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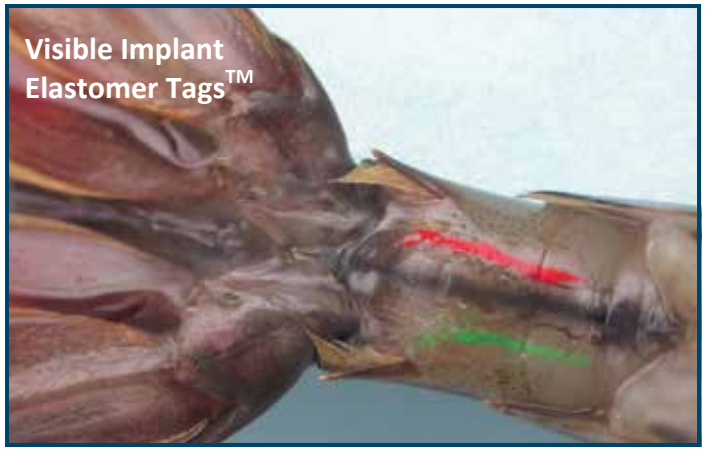

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Corporate Office
360.468.3375 office@nmt.us

Biological Services
360.596.9400 biology@nmt.us

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The Socioeconomic Values of Recreational Fishing

Bob Hughes, AFS President

AFS President Bob Hughes can be contacted at: hughes.bob@amnisopes.com

Although I have been critical of global and North American macroeconomic policies in previous commentaries, I believe that fisheries microeconomics and microeconomists have vital roles to play for the future of fisheries and fisheries biologists. For example, recently I participated in symposia and workshops on recreational fisheries in Finland and China. The Nordic nations, where most freshwater fisheries are privately owned but publicly available for a fee, have evaluated the economic values of recreational fisheries by nation. Toivonen et al. (2000) reported that the value of Nordic recreational fisheries, depending on nation, ranged from $30 million to $300 million per year in 1999 and that 64%–79% of anglers were male. In China, waters and fisheries are owned by the state and interest in recreational fisheries is relatively recent, emerging with the growth of a middle class with leisure time. As a result, those fisheries lack adequate infrastructure, regulations, and ethics—let alone comprehensive economic evaluation. However, Ping (2011) valued Chinese recreational fisheries at $80 million and estimated that such fisheries generated nearly 2 million jobs.

Like many forms of outdoor recreation, fishing can reduce heart rates and anxiety through greater connectedness with nature.

In Canada and the United States, socioeconomic evaluations of recreational fisheries are fairly well developed and informative. Canada has conducted randomized angler mail surveys since 1975. As Brownscombe et al. (2014) described in last month's issue of *Fisheries*, the trends indicate declines in the number of licensed anglers and number of fishing trips, no significant change in catch per unit effort or gender (about 75% male), and increases in angler mean age and rate of catch and release. Direct angling purchases averaged $3.2 billion CAD per year and the total contribution of recreational fishing to the Canadian economy ranged from $6.4–11.3 billion CAD per year (Brownscombe et al. 2014).

Recreational fishing is an economically and culturally important activity in the United States also. In the United States during 2012, marine recreational angling generated 381,000–500,000 jobs and $82–88 billion in trip and gear impacts (National Marine Fisheries Service [NMFS] 2013, 2014). The NMFS developed those estimates from multiple data sources and models. Using national census data on marine and freshwater angling from the U.S. Fish and Wildlife Service (2012), the American Sportfishing Association (2013) estimated that recreational fisheries produced an estimated $115 billion economic impact and over 800,000 jobs.

Regardless of its economic values, recreational fishing also offers important ecological, physiological, psychological, and social values (Parkkila et al. 2010). Ecological benefits include increased concern for natural resource management and conservation. Like many forms of outdoor recreation, fishing can reduce heart rates and anxiety through greater connectedness with nature. For many of us who learned to fish as children with our families and friends, fishing together created some of our most lasting and pleasant memories of those people. So make the time to take a child or a friend fishing—you are likely to connect with more than a fish. But it is not just fishing. As Toivonen et al. (2000) reported, 41%–80% of Nordic nation populations fully *disagreed* with the statement that "Man can be well off without ever going out to … nature."

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Leadership Styles We Can Appreciate

Thomas E. Bigford, AFS Policy Director

COLUMN
Policy

AFS Policy Director Thomas E. Bigford can be contacted at: tbigford@fisheries.org

I write this column with all the wisdom gained from 11 weeks in my AFS position (including two snow days, one holiday, and a root canal). I'm certainly not fluent in all we do but I did want to share some observations based on the most common topics crossing my desk, all of them with direct policy implications and many exhibiting leadership that will benefit AFS. My ideas suggest roles that we might consider as we strive to become more influential as individuals in our chosen fish profession, as AFS members, and as a Society.

One unifying theme is the need to be strategic in picking roles for AFS, for others, and for partnerships designed for the task. That may sound self-evident, but AFS as a Society or its units cannot do everything. We don't want to lead everywhere, or even participate at every turn. Some paths to success are ours to retain or seize; we do fish better than anyone, so it's an appropriate arena for our leadership. Other groups work on conservation, sport fishing, wildlife, or water, each with a fish connection but not squarely in our domain. I'll offer examples below of where an equitable division of roles offers solid rewards. The collective "we" can do more than AFS could by ourselves, to the benefit of all.

Another initial observation was more of a confirmation. In the recent past, no one has been coordinating across the fish disciplines on a national scale. Yes, there are successful efforts within narrow fields (akin to an AFS section such as the International Fisheries Section), but agencies, nonprofits, academia, and industry sectors seem to have drifted comfortably toward their own individual efforts. That's certainly not a crime, but it has divided the fish fields, despite our best intentions to develop partnerships and avoid the dreaded topical or territorial "silos."

In the fish arena, AFS Executive Director Doug Austen and President Bob Hughes addressed the need to nurture roles when they hosted the "Fisheries Leadership Dialogue" last October in Washington, D.C., with help from the President Ward Slacom and Past-President Lee Benaka from the AFS Potomac Chapter. About 25 leaders from across the fish interests assembled in what many acclaimed to be a precedent. AFS plans to host another dialogue this year, again with hopes to encourage those silos to work across the voids that complicate our work. It's a place for AFS to lead, and excel.

As we apply our best scientific and management knowledge, partnerships initiated at senior levels (such as that "Fisheries Leadership Dialogue") are best supplemented by parallel efforts at other levels. Those leadership discussions encouraged by AFS leaders last fall had their genesis in needs long recognized by those toiling in the trenches. Regardless of who started what, it is encouraging that leaders are talking more than they have in the past. There's much to do, but it's nice to be part of efforts led by Doug Austen to develop partnerships with the U.S. Forest Service, National Marine Fisheries Service, U.S. Geological Survey, U.S. Fish and Wildlife Service, Association of Fish and Wildlife Agencies, Theodore Roosevelt Conservation Partnership, The Wildlife Society, Restore America's Estuaries, The Coastal Society, and others. Shared policy interests become more evident with each conversation, always with a connection to our science and management expertise.

Partnerships are essential, but another thread is information. I often hear of the need for an efficient way to share knowledge and experiences. Twenty years ago, the AFS Potomac Chapter hosted monthly luncheons. Even earlier, Nautilus Press published weekly updates on fisheries management, ocean sciences, and other fields—mailed first class to be reasonably fresh. As communication networks matured, in-person events and paper newsletters were replaced by e-newsletters and e-mail listservs. Something similar seems to be happening with conferences and seminars, with webinars doing what travel budgets and tight schedules cannot.

In the recent past, no one has been coordinating across the fish disciplines on a national scale.

This need extends beyond blogs and e-mail list serves. It extends to meetings, involves leadership, and should influence policy and decision making. One successful effort from the fish world is receiving some attention as an option for the future. Gordon Robertson of the American Sportfishing Association created FishNet USA in the 1990s. Until interest waned in the 2010s, the American Sportfishing Association led a regular exchange of fish-related information, including annual budget briefings for congressional staff and members and general news updates for all. Those discussions also offered the chance to explain trends in federal staffing, research budgets, legislation, policies, and other fish issues. There are many similarities to today's list serves but a reincarnated FishNet might help to span those silos that threaten to limit our success.

Robertson retired in June 2014, leaving this leadership opportunity to others. Hopefully a new leader will emerge, especially since many groups have concluded that it is time to invent

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ESSAY

Are We Overlooking Landscape-Scale Threats to Common Freshwater Fishes?

Ryan M. Utz

National Ecological Observatory Network, 1685 38th St., Boulder, CO 80301. E-mail: rutz@neoninc.org

Assigning a legal conservation status to an imperiled species represents perhaps the most powerful means of halting and reversing the extinction trajectory. Success stories such as the recovery of the bald eagle (*Haliaeetus leucocephalus*) and gray whale (*Eschrichtius robustus*) provide vital evidence of how committed management actions can save endangered species (Noles 2008). Although perhaps less well known, freshwater fishes have also benefited from listing under the Endangered Species Act. For instance, the Big Bend Gambusia (*Gambusia gaigei*) and Humpback Chub (*Gila cypha*) persist in far greater numbers today because their legal status demanded management actions that promoted recovery (Hubbs et al. 2002; Van Haverbeke et al. 2013). States also assign legal conservation status to species under the Endangered Species Act, so many species that are threatened locally but not globally may also receive some degree of legal protection.

What about the fate of fishes that are highly sensitive to land use change but are not considered threatened or endangered?

