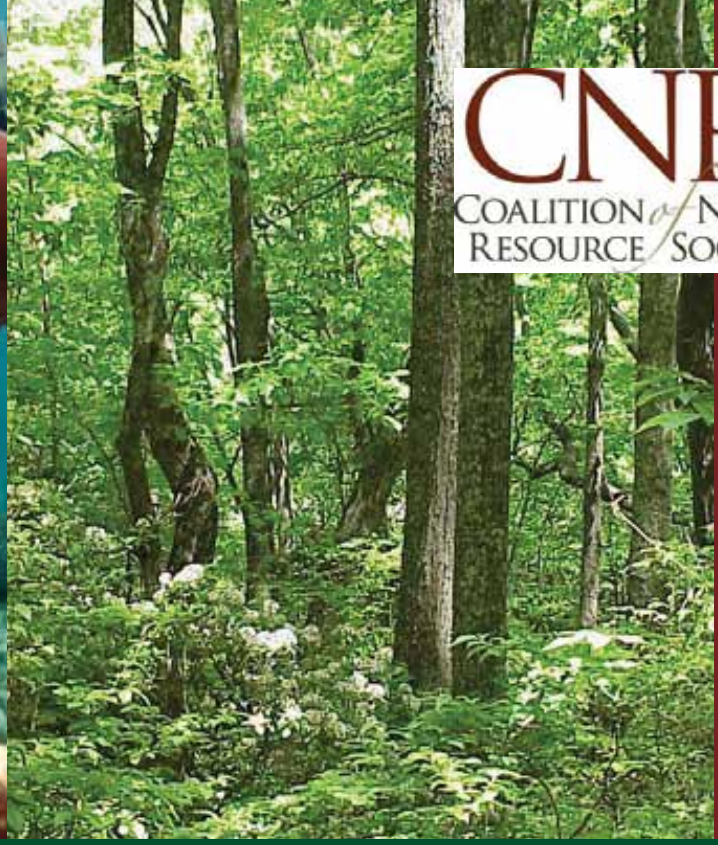
Bob Andrews (left) ceremonially passes the gavel to new President Vic DiCenzo during the business meeting.

A total of 21 technical presentations were given during the 2012 Virginia Chapter AFS meeting held at Virginia Tech in Blacksburg, Virginia.

Newly installed President Vic DiCenzo (right) presents past Treasurer Morgan McHugh with a certificate of appreciation for her service.

The newly installed 2012 Virginia Chapter Excom during the business meeting. Pictured are (left to right) Mike Isel, Dawn Kirk, Vic DiCenzo, John Copeland, and Bob Andrews.





CNRS
COALITION of NATURAL RESOURCE SOCIETIES

AMERICAN FISHERIES SOCIETY

SOCIETY OF AMERICAN FORESTERS

NATURAL RESOURCE EDUCATION AND EMPLOYMENT CONFERENCE REPORT AND RECOMMENDATIONS

SOCIETY FOR RANGE MANAGEMENT

THE WILDLIFE SOCIETY

Table of Contents

Institutional Abbreviations

AFS – American Fisheries Society
AFWA – Association of Fish and Wildlife Agencies
APLGU – Association of Public and Land-grant Universities
NAFWS – Native American Fish & Wildlife Society
NAUFRP – National Association of University Forest Resources Programs
NAUFWP – National Association of University Fisheries & Wildlife Programs
SAF – Society of American Foresters
TWS – The Wildlife Society

Acknowledgments

We appreciate the time, effort, and invaluable insights of all those who participated on the panel and especially the planning committee: Darryl Walter (TWS), Michael Hutchins (TWS), Tom Ryder (TWS and Wyoming Game and Fish), Gus Rassam (AFS), Wayne Hubert (AFS president and University of Wyoming emeritus), Bill Fisher (Cornell University and AFS), Eldon Hawkes (AFS), and Carol Redelsheimer (SAF).

We are particularly grateful for the skillful guidance of our facilitator, Dave Chadwick, from the Colorado Division of Wildlife and the Organization of Wildlife Planners. And we would like to thank Natasha Atkins, author of this report, as well as TWS Executive Director/CEO Michael Hutchins and Director of Communications Lisa Moore, who contributed valuable editorial comments.

Coalition of Natural Resources Societies (CNRS) Natural Resource Education and Employment Conference