But does the current roster of state- and federally protected freshwater fishes align with threat of environmental degradation caused by land use change to help preserve all sensitive fish species? The suite of threats contributing to sensitive species decline in aquatic ecosystems consists of many pervasive and nonpoint environmental stressors. Land use change, such as urban and agricultural expansion, has proven to be among the most critical modern-day stressors in aquatic ecosystems because what transpires on land can greatly impact stream ecosystems in fundamental ways. Ecosystem degradation induced by land use change often proves long-term and irreversible (Booth 2005; Howden et al. 2010). Consequently, regions currently undergoing widespread shifts from natural and seminatural spaces to anthropocentric uses stand to permanently lose populations of fishes as streams degrade in environmental quality. All fishes in such streams will likely be affected, and potentially extirpated, as a consequence of land use–driven environmental degradation. The presence of a species with a legal conservation status may influence land use management plans in a watershed slated for development. Yet what about the fate of fishes that are highly sensitive to land use change but are not considered threatened or endangered? How many such species exist?

One component of my dissertation research at the University of Maryland provides data that may address such a question. Using a large spatiotemporal-scale data set of stream ecosystems developed by the Maryland Department of Natural Resources (Klauda et al. 1998), my graduate mentors and I explored species-specific sensitivity of freshwater fishes to anthropocentric land uses for every species of fish collected more than 30 times in the Maryland Biological Stream Survey (Utz et al. 2010). Our work included thresholds that predict the degree of watershed development in which populations would no longer be expected to persist for 54 species. Analyses were partitioned between the Coastal Plain and Piedmont physiographic regions, the border of which divides both major metropolitan regions in Maryland (Baltimore and Washington, D.C.). Table 1 lists the five species that exhibit population loss at the lowest levels of urban cover and their respective extirpation thresholds. Although all relationships between land use and species sensitivity are inherently complex, the thresholds listed in Table 1 may be considered the greatest degree of urban development within a watershed that each species can typically withstand.

To assess the current protection status of species that are highly sensitive to urbanization, I surveyed endangered species checklists from Mid-Atlantic states that encompass the Piedmont and/or Coastal Plain. Of the species we categorized as acutely susceptible to urbanization, alarmingly few are currently considered in need of conservation management action. A majority of fishes we found to be the most sensitive to land use change do not appear on conservation priority rosters (Table 1). Several made "species of concern" lists and the Least Brook Lamprey (*Lampetra aepyptera*) has been designated as threatened in Virginia. None of the nine fishes in Table 1 appear on federal species conservation lists.

Yet considering the degree of urbanization in the Mid-Atlantic (Figure 1), many sensitive fishes may be already absent throughout large portions of their native ranges and at risk of further decline. All Piedmont fishes listed in Table 1 have very likely already been extirpated from a large proportion of their ranges. Urban-sensitive fishes in the Coastal Plain exhibited relatively greater tolerance to urbanization, but many populations throughout large swaths of Maryland, Delaware, and New Jersey, plus those near metropolitan regions further south, are likely dwindling or already extirpated. The small expanse of Coastal Plain within Pennsylvania consists almost entirely of urban land, which likely explains why populations of Pirate Perch (*Aphredoderus sayanus*) no longer exist within that state. Fortunately, urban cover is localized to a significant degree and entirely rural watersheds persist in almost all regions shown in

Table 1 . Thresholds of tolerance to urbanization of the five most urbanization-sensitive fishes identified by Utz et al. (2010) and their conservation statuses. The quantitative threshold represents the point at which 95% of individuals were observed along gradients of watershed urbanization in a Maryland streams database. Gray shaded cells denote natural species absence. C = candidate species, SC = species of concern, SX = presumed extirpated, T = threatened, T2 = tier-2 species of concern.

Province	Fish	Threshold (% urban)	DE	MD	NC	NJ	PA	VA
Piedmont	Rosyface Shiner (*Notropis rubellus*)	7.3						
	Brook Trout (*Salvelinus fontinalis*)	12.1		SC				
	River Chub (*Nocomis micropogon*)	15.2						
	Margined Madtom (*Noturus insignis*)	22.6	T[2]					*a*
	Common Shiner (*Luxilus cornutus*)	20.3						
Coastal Plain	Pirate Perch (*Aphredoderus sayanus*)	12					SX	
	Redfin Pickerel (*Esox americanus*)	16.1						
	Least Brook Lamprey (*Lampetra aepyptera*)	22.7	T[2]		T		C	
	Margined Madtom (*Noturus insignis*)	34.8	T[2]					*a*
	Bluespotted Sunfish (*Enneacanthus gloriosus*)	37		SC				

[a]**The population of Margined Madtoms in the Dan River, Virginia, could merit federal endangered status if determined to be a new species.**

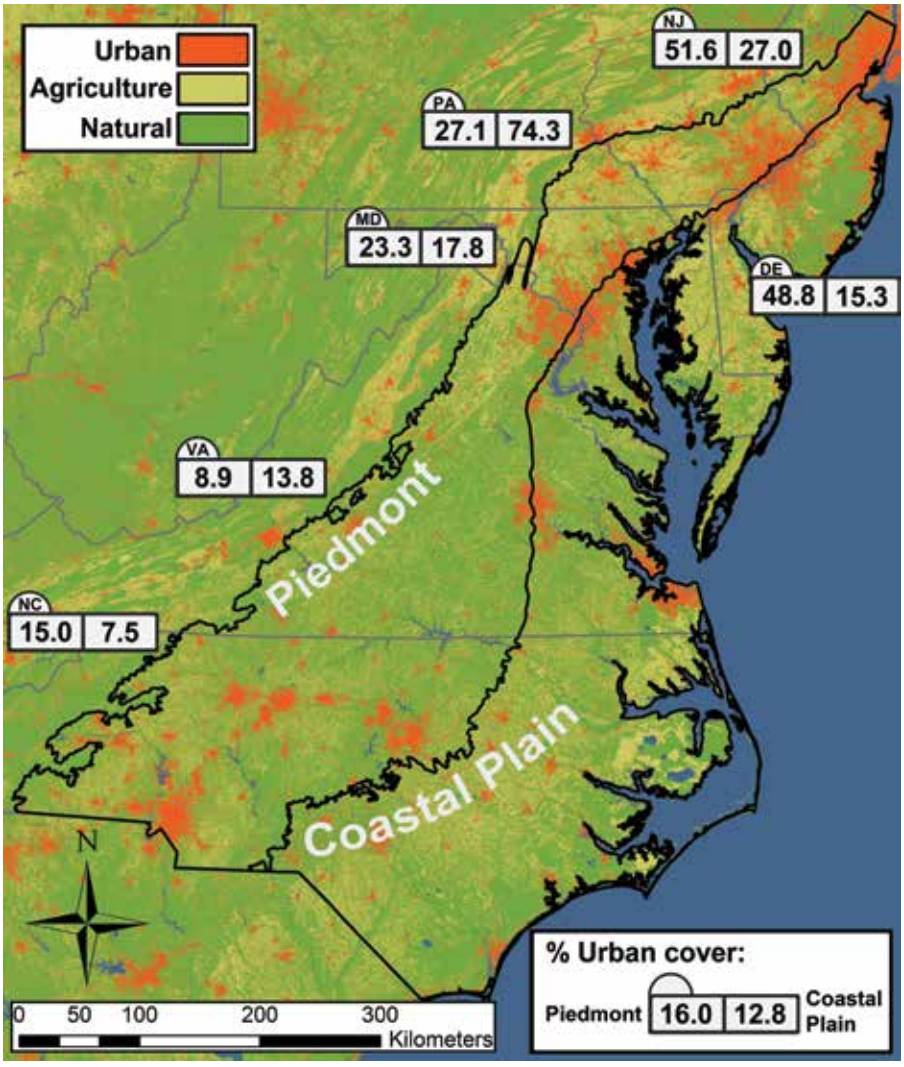

Figure 1. Land use map of the Piedmont and Coastal Plain physiographic regions within the Mid-Atlantic United States. The values in the boxes denote the proportion of land classified as urban in the 2006 National Land Cover Database within the Piedmont (left-hand value within boxes) and Coastal Plain (right-hand value) of each state shown. The total proportion of urban land within each physiographic province of the five-state region is provided in the legend.

Figure 1, thereby offering refuges of high-quality habitat. Some fishes listed in Table 1, such as the Least Brook Lamprey, Margined Madtom (*Noturus insignis*), and Bluespotted Sunfish (*Enneacanthus gloriosus*), are urbanization sensitive but are able to persist in some watersheds with as much as about 35% urban cover. But urban expansion will undoubtedly continue to increase substantially throughout the Mid-Atlantic Piedmont and Coastal Plain (Bierwagen et al. 2010). In light of the current and projected extent of urban development in this region, many fishes with broad distributions could soon require conservation management actions.

In contrast to most taxa assigned legal protection, which tends to be rare and/or endemic to a limited number of drainage basins (Pritt and Frimpong 2010), unlisted sensitive species exhibit broad distributions and are often culturally or ecologically important organisms. For instance, the highly urbanization-sensitive River Chub (*Nocomis micropogon*) constructs well-aerated cobble nests (Peoples et al. 2014) that attract dozens of other fish and invertebrates, resulting in colorful hotspots of ecological activity (Figure 2). Thus, local extirpation of River Chub and other species of *Nocomis* may result in the consequential loss of multiple obligate mutualist species, many of which are rare or threatened (Pendleton et al. 2012). As the only salmonid native to the eastern United States, Brook Trout (*Salvelinus fontinalis*) represent a culturally, economically, and recreationally important species from Georgia to Labrador. Yet only informed anglers from the Mid-Atlantic lowlands realize that native Brook Trout were once found throughout the Piedmont and the few remaining populations in this province persist in watersheds very near to expanding urban sprawl.

The Mid-Atlantic states case study presented herein represents only a small fraction of a trend likely transpiring throughout our rapidly urbanizing world. As the proportion of the global population living in an urban setting is projected to swell from 51.6% to 67.2% between 2010 and 2050 (United Nations 2011), the fraction of watersheds impacted by urbanization will grow accordingly. Lists of potentially overlooked fishes such as those in Table 1 could almost certainly be generated for any expanding metropolitan region, including those in the tropics where a disproportionate proportion of global freshwater fish biodiversity persists near some of the world's fastest growing cities (Grimm et al. 2008). Yet despite recent advancements in urban stream ecology, awareness of common urbanization-sensitive species remains minimal.

So why might traditionally applied conservation management approaches be ill suited to address common, urbanization-sensitive freshwater fishes? Natural resource agencies, which are often confronted with enormous conservation challenges but are rarely provided with adequate resources and/or authority to meet these challenges, justifiably concentrate on species with small populations or limited distributions. Adding common, urbanization-sensitive fishes to the rosters of threatened and endangered species would very likely stretch agency resources to an unsustainable degree and potentially lead to a backlash of public support for species protection programs. The abundance or presence/absence of common sensitive fishes often contributes to Index of Biological Integrity (IBI) scores (Harris 1995), which are successfully applied to help identify impaired ecosystems and should therefore serve as early warning signs of broad-scale population decline for sensitive species. However, unitless IBI scores inherently mask the status of individual populations

Figure 2. A River Chub (*Nocomis micropogon*) tends to his nest while Central Stonerollers (*Campostoma anomalum*) aggregate nearby to take advantage of the structure. Are wonderful scenes such as this endangered in the rapidly urbanizing Mid-Atlantic United States? Photo credit: Jeffrey Basinger / Freshwaters Illustrated.

and the presence of environmentally sensitive nonnative fishes may result in higher IBI scores (Hermoso and Clavero 2013). Given the acute sensitivity of many fishes to urbanization and multivariate nature of IBI systems, a moderately impacted stream could retain a high IBI score and thus fail to signal an alarm bell for one or more particularly sensitive native species.

Consequently, effectively monitoring and conserving populations of common but sensitive fishes may require a mix of traditional and novel approaches. Effective mitigation and preventative measures to reduce the holistic impact of urbanization on streams, such as disconnecting hydrologic pathways between impervious surfaces and natural channels (Jackson and Pringle 2010; Wenger et al. 2010), are becoming mainstream and will likely prove beneficial for all lotic fishes where implemented. Other investigators have highlighted the potential of natural riparian wetlands to significantly moderate the effect of urban development in streams (Harrison et al. 2011). Beyond IBI scores and attention to globally imperiled taxa, a revised professional perspective on individual species may be warranted. Data already routinely collected to calculate IBI scores might also be used to also closely monitor at-risk species such as those listed in Table 1 by focusing attention on individual species in addition to assemblage-scale metrics. Patterns drawn from such data that suggest that populations or distributions are on a clear negative trajectory could help warrant management actions that prevent endangered species rosters from growing. Past experience shows that the mere threat of federal listing under the Endangered Species Act can prompt local management actions that effectively sustain at-risk populations (Federal Register Office 2010). The ubiquity of fishes listed in Table 1 also represents a scientific opportunity: ecosystems where these sensitive species persist despite the presence of urban sprawl could be carefully examined to identify watershed attributes that successfully help retain biodiversity.

Ultimately, I cannot suggest a management solution that I feel will adequately protect all fishes threatened by land use change. My goal here is to highlight the breadth of ichthyofauna we risk losing under our watch if we limit conservation resources to protecting rare species and identify impaired waters only through multivariate indices. If Utz et al. (2010) causes agency personnel to more carefully consider common species that may be on the decline, I would consider my work a success. In my view, preventing losses of backyard biodiversity is a crucial component of biological conservation, even when rare species are not at stake.

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A Case for Accelerated Reestablishment of American Eel in the Lake Ontario and Champlain Watersheds

Wolf-Dieter N. Busch*

Ecosystem Initiatives Advisory Services, 1705 Angelina Ct., Crownsville, MD 21032-1935. E-mail: wolfnbusch@gmail.com

David P. Braun

Sound Science, LLC, New York, NY

ABSTRACT: *The catadromous, panmictic American Eel (*Anguilla rostrata*) historically comprised nearly 25% of fish biomass in Atlantic coastal streams, supporting sizeable fisheries for centuries. However, the population has collapsed in its primary range. It is now proposed or listed as "endangered" by various North American governments, with its fisheries declared "depleted" along the U.S. Atlantic coast. The causes of decline include fragmented governance, loss of physical access to and/or degraded quality of freshwater habitats, lethal entrainment in hydroelectric turbines, changes in marine currents, and excessive harvest. Large gaps exist in knowledge of species biology and the effectiveness of management approaches. Prior to the collapse of eel production, the Lake Ontario and Champlain watersheds of the St. Lawrence River basin produced abundant, large, highly fecund female eels that contributed disproportionately to species-wide reproduction. Abatement of key threats specifically across these two particular watersheds therefore could contribute significantly to range-wide recovery from Greenland to Venezuela.*

Un caso de restablecimiento acelerado de la anguila americana (*Anguilla rostrata*) en el Lago Ontario y en la cuenca hidrográfica Champlain

RESUMEN: *la anguila americana (*Anguilla rostrata*) se considera una especie catádroma y panmíctica e históricamente ha constituido cerca del 25% de la biomasa de peces en los ríos costeros de Norte América, soportando durante siglos importantes pesquerías. Sin embargo, la población ha colapsado a lo largo de su rango principal de distribución. Actualmente, la especie se ha propuesto o bien listado como "en peligro" por varios gobiernos de Norte América, cuyas pesquerías se han declarado agotadas a lo largo de la costa atlántica de los EEUU. Las causas de la reducción incluyen la fragmentación de la gobernanza, pérdida del acceso físico hacia y/o degradación de la calidad de los hábitats dulceacuícolas, arrastre letal hacia turbinas hidroeléctricas, cambios en las corrientes marinas y extracción excesiva. Existen grandes huecos de conocimiento en cuanto a la biología de la especie y la efectividad de los enfoques de manejo. Antes del colapso en la producción de anguila, en el lago Ontario y en la cuenca hidrológica Champlain del río San Lorenzo se producían cantidad de hembras de anguila grandes y fecundas que contribuían de forma desproporcionada a la reproducción de la especie en todo su rango. Por lo tanto, la disminución de amenazas clave en estas dos cuencas en particular, puede contribuir importantemente a la recuperación de la especie en todo su rango de distribución, desde Groenlandia hasta Venezuela.*

INTRODUCTION

The American Eel (*Anguilla rostrata*), a catadromous species, spawns in the Sargasso Sea but spends most of its life in freshwater or estuaries. It has suffered large population declines along the North American coast, the most productive grow-out area within its historic range from Greenland to Venezuela. Historically, it comprised as much as 25% of the fish biomass in coastal streams (Atlantic States Marine Fisheries Commission [ASMFC] 2000) but now comprises <1% with recruitment <1% of pre-1980 levels (ASMFC 2012; Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2012; MacGregor et al. 2014). This decline parallels that of the European Eel (*Anguilla anguilla*) with its current recruitment at 1%–5% of pre-1980 levels (ICES 2013). These declines threaten vast culturally and economically important fisheries in Canada, the United States, and Europe (Ringuet et al. 2002; Astrom and Dekker 2007; MacGregor et al. 2009, 2014; Engler-Palma et al. 2013).

Protection and restoration of the American Eel require urgent action on several fronts. Its large range includes 10,000 km of mainland shoreline spanning many jurisdictions. Greater institutional cooperation and improved governance therefore are crucial to abating threats within freshwaters and coastal zones (Engler-Palma et al. 2013; MacGregor et al. 2014). These threats include artificial barriers to upstream passage in river systems where eels historically reside most of their lives, chemical pollution of river systems and nearshore waters, disease, overharvest, and high mortality rates during downstream migration through hydroelectric turbines (Ontario Ministry of Natural Resources [OMNR] 2007; Council for Endangered Species Act Reliability 2010; U.S. Fish and Wildlife Service 2011;

* Former Chief of Lower Great Lakes (Erie and Ontario) Fisheries Program, Fish and Wildlife Service, U.S. Department of the Interior and former Director of the Interstate Fisheries Management Program, Atlantic States Marine Fisheries Commission, Washington, D.C.

ASMFC 2012; COSEWIC 2012; Hitt et al. 2012; MacGregor et al. 2014).

Additional emerging challenges include changes in ocean circulation (e.g., Knights 2003; Bonhommeau et al. 2008; Baltazar-Soares et al. 2013); a lack of identification and protection of marine migration routes and spawning habitat (e.g., Trott et al. 2010; Engler-Palma et al. 2013); changes in watershed discharge and temperature regimes (e.g., Boyer et al. 2010; de Lafontaine et al. 2010; Verreault et al. 2012); and altered predation by other species (Engler-Palma et al. 2013). These emerging concerns are outside the scope of this article.

We focus on two critically important management actions: (1) restoration of the eel population to the Lake Ontario and Lake Champlain (LO, LC) watersheds, part of the St. Lawrence River (SLR) basin of Canada and the United States; and (2) the closure of all American Eel fisheries. The LO and LC watersheds historically constituted "the single largest freshwater rearing habitats for the American Eel within its geographic range" (COSEWIC 2012, p. 14). They grew very large, highly fecund female eels that contributed 26%–49% of the entire American Eel egg production (COSEWIC 2012). This contribution has collapsed by 93%–98% since 1980 (COSEWIC 2012). Given their historic contributions, reestablishing American Eel in these watersheds could contribute significantly to species recovery overall (MacGregor et al. 2014).