PARTICIPANTS

James Allen, Northern Arizona University (SAF)
Natasha Atkins, Writer
Rick Baydack, University of Manitoba (TWS)
Keith Blatner, Washington State University (SAF)
Ben Bobowski, National Park Service
Dave Chadwick, Colorado Parks and Wildlife
Steve Chase, National Conservation Training Center, U.S. Fish & Wildlife Service
Kate Christen, Society for Conservation Biology
Daniel Edge, Oregon State University (NAUFWP)
Terrell Ericson, Natural Resources Conservation Service
Dwight Fielder, Bureau of Land Management
Wendy Fink, Association of Public and Land-grant Universities
Bill Fisher, Cornell University (AFS)
Gary Frasier, Society for Range Management (AFWA)
John Gassett, Kentucky Department of Natural Resources (AFWA)
Dwight Guynn, Management Assistance Team, AFWA
Molly Harrison, NOAA Fisheries Service
Wayne Hubert, American Fisheries Society
Michael Hutchins, The Wildlife Society
AJ Kroll, Weyerhaeuser
Tina Lancaster, U.S. Fish & Wildlife Service
Fred Matt, Native American Fish & Wildlife Society
Steve McMullin, Virginia Tech (AFS)
Kelly Millenbah Michigan State University (NAUFWP)
Jess Peterson, Society for Range Management
Glenn Plumb, National Park Service
Gus Rassam, American Fisheries Society
Carol Redelsheimer, Society of American Foresters
Terry L. Sharik, Utah State University (SAF)
Jim Siegel, National Conservation Training Center, U.S. Fish & Wildlife Service
Richard Standiford, University of California
Daniel Svedarsky, University of Minnesota, Crookston (TWS)
Inez Uhl, U.S. Fish & Wildlife Service
Yanin Walker, Note taker, The Wildlife Society
Darryl Walter, Meeting planner, The Wildlife Society
Kevin Whalen, U.S. Geological Survey
Tim White, University of Florida (NAUFRP)
Ken Williams, Cooperative Research Units, U.S. Geological Survey

Background

The future of natural resource management and conservation depends on having a workforce of well-trained, dedicated professionals across the public, private, and nongovernmental sectors. A diverse suite of changes over the past several decades—in the natural environment, demographics, workplace attitudes, curricular offerings, and the availability of funding, among others—raises questions about whether there is an adequate supply of well-trained natural resource professionals in the pipeline. With many career employees set to retire, concerns about the supply and competency of their replacements have been voiced more loudly.

Ensuring that students enter the workforce prepared to meet ongoing needs and tackle emerging issues will require a collective effort to develop and implement long-range strategies. To address this situation, the Coalition of Natural Resource Societies (CNRS) convened a Natural Resource Education and Employment Conference on September 11–13, 2011, in Denver, Colorado. The conference brought together leaders from state and federal resource agencies, universities, professional societies, industry, and nongovernmental organizations to review the issues and develop a plan of action. These groups—collectively referred to as "we" throughout this document—are the intended audience for the recommendations in this report.

The Coalition of Natural Resources Societies, formed in 2009, comprises professional and scientific societies focusing on the management and conservation of aquatic and terrestrial ecosystems. CNRS represents and supports tens of thousands of wildlife, fisheries, forestry, and range professionals. At present, CNRS members are The Wildlife Society (TWS), the American Fisheries Society (AFS), the Society of American Foresters (SAF), and the Society for Range Management (SRM). The coalition was formed to concentrate on issues and priorities that provide the maximum opportunity to leverage the existing capabilities of its member societies. Among its objectives are promoting certification and other programs that emphasize professional development and continuing education, and working jointly to increase diversity in the natural resource professions.

The panel was charged with (1) identifying major trends in natural resource education and in the natural resource profession, (2) exploring the reasons for these trends, (3) discussing solutions to reverse or adapt to the trends, and, most important, and (4) making specific recommendations for action. A lack of diversity, particularly of ethnic minorities, is a persistent problem in both academic programs and professional settings. This report therefore treats this subject in its own section.

Natural Resource Education

Trend: Enrollment in traditional natural resource programs has been steadily decreasing.

Enrollment in traditional natural resource programs at the undergraduate and graduate levels reached its peak in the mid-1990s and has generally been declining since (Baydack 2009). However, this decline has been concomitant with a rise in enrollment in "environmental science" and other such conservation-oriented programs. This shift is attributable to a variety of factors. Sometimes it might largely reflect a name change to take advantage of changing societal interests (such as "wildlife conservation" vs. "game management"). In many cases, though, universities have added newer environmental science programs with a broader curriculum, combining biology and wildlife courses with courses on human dimensions, genetics, and statistics (Millenbah & Wolter 2009). Traditional wildlife programs offered by institutions affiliated with the National Association of University Fisheries and Wildlife Programs (NAUFWP), which include more courses directly related to fish and wildlife conservation, constitute a minority of the wildlife programs now available to U.S. college students.

Studies suggest that other factors affecting enrollment are related to demographics and other societal changes, and to a lack of information or misperceptions among students about what natural resources programs entail and what sorts of jobs or careers might follow. The student population in general has become more urban, so fewer students have traditional outdoor experiences such as hunting, fishing, and farming, and many may have little or no connection with nature except through television or other media. The new, broader environmental programs are often designed to appeal to a generation more concerned with sustainability and conservation than with resource extraction and utilization, which, though important for society, some perceive as the focus of traditional programs in forestry, fisheries and wildlife.