We briefly review the state of knowledge concerning American Eel in general, the reasons for its decline in the LO and LC watersheds, and the potential challenges of reestablishing the species in these two watersheds. We cite only a small fraction of the deep literature on these topics. Dittman et al. (2010a, 2010b), ASMFC (2012), COSEWIC (2012), MacGregor et al. (2014), and Engler-Palma et al. (2013) provide detailed bibliographies. Our purpose is not merely to review the situation but to advocate for an aggressive approach to reestablishment, because it will take decades to improve governance and for closure of the fisheries and other key conservation actions to produce their intended benefits.

AMERICAN EEL LIFE HISTORY, THREATS, AND STATUS

American and European Eels spawn in adjacent areas of the Sargasso Sea, western North Atlantic, and are panmictic; that is, spawners from across the entire range of each species mix together (Als et al. 2011; Côte et al. 2013). Different ocean currents carry their transparent larvae ("leptocephali") west and east to their respective continental shelves (COSEWIC 2012; Baltazar-Soares et al. 2013). The U.S. southeastern Atlantic coast may be the historic geographic center of landfall for the American Eel (MacGregor et al. 2008). Local density and other factors affect their sexual differentiation following landfall, resulting in much higher proportions of females, as high as 95%, across the northern part of their range (Oliviera 1999; COSEWIC 2012).

Numerous publications (e.g., ASMFC 2012; COSEWIC 2012) describe the life history of the American Eel. The leptocephali grow to 5–6 cm over the course of 6–12 months as they approach the coast and metamorphose into transparent "glass" eels. Entering brackish and fresh waters, they develop pigmentation at less than 10 cm and become "elvers," which in turn grow into "yellow" eels, usually by age 2 at 10–13 cm. Most yellow eels then migrate further into estuaries and upstream into freshwater systems as far as natural and artificial barriers allow. This upstream movement may take several years, averaging 6 years to reach the upper SLR (COSEWIC 2012). Yellow eels occupy a wide range of habitats, including rivers, streams, lakes, and wetlands to depths of ~10 m (e.g., COSEWIC 2012). They burrow and forage in the substrate and consume aquatic insects, crayfish, and small fish—apparently opportunistically, although they may select among insect prey (e.g., Facey and Van Avyle 1987; Denoncourt and Stauffer 1993). Over the next 7–20 years they grow to over 1 m in length (females larger) and gain more than 1.5 kg (Casselman 2003; COSEWIC 2012). At maturity they become "silver" eels, changing several aspects of coloration and morphology; migrate back downstream; and follow ocean currents back to the Sargasso Sea to spawn and die (ASMFC 2012; COSEWIC 2012).

Their complex life cycle and vast geographic range make eels susceptible to numerous stresses. Smaller (<10 cm) American Eels are competent, tenacious climbers on damp surfaces (e.g., Facey and Van Den Avyle 1987; Haro et al. 2000; Verdon et al. 2003; Schmidt et al. 2009), but dams nevertheless hinder their reaching an estimated 84% of their historic North American freshwater habitats (ASMFC 2000). Dams > 2.5 m are thought to pose significant barriers to upstream movement (e.g., Verreault et al. 2004). Hydroelectric dams can present a double threat, blocking upstream passage and causing mortality during downstream migration (ASMFC 2012; COSEWIC 2012; Haro 2013; MacGregor et al. 2014).

Infection by an exotic East Asian swimbladder nematode, *Anguillicola crassus* (aka *Anguillicoloides crassus*), poses an increasing threat (e.g., COSEWIC 2012). Infections by *A. crassus* can occur in most life stages including glass eels (Nimeth et al. 2000), impairing swim bladder function, buoyancy, growth, and overall health (Sokolwski and Dove 2006; Kennedy 2007). Infected eels have appeared as far north as LO, likely from stocking of infected individuals (S. LaPan, New York State Department of Environmental Conservation, personal communication, 2011; OMNR 2012). Exposure to chemical contaminants also may lower survival (Couillard et al. 1997; Belpaire et al. 1999; Dittman et al. 2010a, 2010b; COSEWIC 2012).

American Eel abundance has declined range-wide (Department of Fisheries and Oceans, Canada [DFO] 2010; Dittman et al. 2010a, 2010b; ASMFC 2012; COSEWIC 2012; MacGregor et al. 2014). After fluctuating widely during the first two-thirds of the 20th century, landings rose into the late 1970s before declining consistently and severely to the present. Landing rates reflect not only abundance but market demand and other factors. However, direct measurements of eel demography, crucial

to evaluating the effects of specific stresses and management actions, face unique challenges (de Lafontaine et al. 2010; Engler-Palma et al. 2013; Zhu et al. 2013). ASMFC (2012) and COSEWIC (2012) use several types of data from numerous locations and apply several standardization methods to present the most complete demographic summaries available.

The post-1980 decline in American Eel abundance has prompted repeated petitions for the United States to list it as "threatened or endangered" nationally (U.S. Fish and Wildlife Service 2011), but no decision has been released. Canada is considering classifying it as "threatened" nationally (COSEWIC 2012); and the Provinces of Ontario, Quebec, Newfoundland, and Labrador have classified or are considering classifying it as threatened, vulnerable, or endangered under provincial law (Engler-Palma et al. 2013). Canada has set a goal to reduce eel mortality from all sources by 50% relative to the 1997–2002 average, as a first step toward rebuilding overall abundance (DFO 2010). The United States has not yet set goals for restoration but has implemented measures to reduce harvest of elvers, yellow, and silver eels (ASMFC 2013; Engler-Palma et al. 2013). Concurrently, demand and market prices for glass eels for export have reached all-time highs, and market prices for yellow and silver eel are similarly high (ASMFC 2012; COSEWIC 2012).

AMERICAN EEL IN THE LAKE ONTARIO AND CHAMPLAIN WATERSHEDS

The single strongest factor in the 93%–98% decline in escapement from the LO and LC watersheds appears to be dams that block or limit yellow eel migration to large portions of their historic habitat, some of which also cause mortality among silver eel as they attempt to migrate back to the ocean (ASMFC 2012; COSEWIC 2012; MacGregor et al. 2014). A radical decline in the numbers of yellow eel even attempting to migrate upstream into these watersheds in recent decades (see below) appears to be due to poor recruitment of spawning adults across the entire species range but not a cause of the post-1980 decline in escapements from these watersheds (de Lafontaine et al. 2010).

Reports on the effects of dams on eel distributions in the LO and LC watersheds differ between Canada and the United States in the ways these effects are calculated but present the same general picture. Figure 1 presents the locations of dams >15 m high on the U.S. tributaries to LO and LC and adjacent portions of the SLR basin (Dittman et al. 2010a, 2010b). Dittman et al. (2010a, 2010b) estimate that dams have reduced the overall extent of accessible tributary habitat in the U.S. portions of the LO and LC watersheds by nearly 77% and 40%, respectively. Eel habitat in the Province of Ontario historically consisted largely of the watersheds of LO and the Ottawa River. Maps presented by MacGregor et al. (2010) show an approximately 70% reduction in the total extent of eel distribution across the Province and an approximately 80% reduction in tributary extent (excluding Lake Ontario). These maps also show a much greater density of dams in the LO watershed within the province, suggesting that its losses may be proportionally greater. (These maps address losses in terms of watershed area, within which only water <10 m deep would have provided actual habitat; Verreault et al. 2004, 2012.)

Eel abundance in the LO watershed declined as tributary dams proliferated during the nineteenth to mid-twentieth century (Dittman et al. 2010b; MacGregor et al. 2010, 2014; COSEWIC 2012). However, the largest decline appears to have followed changes at two sites on the SLR downstream from LO: modifications to the hydroelectric station at Beauharnois, Quebec, first completed in 1932, and completion of the Moses-Saunders Power Dam in 1958 at Cornwall, Ontario, and Massena, New York (de Lafontaine et al. 2010; Dittman et al. 2010b; MacGregor et al. 2010; COSEWIC 2012).

Eel ladders have operated on the Canadian side of Moses-Saunders since 1974, on the U.S. side since 2006, and at Beauharnois since 1998 (Dittman et al. 2010b; MacGregor et al. 2010). Nevertheless, counts of upstream passage remain extremely low. COSEWIC (2012) estimates that, even with the additional ladder on the U.S. side, upstream movement past Moses-Saunders remains at only ~3% the rate observed in the early 1980s.

The LC watershed flows into the SLR through the Richelieu River, site of a historically robust eel fishery (Verdon et al. 2003). The decline of this fishery also followed proliferation of tributary dams during the nineteenth to mid-twentieth century (Verdon and Caumartin 2006; Dittman et al. 2010a). However, modifications to the Saint-Ours and Chambly dams on the Richelieu River between 1965 and 1969 blocked further upstream migration into the entire watershed. Eels that had migrated upstream prior to that date continued to mature and depart, sustaining the Richelieu silver eel fishery even after the changes to the dams, but landings began to decline in the 1980s and the fishery closed in 1998 (Axelson 1997; Verdon et al. 2003; Dittman et al. 2010a). Eel ladders were added to Chambly in 1998 and to Saint-Ours in 2001 (Dittman et al. 2010a). However, their benefits have resisted quantification. A significant fraction of the eels passing up the ladders have been individuals previously stocked upstream that had moved downstream through the facilities before heading back up again (DFO 2010). Neither dam generates hydroelectric power (Verdon and Caumartin 2006) and so lack turbines to harm silver eels migrating downstream.

Experimental programs stocked nearly 3 million elvers above Chambly and Saint-Ours during 2005–2008 and roughly 4 million into LO during 2006–2010 (COSEWIC 2012). Although screened for *A. crassus*, some infected individuals escaped detection (S. LaPan, New York State Department of Environmental Conservation, personal communication, 2011; OMNR 2012). Both programs are now suspended, for reasons we discuss further below.

Both watersheds have numerous hydroelectric dams, including Moses-Saunders and Beauharnois (Figure 1; Dittman et al. 2010a, 2010b; MacGregor et al. 2010). Silver eels experience significant injury and mortality during downstream passage through hydroelectric turbines (Figure 2), with annual mortality typically 10%–60% per dam but approaching 100% at some dams (Durif et al. 2003; Verreault et al. 2004; DFO

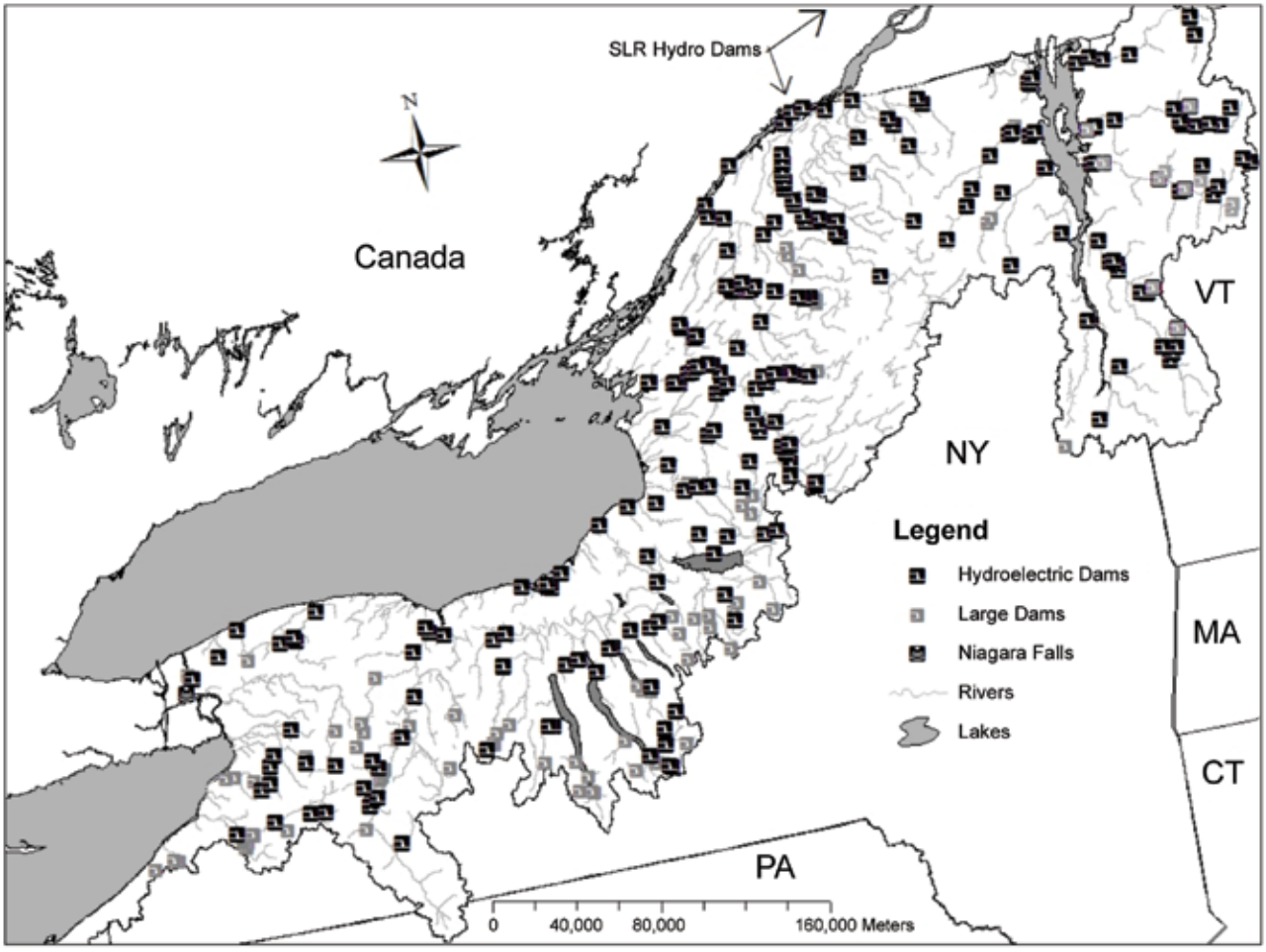

Figure 1. Hydroelectric power and other large (>15 m) dams on the U.S. tributaries of Lakes Ontario and Champlain. Map provided by D. Dittman and M. Chalupnicki, United States Geological Survey.

2010; ASMFC 2012; COSEWIC 2012; MacGregor et al. 2014). Impacts are cumulative, with Moses-Saunders and Beauharnois affecting the escapement of the entire LO watershed. COSEWIC (2012) estimates that hydroelectric dams cause 75% of all anthropogenic eel mortality in Canadian waters and reduce silver eel escapement by at least 40%. Injury and mortality rates vary with water flow (Jansen et al. 2007) and size, type, and design features of hydro-production facility and are greater for larger eels (Calles et al. 2010; ASMFC 2012; COSEWIC 2012; MacGregor et al. 2014; Haro 2013). Improvements to some hydroelectric facilities have not alleviated the overall problem (Lake Ontario Committee, Great Lakes Fisheries Commission [LOC/GLFC] 2005; COSEWIC 2012).

REESTABLISHING AMERICAN EEL IN THE LAKE ONTARIO AND CHAMPLAIN WATERSHEDS

Reestablishing the historic contribution of silver eels from the LO and LC watersheds to the international American Eel population requires action on four fronts (in order of feasibility and likely benefits): (1) closure of the fisheries; (2) improved governance; (3) improved up- and downstream passage; and (4) expanded research on unique life history and inherited traits.

The precarious condition of the international American Eel population demands a precautionary approach to eel management, starting with the closure of the fisheries for all life stages in marine, coastal, and freshwaters. This action can be implemented regionally by the ASMFC for U.S. Atlantic coastal waters. U.S. governance and management would be strengthened by listing the species at least as "threatened" under the U.S. Endangered Species Act; this would also promote its inclusion in the Convention on International Trade in Endangered Species, Appendix II. Protections under Canadian and provincial law also need to be strengthened, along with Canada–U.S. binational cooperation in eel management (Engler-Palma et al. 2013). Completion of the above would parallel actions taken for the European Eel (International Council for the Exploration of the Sea ICES 2013). Protection of the Sargasso Sea under the United Nations Convention on the Law of the Sea, which the United States has not yet ratified, would also be beneficial (Trott et al. 2010).

Fisheries management agencies need to aggressively promote substantial improvements in fish passage past artificial barriers in both directions (e.g., Haro 2013). A model by Beak International (2001) indicated that effective upstream migration and improved downstream passage "could confer sub-

Figure 2. Eel mortality during downstream migration caused by hydroelectric turbines on the St. Lawrence River. Photo credit: K. Reid, Ontario Commercial Fisheries Association.

stantial benefits to egg production from LO and SLR eels" (p. 5.9). Improved up and downstream passage will amplify the benefits from closing the fishery. However, even an aggressive campaign to improve eel passage, coupled with closure of the fishery, will take decades to benefit range-wide eel abundance. Yellow eels able to reach suitable upstream habitat, which alone can take several years (COSEWIC 2012), require 7–20 years to mature and migrate back to the Sargasso Sea before they can spawn any new cohorts.

Stocking, a common enhancement tool, is not a desirable alternative to accelerate upstream reestablishment of the American Eel. Stocking may expand the range of *A. crassus*. Further, stocking can alter population genetics and sex ratios. Higher individual heterozygosity in American Eel has been associated with greater size attained during inland maturation (Pujolar et al. 2005; Laflamme et al. 2012). American Eels also have a "globally advantageous allele with spatially variable effects on fitness" (Als et al. 2011; Gagnaire et al. 2012, p. 734). The stocking of the SLR and LO with "bootlace" eels from Nova Scotia resulted in male dominance, as well as accelerated maturity (i.e., "petite matures"), historically atypical for this system (S. LaPan, New York State Department of Environmental Conservation, personal communication, 2011). Stocking could therefore potentially undermine the unique maturation process in the LO and LC watersheds and reduce natural selection during inland migration, introducing less fit eels into historic freshwater habitat and from there into spawning cohorts (COSEWIC 2012).

Finally, there is a pressing need to fill in crucial gaps in the approaches and knowledge that hamper management of the species. Dittman et al. (2010a, 2010b), ASMFC (2012), COSEWIC (2012), Engler-Palma et al. (2013), and Haro (2013) identify crucial research needs concerning eel biology, demography, geography, threats, and the effectiveness of methods to abate or mitigate threats. Haro (2013), for example, specifically addresses potential ways to improve eel up and downstream passage. The depth of existing knowledge, together with ongoing research, could support a rigorous program of adaptive management built on a detailed conceptual model of the American Eel lifecycle, as called for in ecosystem-based approaches to fisheries management (Busch et al. 2003; Curtin and Prellezo 2010). This program should seek to establish numerical abundance (not harvest) goals for eels at various life stages (i.e., glass, yellow, and silver) based on a specific historic reference period (e.g., 1940–1950 or 1970–1980) identified by consensus as having relatively healthy but not necessarily best "historic" levels (Busch et al. 2003). These goals would be the initial targets against which to evaluate and quantify the stresses that are hindering recovery and against which to measure periodic progress. More specific research should address the location of the spawning area and its specific chemical and physical parameters through radio tagging. If this location has identifiable "attractants" for silver eels, those might be used to help guide eels past hydroelectric facilities.