Those who enroll in natural resource programs of any kind may be motivated by a general love of the outdoors or of animals, but studies have shown that they are sometimes disappointed by the realities of such programs. For example, fewer natural resource programs now offer field experience or other hands-on opportunities because of time and budget constraints or liability issues. In addition, some students are unprepared for the science and math requirements of traditional natural resource programs or even of the newer, more general environmental science programs (Wolter et al. 2011). These are among the reasons students have given for transferring out of natural resource programs.

Other deterrents are the misconceptions students may have about where a natural resources degree will lead. Many conceive of related jobs as being poorly paid and limited. They are unaware that careers in natural resources can require and help develop expertise in diverse fields, from biology, chemistry, and geology to information technology and accounting, to law, policy, planning, and public relations.

Although data on students' choices are slim, a recent study of students in forestry degree programs (Sharik & Frisk 2011) bears out some of these doubts and perceptions on the part of students. What attracted students to the discipline was having a career in the outdoors; any hesitancy they had about matriculat-

ing in the field was due to pessimism about wages and the job market and to a negative public perception of forestry.

Related to this might be that many natural resource degree programs continue to be geared toward training students for a job in a government agency. This is happening as state and federal budgets are shrinking and many jobs are moving to the private sector, such as consulting firms, NGOs, and industry.

Finally, traditional natural resource academic programs emphasize research at the M.S. and Ph.D. levels. The panel discussed the possible benefits of a two-track system that offered professional and research degrees. The expanding field of natural resource professions needs practitioners as well as scientists. It needs scientists who can conduct basic research and those who know how to apply research to solve real-world problems.

Solutions

1. Youth Engagement

Getting a good crop of students to enroll in natural resource programs requires having them be interested in the subjects to begin with. Many educators lament that kids today are less familiar with and less interested in the outdoors in general and thus are not likely to want to follow a relevant academic path. It's generally believed that to develop a love of nature and the outdoors, kids must be reached by or before middle school.

The field therefore needs to increase its visibility in today's popular culture through new and existing avenues that appeal to young people. These include specific programs such as 4H, Boy and Girl Scouts, and Future Farmers of America. But recognizing that many students come from urban backgrounds without opportunities to fish, farm, hunt, bird watch, or engage in other outdoor experiences, we need to broaden our outreach. Kids can be engaged with the outdoors through community activities such as nature/adventure playgrounds, festivals, community gardens and the local food movement, or through online programs such as the National Wildlife Federation's Wildlife Watch.

Getting natural history and environmental topics into the curriculum more widely is paramount. To incorporate nature into the classroom, we need closer associations with teachers and school organizations. One teacher-training program geared toward the natural sciences is SAF's Forestry Institute for Teachers, which brings together teachers, forestry professionals, and environmental education specialists to develop curricular material on forest ecology and forest management. We can also encourage greater use of existing curriculum programs such as Project Wild and Project Wet. The Fish and Wildlife Service's National Conservation Training Center (NCTC) has a number of programs designed to get kids outside, to expose high school students to natural resource careers, and to bring natural resource awareness back to the classroom. We should work more closely with math and science teachers to help cultivate an interest in natural resources in their students.

We also need to reach kids through today's social media, using social networking tools such as Facebook, Twitter, blogs, and mobile applications ("apps"). And we should find popular culture heroes who can be associated with our efforts.

Finally, many of today's youth are concerned about societal connections, making a difference, and sustainability. We therefore need to develop a unified message and a public marketing campaign that promotes active stewardship of our natural resources. Such public outreach is especially crucial to counter the push by industry to highjack the message of "sustainability."

Action and Recommendations

- Michael Hutchins of The Wildlife Society agreed to take the lead and said TWS and the American Fisheries Society would develop a list of partners with whom to work on initiatives aimed at youth engagement. This is a critical element of the strategy, as professional/scientific societies do not normally focus on youth from K-12.

- Steve Chase of the NCTC says it will expand and promote search tools for young people about jobs in the natural resources.

- CNRS needs to collaborate with other societies, universities, and agencies to develop core stewardship messages, and then work to get them out to the public.

- Natural resource societies should develop career materials. Once the partners are on board, the societies should work with them on creating K-12 information and disseminating it through appropriate avenues.

- CNRS should work with the Association of Fish and Wildlife Agencies (AFWA) and NCTC about developing a webinar on natural resource careers for secondary school classes.

- CNRS should develop a message for high school guidance counselors so that students will consider an academic path in the natural resources.

- To reach and engage primary and secondary school teachers, CNRS and other societies should try to replicate the SAF's Forestry Institute for Teachers.

- We need to identify events where we could do outreach and provide materials to large numbers of kids and their parents. One example is the National Wild Turkey Federation Convention, which attracts many families and offers many wildlife-related activities.

- For younger audiences, we need to think of easy, replicable ways of getting kids to experience the natural world more frequently, such as adventure playgrounds that give kids more natural environments to explore in an urban setting.

- CNRS members should work with partners to develop chil-

dren's books, and possibly related DVDs, highlighting careers in natural resources fields. Michael Hutchins has already met with an author/illustrator and is in discussions about a book series.