The research agenda should also address the effects that reestablishing American Eel in the LO and LC watersheds could have within their ecosystems. Losses of migratory species caused by river dams often have wide-ranging ecological consequences within the blocked freshwater systems (Freeman et al. 2003); reestablishing these species would likely also have significant ecological consequences. The current ecosystems in LO and LC and their watersheds are vastly different from their historic, native ecosystems (Mills et al. 2003; Marsden and Langdon 2012). Reestablishing native fishes such as the American Eel in these watersheds will result in further evolution of these ecosystems, not the restoration of previous systems. Adaptive management of this process requires research into the potential ecological impacts of their return, in order to provide options for fisheries managers (Marsden et al. 2010; Stewart et al. 2012; Marsden and Langdon 2012).

For example, as noted, yellow eel prey opportunistically on benthic fauna in shallow waters. At 25% of the historic fish biomass across their freshwater range, yellow eels as predators would have strongly shaped the overall freshwater food web wherever they occurred (Christie 1974). Reestablishing yellow eel therefore could affect numerous native and nonnative

benthic species and life stages. Species that prey on yellow eel (Facey and Van Den Avyle 1987; ASMFC 2012) will be affected as well. Finally, the American Eel is the primary larval host species for the Eastern Elliptio (*Elliptio complanata*), an abundant and ecologically important freshwater mussel native to the Atlantic coastal drainages of North America (Vaughn et al. 2008; Lellis et al. 2013). Reestablishing the American Eel in the LO and LC watersheds could therefore affect the abundance of the Eastern Elliptio in these watersheds, with additional cascading effects.

CONCLUSIONS

The life cycle of the American Eel is complex and spans a vast geographic range under many jurisdictions. Effective protection, restoration, and management of this species cannot be accomplished piecemeal (Engler-Palma et al. 2013). As a panmictic species, it requires a high level of coordinated jurisdictional protection throughout its range that currently does not exist.

Protecting eels from harvest by closure of the fisheries should increase the overall number of recruits to every life stage. This should increase the abundance of recruits specifically moving into the SLR basin and help reestablish the American Eel in the LO and LC watersheds. Based on historic records, the growth of large, highly fecund females in the LO and LC watersheds would enhance the egg supply for the entire species. Increasing freshwater habitat and the production of silver eels may also buffer population numbers from the effects of variation in ocean currents and in watershed hydrology in different parts of the species' range. However, it will take many decades to modify the dams and allow population dynamics to play out, even if all recommended actions are carried out with urgency. Similarly, Astrom and Dekker (2007) estimate that it will take 80 years after complete closure of its fisheries to restore European Eel abundance. The potential time lag between actions and full benefits in turn highlights a need for improved methods of American Eel population assessment, to better support adaptive management of the restoration process. At the same time, we caution against stocking as a rapid, high-volume approach for increasing upstream eel numbers and note that the return of the American Eel to its former habitat will likely result in a cascade of additional ecological effects that will also demand careful attention.

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RELATED AFS POLICY:

AFS Policies #10 on "Protection of Threatened and Endangered Species," #15 on "Introductions of Aquatic Species," #19 on "Introduction of Threatened and Endangered Species," and #27 on "Conservation of Imperiled Species and Reauthorization of the Endangered Species Act." Although eels are not yet listed under the Endangered Species Act, our related policies do offer usual perspectives.

Anglers' Motivations for Volunteering with Fishing or Conservation Organizations

Michael A. Schuett

Department of Recreation, Park and Tourism Sciences, 2261 TAMU, Texas A & M University, College Station, TX 77843-2261. E-mail: mschuett@tamu.edu

Gerard T. Kyle

Department of Recreation, Park and Tourism Sciences, Texas A & M University, College Station, TX

Jeremy Leitz and Ken Kurzawski

Texas Parks and Wildlife, Austin, TX

Kyunghee Lee

Department of Recreation, Park and Tourism Sciences, Texas A & M University, College Station, TX

ABSTRACT: *Each year many individuals volunteer their time with fishing or conservation organizations. Research has shown the importance of organizational volunteers in the effectiveness of environmental stewardship; however, the literature on motivations for environmental volunteering is limited. This study examined the motivations of licensed recreational anglers for volunteering with fishing or conservation organizations. Data were collected through the 2012 Texas statewide angler study (n = 1,888), which queries licensed recreational anglers. Results showed that 454 individuals are members of fishing or conservation organizations and of those members, 153 individuals responded that they volunteer. Anglers volunteered an average of 10 years and 33 hours annually. Motivations were analyzed using principal components analysis yielding three dimensions: "helping/learning about the environment," "social," and "policy." Study results have implications for those who work with volunteers in targeting recruitment based on volunteers' values: protecting the environment, meeting new people, and influencing policy decisions. Other implications for voluntary associations and agencies include a formalized program for recognition/rewards through using T-shirts, hats, etc., and timing volunteer projects to people's schedules; for example, weekend-long events. Future research is suggested on the value orientations of volunteers in the natural environment and collecting more representative data nationally.*

Motivaciones de los pescadores para ofrecerse como voluntarios en organizaciones de pesca y conservación

RESUMEN: *cada año, muchos individuos se ofrecen como voluntarios en organizaciones de pesca y conservación. Investigaciones han demostrado la importancia que tienen los voluntarios organizados en la efectividad de la gestión ambiental; sin embargo, la literatura concerniente a la motivación de los voluntarios ambientalistas es limitada. En este estudio se examinan las motivaciones de los pescadores con licencia para ofrecerse como voluntarios en organizaciones de pesca y conservación. Los datos se colectaron durante el estudio estatal de Texas 2012 sobre pescadores (n = 1,888), en el cual se consultaron a los pescadores con permiso de pesca recreativa. Los resultados mostraron que 454 individuos son miembros de organizaciones de pesca o conservación y de éstos, 153 individuos dijeron haberse ofrecido como voluntarios. Los pescadores se ofrecieron como voluntarios, en promedio, durante 10 años y 33 horas por año. Las motivaciones se analizaron mediante componentes principales y se obtuvieron tres dimensiones: "ayudar a y aprender sobre el ambiente", "social" y "política". Los resultados tienen implicaciones para aquellos quienes trabajan reclutando voluntarios tomando en cuenta sus valores: proteger el ambiente, conocer gente nueva e influenciar las políticas públicas. Otras implicaciones de las asociaciones y agencias de voluntarios incluyen un programa formal de reconocimientos/recompensas utilizando camisetas, gorras, etc., y concertar los proyectos de los voluntarios con la agenda de la gente; por ejemplo, eventos en fines de semana largos. Se sugieren líneas de investigación futuras que consideren el valor de las orientaciones de los voluntarios en lo que respecta al ambiente natural y colecta de datos que sean más representativos a nivel nacional.*

INTRODUCTION

Voluntary associations are groups composed of individuals who join together for a specific purpose or goal and are often supported by donations or membership dues (Lohmann 1992). These types of organizations number in the thousands and represent millions of members nationwide (Ladd 1999). Environmental volunteering activities are quite diverse, ranging from assessing water quality (Nichols and Williams 2006) to fish monitoring programs (Pattengill-Semmens and Semmens 2003). These types of volunteering activities can provide individuals, communities, and organizations with numerous benefits, including practical educational opportunities and resource protection.

In the specific area of fisheries, voluntary groups represent the conservation of marine resources (Coastal Conservation Association), coldwater fisheries (Trout Unlimited), or specific outdoor recreation user groups (Federation of Fly Fisherman). Given the fiscal challenges that federal, state, and local governments face in managing our public lands, lakes, and watersheds,

voluntary groups have increased importance in assisting public agencies in fulfilling their mission and taking advantage of an informed and diversified citizenry (Ryan et al. 2001). However, when examining specific groups of outdoor recreation participants who volunteer for environmental or conservation organizations, the literature that has explored environmental volunteering has not focused on any one group of outdoor recreation participants. Considering the vast number of anglers nationwide, more information is needed about their volunteering motives and behavior. Do anglers volunteer for environmental or conservation organizations? What do they get out of it? Are there any differences between nonvolunteer and volunteer anglers? Therefore, this study explores the motivations of licensed recreational anglers who volunteer with fishing or conservation organizations. Through a review of the literature and survey research, the goals of this research are to obtain information about why anglers are motivated to get involved with voluntary groups and how our results compare with past research, demonstrate how this information can be used to benefit organizations/volunteers, and assist public agencies in utilizing individuals who are dedicated to the stewardship of natural resources.

LITERATURE REVIEW

Understanding what motivates individuals to volunteer can help organizations recruit committed individuals. However, it is important for any voluntary organization to better understand what factors drive these individuals to volunteer their time and what will make them both remain and return. In general, research on examining motives for volunteering with environmental organizations has been limited, although a body of literature has begun to emerge. A review of selected studies shows several key factors that contribute to participation. For example, O'Brien et al. (2008) examined motives for environmental volunteering in Britain and found several key benefits including fitness, keeping alert, meeting others, and reducing stress levels. Ryan et al. (2001) studied motives for continued participation among individuals in ecological stewardship programs. They found three main factors that explain why volunteers stay involved, including helping the environment, learning, and project organization.

Pillemer et al. (2009–2010) focused on environmental volunteering for a water quality program involving older adults (60 years of age or older). They found that motivations for volunteering were centered on physical activity, exposure to nature, and health. Bruyere and Rappe (2007) explored motives for volunteering in six natural resource organizations. They found that helping the environment was the most important motive followed by improving areas that volunteers use for recreation, expressing their values, and learning about the natural environment. Hence, the motivating factors of environmental volunteering are complex and can vary by age, demographics, type of organization, past experience, and level of commitment, with some factors revolving around individual needs (e.g., social) and others more resource related (e.g., protecting the resource; Jacobsen et al. 2012).