- Our audience needs to be expanded to include parents and grandparents of students. We should consider writing articles in magazines such as the AARP magazine. Grandparents University at Michigan State University (http://www.grandparents.msu.edu/) might be a model to explore at universities with natural resource programs; it could be adapted as a way to connect kids with their alumni grandparents over environmental and wildlife topics.

- We should identify programs in urban areas that could be broadened to include natural resources, such as community and school garden initiatives.

2. Recruiting and Retaining University Students

Why some traditional natural resource degree programs are suffering declining enrollment at the same time that more conservation-oriented programs are on an enrollment upswing is still largely speculative. However, before we can really figure out how to respond to these trends, we have to understand them better. We need much better information across the spectrum of degree programs about why students make the choices they do, such as what draws them to a major and why they do or do not stay with it. We also need better information about the demand for graduates in natural resources fields. How valid is the concern about limited job possibilities in these fields?

In the meantime, we can begin to address students' perceptions about natural resources careers, recruit students who may be considering academic areas that are relevant to natural resource careers but not obviously so, and support those who have decided on a natural resource degree program.

Action and Recommendations

- To get better information on enrollment trends, motivation for enrollment, and level of employer demand, CNRS is setting up a task force that will identify the necessary research and seek funding to carry it out. The U.S. Department of Agriculture is already compiling enrollment data on agriculture and other natural resource programs through its Food and Agricultural Education Information System (FAEIS). We should see how we can use this information, or perhaps work with FAEIS to expand the sorts of information being collected.

- CNRS and professional societies should develop a message for incoming university students about natural resource careers and how diverse they can be (not just wildlife biology and forestry but also social sciences, economics, and law). This can also be targeted for career counselors.

- CNRS and professional societies should encourage other federal agencies to promote our professions the way the U.S. Fish and Wildlife Service does through its NCTC.

- If students really are leaving natural resource academic programs because they are math intensive, we should try to pitch ourselves to those leaning toward math-related fields including physics and engineering.

- CNRS should develop a task force to explore whether to promote a two-tier degree structure for separate professional and research degrees.

- Societies should promote interest in natural resources and expand student involvement through their university chapters, student conclaves, and conferences, and consider cross-fertilization with other societies or related organizations.

- Student chapters of societies should reach out to students outside their disciplines to engage students in environmental sciences and other natural resource programs.

- Students should be represented in the power structure of professional societies, such as welcoming student liaisons or advisors on governing boards.

- Professional societies and natural resource professionals should become more fully engaged in the new social media, which have enormous reach, such as through Facebook pages, YouTube, and blogging.

Natural Resource Profession

Trend 1: Employers – particularly natural resource agencies and industry – have been citing a dearth of employee candidates with the necessary combination of technical and people skills.

Any natural resource professional will tell you that natural resource management is really people management, and that may never have been truer than it is today. Societal and technological changes have caused the profession to become more diverse. Management of natural resources historically focused largely on maintaining a sustainable resource base— wildlife, fish, trees—but now involves managing the social, economic, and cultural needs of disparate stakeholders. Societal changes have forced the profession to focus increasingly on habitat effects from changes in global climate and land-use patterns, human-wildlife conflicts, at-risk and endangered species, and problems caused by invasive or overabundant species. Natural resource professionals can expect their jobs to require not only technical expertise but also people skills such as collaborating, writing reports, speaking to the public, and resolving disputes. Moreover, they are expected to be adept at using new technologies for monitoring and managing natural resources.

Surveys of employers, including state agencies, industry, and NGOs, have routinely found that new employees lack the "soft skills" needed for their jobs (Crawford et al. 2011). Also known as "transferable components," these are general skills that are useful in most fields. The most important of these, as identified by a diverse suite of employers, are communications skills,

which include effective oral and written communication along with listening well and asking good questions. The employers also emphasize the importance of decision-making and problem solving skills. Several studies have shown that students tend to be more confident of their preparedness in these areas than is warranted.

In addition, many graduates of natural resource programs also lack basic technical and field skills necessary for entry-level jobs. This has been attributed in large part to many universities having shifted away from the core organismal courses such botany, wetlands ecology, mammalogy, herpetology, (and the other "-olgies") toward more general and sometimes theoretical courses such as conservation biology, ecology, or population biology. With the growth of new degree programs, it is unclear whether traditional subject material is being covered. Employers cannot expect, however, that universities will be able to provide all of the technical training a graduate might need, given constraints of credit hours, cost of tuition, and other demands on curricula.

Solutions

First, we need more information about what types of coursework the newer, broader majors (e.g., environmental science) require. Some natural resource curricula go through an accreditation process. SAF, for example, is responsible for accrediting degree programs in forestry-related fields. CNRS believes that we should examine whether accreditation of other professional societies would help natural resource programs continue to address the core competencies needed for employment.

Second, employers need to communicate with the universities about the skills they expect graduates to have for employment. Effective oral and written communication, teamwork, and critical thinking that are all areas that employers have identified through surveys as important but lacking in many new hires. We need to make certain that these transferable components are integral parts of the education natural resource students are getting. Ensuring that students are well prepared can best be accomplished through partnerships among universities, professional societies, and employers. These might be formal and informal teaching arrangements, inclusion of employers on university advisory boards, and student mentoring and advising programs, among others.

A formal model that could be emulated is Michigan State University's Partnership for Ecosystem Research and Management (PERM). By underwriting several faculty positions at Michigan State University, the state's Department of Natural Resources can involve the university and its resources in research, management, and stakeholder interaction concerning natural resource management and conservation challenges. Other possible models include having employees from state agencies teach workshops and modules, which would help ensure that students are better trained in technical skills or specialized areas.

Finally, learning does not stop once students graduate. Employers and employees need to be committed to lifelong learning. Professional societies have an important role to play here. To start, we need to promote the opportunities already available—for example, AFS teaches over 70 courses, and TWS has a database of wildlife courses, offers seminars at its annual conferences, and administers an online mentoring program.

Trend 2: Younger employees are often reluctant to move up to leadership jobs.

Federal natural resource agencies are losing many of their most experienced personnel. By 2007, almost two-thirds of the program managers in the U.S. Department of the Interior were eligible for retirement. Likewise, a survey of state fish and wildlife agencies (Mc- Mullin 2004) found that more than three-quarters of those in leadership positions planned to retire by 2015. At the same time, for family and financial reasons, younger employees are less willing to advance their careers if doing so means relocating, as it often does.

Solutions

Younger employees need to be encouraged to develop leadership skills. Mentoring is an effective tool for building confidence and should be promoted throughout an employee's career. In addition, employers should encourage employees to participate in leadership training, such as the leadership courses offered by NCTC.

Action and Recommendations

- A CNRS task force will bring together representatives from universities, employers, and societies to mine existing databases to (1) develop a complete skill set for natural resource professionals and (2) determine where, when, and how they are being taught.
- A CNRS task force will examine changes in academic natural resource programs, exploring how they are changing and why. This will involve developing a list of core competencies and then looking at how universities meet them.
- A CNRS task force will begin to compile information on current practices and options regarding accreditation. A future CNRS meeting will focus on this topic.
- CNRS will pursue how to encourage creating formal connections between employers, universities, and societies.
- CNRS and affiliated partners should develop and maintain an online clearinghouse of lifelong learning opportunities—including online courses, internships, field modules, and workshops—offered by agencies, professional societies, industry, and NGOs.

Diversity in Natural Resource Programs and Professions

Trend: Lack of diversity, particularly of ethnic groups, is significant among students and professionals in the natural resource fields.

Natural resource professions are still dominated by white males, a disparity that is also reflected in the lopsided memberships of professional societies. Interestingly, however, enrollment by women in undergraduate natural resource programs has outpaced that of men in recent decades. Although there are still fewer women than men at the graduate level, the gap appears to be closing in many areas. The underrepresentation of women in the profession is probably a legacy of tradition: Because historically the profession has been the purview of men, there is a perception that the environment is not very welcoming for women. Significant change may come only once the Baby Boomers retire, opening opportunities— and perhaps removing obstacles—for women.

While women are no longer underrepresented as students in academic programs, participation by many ethnic minority groups is still very limited. The reasons for this not only include those noted earlier—limited exposure to the outdoors and misperceptions about the value of a career in natural resources—but also involve the historical legacy of some ethnic groups. Many Latinos and African Americans come from large urban centers, where they are less likely to be exposed to the natural world and hence unfamiliar with career possibilities in natural resources. Minority students, especially those who are the first in their families to attend college, may feel pressure to follow a career path they perceive as being more lucrative or prestigious. Moreover, natural resources may lack appeal to ethnic groups if family members have negative associations with the outdoors. Finally, those few minorities who are natural resource professionals sometimes express a sense of isolation and a lack of support, underscoring why efforts aimed at retaining minority employees are so important.

Solutions

Increasing minority participation means getting children started early, which is true for all sectors of society. In addition to the recommendations above for getting youth involved early, we need to expand efforts to target underrepresented groups. These could include teaming with organizations such as Boys and Girls Clubs in cities or counties with large minority populations.

Partnering with existing programs that promote diversity in related areas would help increase the visibility of natural resource careers for older youth. The University of Michigan's Multicultural Environmental Leadership Development Initiative, for example, "aims to increase diversity in environmental organizations as well as the broader environmental movement [and]… promotes greater diversity in leadership in the environmental field."

Another way to extend our reach to high school and university students is to replicate or expand on existing successful programs. The Hutton Program of AFS provides mentoring and hands-on experience to high school students in underrepresented groups to get them interested in careers in fisheries science and management. The Fisheries Scholar Program, a cooperative program between the U.S. Geological Survey and the University of Arkansas at Pine Bluff, is somewhat similar but targets minority undergraduate students. TWS has a mentoring program specifically targeted at Native American wildlife students. Partnerships with historically black colleges and universities might enable us to reach out to interest math and science majors in natural resource careers. UC-Davis's EEGAP program, for example, is a partnership that aims to get minority students interested in a career in ecology and evolutionary biology; it provides Howard University biology students with summer research opportunities in the Ecology and Evolutionary Biology Department at UCD, and mentoring by faculty. The National Park Service takes this one step further: It has arrangements with several universities to recruit and train Native American students with the aim of retaining them in the NPS workforce.