In the fisheries literature, past research has described a plethora of activities in which volunteers are engaged. These activities serve as a mechanism to gain skills, including field survey training (Pattengill-Semmens and Semmens 2003), data collection validity (Gollam et al. 2012), horseshoe crab monitoring (Smith and Michels 2006), and ways to improve safety and efficiency of using volunteers on projects (Leslie et al. 2004). And though federal and state agencies as well as volunteer associations have benefited considerably by volunteer participation, the body of literature that has examined volunteer motivations and benefits has been broadly focused (Bruyere and Rappe 2007). The vast majority of these studies have queried the general public or those actively engaged with specific public agencies or stewardship programs.

We explore one specific group that has not been investigated in much detail, licensed recreational anglers. This is the primary group connected to fisheries professionals and public agencies. The purpose of this study is to examine the motivations of licensed recreational anglers and the amount of time spent volunteering with fishing or conservation organizations. Information from the study will provide voluntary associations and agency managers with a better understanding of what motivates anglers to volunteer. We will discuss the potential of using these results to promote stewardship programs, recruit/retain volunteers, and suggest strategies to engage a future generation of volunteers.

METHOD

Sample and Data Collection

In 2012, the Texas Parks and Wildlife Department (TPWD), in cooperation with Texas A&M University, conducted its Statewide Survey of Licensed Anglers. This statewide angler survey has been taking place since 1989 and includes residents who purchased a freshwater fishing license, a saltwater fishing license, a combination freshwater and saltwater license, or a combination hunting/fishing license during the state fiscal year 2012 (September 1, 2011—August 31, 2012). Data were collected from anglers randomly and selected from the list of licensed anglers statewide, and data collection began in October 2012.

For this study year, data were collected using three modes: mixed mode (paper mail and electronic), e-mail only, and a combination of mixed mode and e-mail. This is the first time the statewide angler survey employed electronic data collection, which was done to save costs and examine the utility of using electronic data collection in the future. All respondents were contacted four times at one-week intervals following procedures recommended by Dillman et al. (2009). For the mixed-mode option, an initial letter was sent to potential respondents informing them of the study and inviting them to complete the survey questionnaire online. The second contact included a reminder/thank you postcard and an associated URL link inviting them to complete the survey online. The third contact included another letter reminding them of the study and inviting them to complete it online. The fourth and final contact included a survey packet

containing a (a) cover letter informing them of the study and inviting them to complete the survey questionnaire online or to complete the enclosed hard copy; (b) hard copy of the survey questionnaire; and (c) postage-paid addressed return envelope.

For the group that received an electronic-only invitation, potential respondents received an e-mail invitation to participate in the study via a hyperlink. They received four e-mails one week apart. The combination group followed the mixed-mode protocol but was also sent an e-mail inviting them to participate. These respondents received four mail contacts one week apart. All postal invitations were sent using TPWD letterhead, and the TPWD logo was also on the postcard reminder, e-mail invitations, and questionnaires. The original sample size was 9,000 (mixed mode, n = 4,000; e-mail only, n = 4,000; and combination, n = 1,000). After removing duplicate listings and bad addresses/e-mails, the final sample size was 6,742 (mixed mode, n = 3,486; e-mail, n = 2,615; and combination, n = 641).

Instrument

The statewide survey is extensive and has used many core variables since its inception in 1989. The variables used in the 2012 questionnaire measured angler participation and experience, species preferences, motivations, affiliation with fishing or conservation organizations, and sociodemographics. The 13 items that measured volunteer motivations were based on previous work by Clary et al. (1996), Propst et al. (2003), and Bruyere and Rappe (2007). The motivation items examined the personal and social motivations for being engaged with these voluntary groups. These items (e.g., protect natural areas, meet new people, observe nature, etc.) were measured using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." Two items measured volunteer time experience; that is hours spent volunteering in the last 12 months and other years volunteering. Given the extensive nature of the statewide survey questionnaire, the focus of this article is on the recreational anglers who are members of fishing or conservation organizations and their motivations to volunteer, as well as to show a demographic comparison with those who did not volunteer. The Statistical Package for the Social Sciences (IBM Corp., Armonk, NY) was used to analyze these data.

RESULTS

This study investigated motivations for membership in fishing or conservation organizations; hence, data results from all three data collection procedures were aggregated. A total of 1,888 completed responses were sent back for a combined response rate of 28% (mail only, n = 697/3,486, 20%; e-mail only, n = 784/2,685, 30%; mixed mode, n = 407/640, 63%). Even though the combination mode yielded the highest response rate, the e-mail-only mode was the most cost effective and efficient method for data collection. Overall response percentage was similar to the 2009 statewide angler study response rate of 30% (Landon et al. 2012). Errors introduced by nonresponse can contribute as much or more than sampling errors to total error. Given our response rate, checks for nonresponse bias were completed comparing the variable of age with the entire sample (Fisher 1996). A t-test was used to compare mean age between respondents (43.8) and the entire sample (43.2); no significant differences were found within a 95% confidence level after applying a weighting multiplier. For a complete description of the procedure see Fisher (1996).

Volunteer Profile

Results showed that 454 respondents (31%) were members of fishing or conservation organizations out of the 1,483 individuals who responded to the item on memberships. The organization with the highest membership was the Coastal Conservation Association followed by Ducks Unlimited and the Bass Anglers' Sportsman Society. Of those who reported that they were members of an organization, 153 (10%) responded that they volunteer with fishing or conservation organizations. The volunteer percentage for those who were not members of an organization was low at 2% (n = 33).

The overall profile of those who did volunteer was mostly white (99%), male dominated (93%), with a mean age of 50 years. The mean number of years volunteering was 10. Mean number of hours volunteering in the last 12 months was 33. In examining the annual volunteer hours and years by age groups, those who were less than 29 years, mean hours = 23 and mean years = 4; ages 30–50, mean hours = 29, mean years = 6; and for those who were 50+, mean hours = 29, mean years = 14. As expected, as anglers' age increased, the amount of time spent volunteering increased. In terms of their angling behavior, volunteers fished in freshwater approximately 24 days per year and 30 days for saltwater. In a brief comparison with those who did not volunteer, the demographic results were similar; nonvolunteers were mostly male (92%) and middle-aged (50 years) but fished less at 21 days per year in freshwater and 17 days per year in saltwater.

Volunteer Motivations

Overall results show that individuals are motivated to volunteer by being engaged with the natural environment (Table 1). The highest mean scores were found for the following items: enrich activities that I enjoy doing (4.72), see improvements in the environment (4.36), protect natural areas (4.32), and observe nature (4.23). The motivation items that were rated lower were in four general areas: gives me more access to managers (2.91), expand my social network (3.28), feel better about myself (3.45), and gain knowledge about public policy (3.53).

A principal components analysis with varimax rotation was used to identify factors from the motivation items (Table 1). All three factors had eigenvalues of 1.0 or higher, which meets the acceptable criteria (Tabachnick and Fidell 2013). Based on loading values of 0.50 or higher, three to six items were retained per factor. Reliability analyses were conducted to examine the internal consistency; Cronbach's alpha for each of the three factors ranged from 0.77 to 0.86, indicating good internal consistency for each factor (Bohrnstedt and Knoke 1994). Nunnally

(1978) has indicated 0.7 to be an acceptable reliability coefficient, but lower thresholds are sometimes used in the social science literature; for example, 0.6. In other words, the higher the score, the more reliable the scale. A 0.86 alpha shows the factor (set of motivation items) is 86% reliable, demonstrating that the motivation items in each factor are strongly related. These three factors accounted for 61% of the variance, which is satisfactory in the social sciences (Hair et al. 1992), although there may be other unidentified motivations not included in this study.

The fact that individuals who volunteer in this study were members of a fishing or conservation organization shows that this may be the most practical source to recruit from and stay connected with to obtain future volunteers.

Factor 1 explained 26% of the variance and was labeled as "Helping/Learning about the Environment." This factor consisted of six items: "protect natural areas," "see improvement in the environment," "observe nature," "learn about conserving natural resources," "helps me understand natural resource management," and "enrich the activities I enjoy doing." This factor encapsulates a desire for volunteers to do something positive for the environment and themselves and also learn from these experiences. Factor 2 was the "Social" factor and explained 18% of the variance. This factor consisted of six items: "meet new people," "feel better about myself," "expand my social network," "be with people like me," "meaningful use of my time," and "share knowledge with others." In this group of motivations, volunteers want to associate with others who have similar interests, expand their social network by meeting new people, and use their time in meaningful ways. Factor 3 was labeled the "Policy" factor and explained almost 17% of the variance. This factor contained three items: "more influence over policy decisions," "gain knowledge about public policy," and "gives me more access to managers." This factor shows a desire for volunteers to gain knowledge about public policy and have influence over policy decisions.