Students and new employees who find themselves without similar peers are likely to feel isolated. Until we see improvement in recruitment of minorities and women into educational programs and the profession, more effort should be devoted to mentoring and creating inclusive social networks as a way to increase retention. As Lopez and Brown (2011) sum it up, "Offering supportive mentors who are culturally literate and sensitive to the needs of new recruits…will go a long way toward increasing diversity." Given the paucity of diverse ethnic and female role models in many natural science fields, mentoring is an effective way to help achieve better balance in the profession. Moreover, studies have shown that the benefits of mentoring also include greater upward mobility, better job satisfaction, and a higher level of career commitment (Willemsen 2011).

Recommendations

- CNRS should select a core group of programs in urban areas with which we could partner to broaden the reach of our message to minority youth.
- Professional societies and employers should examine existing models for recruiting, training, and retaining minority students, with an eye to expanding the availability and diversity of such programs.
- CNRS and professional societies should explore avenues for partnerships with institutions that serve underrepresented groups, such as Historically Black Colleges and Universities, tribal colleges, and Hispanic Serving Institutions.
- CNRS and professional societies should explore ways to increase mentoring minorities and women on campus and in the workplace.

Conclusion

We are facing increasing demands to expand our natural resources education programs to meet the challenges of a changing world. Although we are not prepared to sacrifice natural resource science in order to accommodate the teaching of "transferable components," there is clearly a need for us to promote important skills such as critical thinking, effective communication, and approaches for continuous learning. We are undertaking this effort at a time when scientific credibility among the general public is weak and the political influence of natural resources organizations is diminished. Support has decreased for natural resource programs, and budget woes have put enormous pressure on state and federal agencies. We hope that this summit will jumpstart a collective effort to adapt natural resource education to these changing circumstances in ways that will increase its stature, legitimacy, and influence.

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From the Archives

We have, too, some very pretty girls who make a splendid exhibit themselves, where high flyers can see the fly-tyers. We have a manufactory there of fishing lines that is quite interesting and is well worth visiting. There is a very fine exhibit of baits and trolling spoons, and with this exhibit we have the first trolling spoon that was ever made. In addition to the multiplying reels, we have an automatic reel which is fancied by some fishermen. Of course, there is a large collection of other fishing tackle. In addition to this, we have a collection of literature on angling in the way of books that have been published in this country. There are also exhibited angling trophies, including the largest tarpon ever taken on a rod, the fish weighing 205 pounds, which was taken by a lady, Mrs. Stagg.

There is one thing I did not speak of, a very ingeniously contrived glass cylinder for inclosing a live minnow. The cylinder is surrounded by a chevaux de frise of hooks, and of course the glass does not show in the water. In other words, it is "carrying your bait in a bottle." There are several articles in the exhibit which are of interest aside from those of which I have spoken, but I cannot stop to enumerate them all. I would like to call attention, however, to a patent reel-seat, which was invented by our worthy President, as among the things I would like to have you see.

I hope the Society will take occasion to examine all these articles at their leisure

J.A. Henshall (1893): The Angling Exhibit at the World's Fair, Transactions of the American Fisheries Society, 22:1, 129-131.

To submit upcoming events for inclusion on the AFS web site calendar, send event name, dates, city, state/province, web address, and contact information to sgilbertfox@fisheries.org.

(If space is available, events will also be printed in Fisheries magazine.)

More events listed at www.fisheries.org

CALENDAR
Fisheries Events

DATE	EVENT	LOCATION	WEBSITE
July 2-6, 2012	36th Annual Larval Fish Conference	Osøyro, Norway	www.larvalfishcon.org
July 9–12, 2012	Algae for the Future: 8th Asia-Pacific Conference on Algal Biotechnology	Adelaide, Australia	www.sapmea.asn.au/apcab2012
July 9–13, 2012	12th International Coral Reef Symposium	Cairns, Qld Australia	www.icrs2012.com
July 15–July 19, 2012	10th International Congress on the Biology of Fish	Madison, WI	conferencing.uwex.edu/conferences/icbf2012/index.cfm
July 25–27, 2012	International Conference on Fisheries and Aquatic Sciences	Amsterdam, Netherlands	www.waset.org/conferences/2012/amsterdam/icfas
July 31–August 3, 2012	AFS–Fish Health Section Meeting	LaCrosse, WI	www.afs-fhs.org/meetings/meetings.php
August 19–23, 2012	142nd Annual Meeting of the American Fisheries Society – Fisheries Networks: Building Ecological, Social, and Professional Relationships	Minneapolis-St. Paul, MN	www.afs2012.org
September 17-21, 2012	ICES Annual Science Conference 2012	Bergen, Norway	www.ices.dk
November 5–9, 2012	International Symposium on Fish Passages in South America	Toledo-Paraná, Brazil	www.unioeste.br/eventos/sympass/
April 8–12, 2013	7th International Fisheries Observer and Monitoring Conference (7th IFOMC)	Viña del Mar, Chile	http://www.ifomc.com/

Professional
Ecological Social
Twin Cities - 2012

The American Fisheries Society Annual Meeting in the Twin Cities in 2012 provides a great opportunity for groups to host workshops, alumni gatherings, technical work groups and other meetings in conjunction with the main conference.

To host an event or gathering at Twin Cities 2012 between August 18 to 23, you need to register with conference planners no later than July 6th. Events will be scheduled on a first come, first served basis.

To register and request information contact: Henry Van Offelen, **henry.vanoffelen@gmail.com**

Or visit the AFS2012 website at **www.afs2012.org** and click "Associated Meetings" for a registration form.

Employers: to list a job opening on the AFS online job center submit a position description, job title, agency/company, city, state, responsibilities, qualifications, salary, closing date, and contact information (maximum 150 words) to jobs@fisheries.org. Online job announcements will be billed at $350 for 150 word increments. Please send billing information. Listings are free (150 words or less) for organizations with associate, official, and sustaining memberships, and for individual members, who are faculty members, hiring graduate assistants. if space is available, jobs may also be printed in *Fisheries* magazine, free of additional charge.

Maintenance Engineer
Snettisham Hatchery, AK
Permanent

Salary: DOE, Generous benefits package, three-bedroom home, and bi-weekly mail/grocery flights.

Closing: Until filled

Responsibilities: Snettisham Hatchery (remote facility), Juneau, Alaska. Operated by Douglas Island Pink & Chum, Inc. Permanent full-time position responsible for all aspects of facility and equipment maintenance.

Qualifications: Minimum five years experience in maintenance with a strong background in electrical, mechanical, and plumbing. Candidate should also have strong organizational and problem solving skills, and be able to effectively and efficiently plan, schedule, and implement projects within timelines and budget. Other desirable skills: carpentry, welding, small boat operation and repair, refrigeration, hydraulics, front-end loader operation, diesel and gas engine repair, computer experience. Candidate must have the ability to work and live in a remote setting and be in good physical health.

Contact: Kevin Steck, Hatchery Manager; kevin_steck@dipac.net; www.dipac.net

Fisheries Biologist II, Commercial Data Collection
IAP World Services, Miami, FL
Permanent

Closing: Until filled

Responsibilities: IAP World Wide is a federal contraction for the NMFS. This position will be based at the SEFSC Miami Lab, Fisheries Monitoring Branch of the Fisheries Statistics Division. The position is for part time 15 hours per week. Candidate will perform data management and personnel support activities. Data management of commercial landing data, samplers reports, vessel log books and dealer landing reports to be reviewed and audited for clarity and necessity of correction. Assist with data processing, summarization and calculations.

Qualifications: MS or BS with 5 years relevant experience.

Contact: Apply at www.iapws.com; Job requisition 13907

Lead Fish Counters and Fish Counters
Normandeau Associates, Inc., Pacific Northwest
Permanent

Closing: 6/30/2012

Responsibilities: Normandeau Associates anticipates openings for Lead Fish Counters and Fish Counters for a temporary project identifying and counting upstream migrating salmon at hydroelectric sites located in the Snake and Columbia River drainages. Positions begin around July 1st (4 am to 12 pm or 12 pm to 8 pm). Responsibilities are to identify/record the passage of target fish; interact with project/agency personnel and supervise others. Fish counters work long, irregular hours alone, with little supervision, performing repetitive work. Must be able to walk up to 1/2 mile, in all weather conditions, and able to climb steep stairs. Applicant must be able to pass a federal background check including drug testing.

Qualifications: Minimum qualifications high school Diploma/GED including valid driver's license; degree in fisheries or related subject is preferred. Those with experience counting fish at Snake or Columbia River projects are strongly urged to apply.

Contact: Submit cover letter and resume to HR@normandeau.com

Fish Culture Chief
VT Fish and Wildlife Dept
Permanent

Salary: $26.42 per hour (Pay Grade 28), plus benefits.

Closing: 7/9/2012

Responsibilities: The Vermont Fish and Wildlife Department is currently recruiting for a Fish Culture Operations Manager to oversee the fish culture program and five state hatcheries in Vermont.

Qualifications: A description of the position/responsibilities and an online application can be found at the State of Vermont Career Center website below. You can search by keyword, or use reference number 30223.

Contact: If you would like more information about this position, please contact Eric Palmer at below email. Resumes will not be accepted via e-mail. You must apply online to be considered. The State of Vermont is an Equal Opportunity Employer. Applications from women, individuals with disabilities, veterans, and people from diverse cultural backgrounds are encouraged. Applications must be received by 7/9/2012.

Email: eric.palmer@state.vt.us

Link: http://humanresources.vermont.gov/career_center

Biologist III/Analyst II
Cramer Fish Sciences, Lacey, WA
Permanent

Salary: $63,186 – $70,479 plus bonuses; excellent benefits

Closing: Until filled

Responsibilities: Biologist III/Analyst II – Simulation Modeler, Cramer Fish Sciences seeks an individual with strong quantitative skills and experience in ecology and resource management to conduct advanced ecological simulation modeling projects. Project development and execution is a primary part of this position and includes assisting wth identification of objectives, scope of work and budgets and independently completing significant portions of larger projects.

Qualifications: Master's degree in a natural resources or related field with 3 years of related experience. Must have excellent computer skills including GIS and statistical programs and strong written and verbal communication skills including technical writing. Must be able to lead small to moderate sized projects.

Contact: HR@fishsciences.net; www.fishsciences.net

JOURNAL HIGHLIGHTS
North American Journal of Fisheries Management
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From the Archives

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R.A. Wheeler (1949): Fish and Wildlife in the Federal Program of Navigation and Flood Control, *Transactions of the American Fisheries Society*, 77:1, 253-262.

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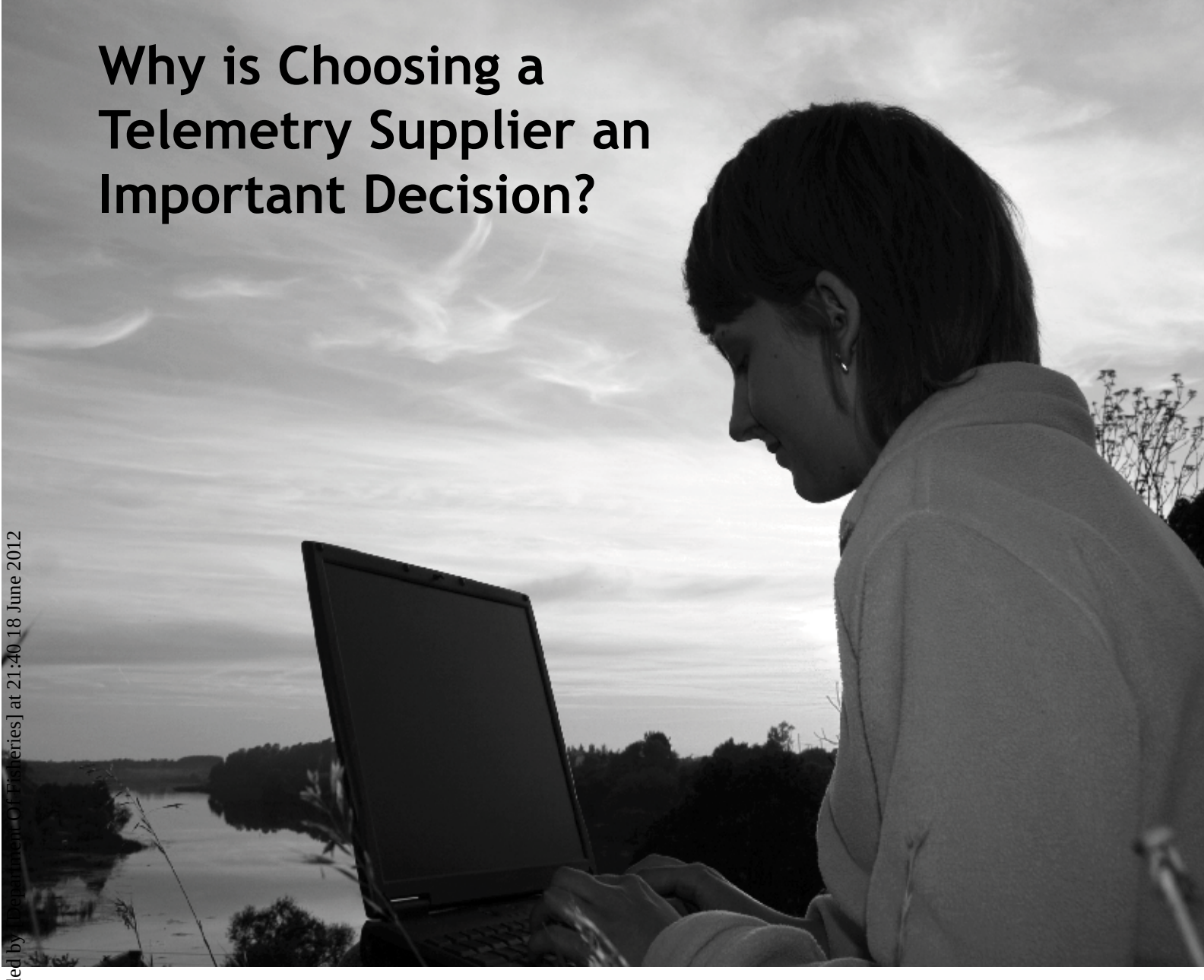

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