Table 1 . Principal component analysis of volunteer motivation items.[a]

Item		Component		
	Mean	1	2	3
Factor 1: Helping/learning about the environment				
Protect natural areas	4.32	0.823		
See improvement in the environment	4.36	0.766		
Observe nature	4.23	0.747		
Learn about conserving natural resources	4.01	0.710		
Helps me understand natural resource management	3.88	0.667		
Enrich the activities I enjoy doing	4.72	0.632		
Cronbach's alpha 0.86				
Factor 2: Social				
Meet new people	3.74		0.733	
Feel better about myself	3.45		0.685	
Expand my social network	3.28		0.622	
Be with people like me	4.01		0.599	
Meaningful use of my time	4.01		0.558	
Share knowledge with others	4.01		0.506	
Cronbach's alpha 0.77				
Factor 3: Policy				
More influence over policy decisions	3.42			0.791
Gain knowledge about public policy	3.53			0.734
Gives me more access to managers	2.91			0.719
Cronbach's alpha 0.77				
Eigenvalues		3.93	2.74	2.53
Percentage of variance		26.2	16.9	18.3

[a] 1 = Strongly disagree, 5 = strongly agree

DISCUSSION AND IMPLICATIONS

This study has built on a limited amount of research that has explored volunteer motivations in the area of conservation and natural resources. The purpose of this study was to examine licensed recreational anglers' motivations for volunteering and estimated time spent volunteering with fishing or conservation organizations. Our study focused on one specific group of volunteers, recreational anglers, which has not been examined in the current literature.

The majority of past research has examined the general public or volunteers in specific voluntary associations; hence, our results shed some light on licensed recreational anglers' volunteer motives. Our findings showed that 31% of the sample are members of fishing or conservation organizations, and of those that are members, 10% volunteer with these groups. They volunteer on average about 33 hours per year and have volunteered for approximately 10 years. They volunteer primarily to help and learn about the environment, socialize, and impact policy.

In exploring anglers' motivations for volunteering, they are most interested in helping and learning about the environment; these anglers are a concerned group of outdoor enthusiasts who feel a need to conserve our natural resources. Motivation for learning and helping the environment is consistent with past research that has examined environmental volunteering by the general public (Ryan et al. 2001; Bruyere and Rappe 2007). Past studies are similar as most query current volunteers from several types of groups including federal/local government and nonprofits about their motives; thus, a consistent motivation theme was identified from this study. These benefits may translate into stewardship programs for voluntary associations or agencies that can be specifically geared toward certain individuals (e.g., youth, minority groups, or seniors). As for why these anglers want to learn more about and help the environment, these issues were not identified and are ripe for further research.

Volunteers were motivated by socialization, such as sharing knowledge with others, using their time in a meaningful way, being with similar people, or meeting new people. As

identified in past research, the social benefits of environmental stewardship are important and can lead to positive personal outcomes—for example, friendships—and can also help voluntary associations expand their volunteer base (Ryan et al. 2001; Bruyere and Rappe 2007; Jacobsen et al. 2012). However, in our study the social benefits were rated as less important than the previous research, which may show that anglers are less interested in this aspect of the volunteer experience. This type of benefit is important for voluntary associations to capitalize on because keeping volunteers connected and involved can be a challenge over time. Again, the social aspect of volunteering should be explored in more detail because it may be linked to specific types of voluntary organizations as well as recruitment and retention.

The third group of benefits was quite practical and geared to those who want to gain knowledge about public policy and possibly influence policy decisions. This dimension has not been examined in many past studies on environmental volunteering, so our results add to the literature on volunteer motivation regarding policy and influence. Many anglers are very concerned about policy issues that can impact catch limits, regulations, and habitat (Aanesen and Armstrong 2013). One way to learn more about these types of issues is to become more informed through volunteering and having input into future planning decisions. Personal interactions and specialized knowledge may also help volunteers who may want to work in administrative roles in voluntary organizations or in other natural resource-related areas. Natural resource decision making has taken on a more collaborative approach where informed stakeholders can provide insight on the importance of collective action and community empowerment (Brinkman et al. 2012). Learning more about the connection between volunteering and learning about influencing policy is a topic that has not been explored in the literature and may provide more information on whether or not volunteers feel it pays any dividends over time.

Average Time and Years Spent Volunteering

Respondents in this survey volunteered 33 hours annually. Given the number of hours respondents volunteer per year, it is suggested that voluntary association managers could focus on major weekend volunteer events that could possibly draw in volunteers once or twice a year. For some individuals this might be the best way to volunteer, whereas others may find it best to volunteer a few hours per month and be engaged all year.

If the figure of 33 hours per year for volunteering per angler were multiplied by all anglers who are members of fishing or conservation organizations nationwide, the amount of volunteer time would be considerable, reaching millions of hours annually; however, no national data are available on environmental volunteering of specific outdoor recreation participants. In the only national study that includes a variable for volunteering with environmental voluntary associations, the General Social Survey (GSS) asks respondents whether they have done any volunteering over the last 12 months. The GSS has been conducted since 1972 and explores volunteering behavior on a limited basis (1972–2006 for environmental). The GSS found that 8% of the general public had volunteered with an environmental organization (General Social Survey 2013), but these data do not give any time frames; for example, number of hours per year.

In one related study on the amount of time spent per year on environmental volunteering, Propst et al. (2003) found that the mean number of years volunteering in outdoor recreation and natural resource management (both nonprofits and public agencies) in New Jersey and Michigan was 10; their volunteers averaged 21 days per year; however, they were not given an hourly response choice, and their study surveyed the general public. Nationally, according to the Bureau of Labor Statistics (BLS), the median number of hours spent volunteering in any type of activity (e.g., education, fundraising) annually was 50 (BLS 2012), well above our study findings. Again, these results are from the general public and not a specific group of outdoor recreationists. Thus, anglers in this study appear to be actively engaged with fishing or conservation organizations but it is difficult to compare our annual/hourly totals with other research. For any agency or voluntary association, the amount of consistent time and effort put forth by volunteers is critical in working on stewardship projects, teaching valuable skills, and helping communities and should be quantified.

Keeping volunteers connected over time is a challenge for voluntary associations. In this study, respondents averaged 10 years, which is very positive in terms of commitment. Learning more about how volunteers should be rewarded—for example, certificates, T-shirts, hats, etc.—is fundamental in demonstrating appreciation and will lead to better retention (Jacobsen et al. 2012). More research is needed on how best to reward environmental volunteers so recruitment is more cost effective and better meets the needs of the volunteer and voluntary association. Jacobsen et al. (2012) also found that retention is tied to volunteer satisfaction, and voluntary associations should develop a retention plan that includes recognition. As mentioned previously, the retention issue could also be linked to the social aspects of volunteering but needs to be explored.

Angler Comparison

In taking a look at the anglers' behaviors in this study, recreational anglers who volunteer appear to fish more often (spending more days fishing annually in both freshwater and saltwater) than those who do not volunteer. Of those that did volunteer, the Coastal Conservation Association had the largest membership contingent, which is not surprising considering that the Coastal Conservation Association started in Texas. The fact that volunteers were the most active anglers may point to the dedicated nature of these anglers who seem to have a strong desire to be out in the field both volunteering and recreating. This subgroup is one that fisheries managers and voluntary associations may want to learn more about due to their time commitment to outdoor recreation and environmental stewardship values. In addition, older anglers (50+) in this study appear to volunteer more often and have been volunteering longer. Getting them involved

when they are younger might be an important recruitment goal for voluntary associations to pursue. In terms of the "best" age or age range to recruit, that may require longer term research and could vary by organization.

Benefit to Managers

Voluntary organizations focused on fishing or conservation can be vital advocates for preserving and protecting natural habitats. A growing constituency of informed volunteers has the potential to create a dominant voice in the protection and conservation of the natural environment. Once trained, skilled volunteers can be used as citizen scientists to help collect scientific data and conduct technical field work (Hobbs and White 2012; Thornton and Leahy 2012). Because this study surveyed a specific group of outdoor recreation participant—that is, anglers—this group's level of knowledge on fisheries habitat and issues may exceed that of the general public; hence, pursuing anglers as volunteers with fisheries-related projects could be even more helpful to managers. The fact that individuals who volunteer in this study were members of a fishing or conservation organization shows that this may be the most practical source to recruit from and stay connected with to obtain future volunteers.

Scientific data collected through volunteers can be used to add to or augment key information needed for fisheries managers. If monitored carefully, this type of scientific activity provides satisfaction to the volunteers and incalculable benefits to agencies and the environment (Gollam et al. 2012). Volunteer organizations can also provide practical field experience for students or youth, which is helpful for future professionals in gaining agency employment down the road (Gabelhouse 2010). Applicable paperwork and approvals are always necessary for public agencies using volunteers to cover any legal, safety, and ethical issues (Leslie et al. 2004).

Limitations and Future Research

Methodologically, this study was limited to licensed recreational anglers in Texas. It is necessary in future studies to obtain a larger, more representative sample to examine levels of volunteer commitment across the nation or specific types of anglers. A national study would allow more specific data to be collected about environmental volunteering with various types of voluntary associations or public agencies. Due to the scope of the study and the representative nature of its sample, it is suggested that the U.S. Fish and Wildlife Service's national survey of fishing, hunting, and wildlife-associated recreation explore environmental volunteering. This large-scale study takes place every 5 years; in the last year it was completed (2011), 42,800 interviews were conducted (2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation). The U.S. Fish and Wildlife Service could add a question or two to the survey instrument that could measure whether participants volunteer with conservation organizations or a public agency. If access to other groups of outdoor recreation participants could be obtained, environmental volunteering could also be explored for specific angler subgroups—for example, fly fisherman or highly specialized anglers (Oh and Ditton 2006)—to determine how they compare in their motives and commitment to volunteer.

Value orientations about wildlife are shifting over time, moving away from domination to mutualism (Manfredo 2008). As a result of these changes, attitudes may be moving more toward protection and care; therefore, understanding more about individual views can be beneficial for fisheries managers, voluntary associations, and recreational anglers. It seems plausible that those who enjoy the outdoor environment through the recreational angler experience would volunteer with fishing or conservation organizations. However, the number who volunteered in this study was only about 10% of the total number of respondents. This finding may be related to lack of time or access to voluntary groups, but this issue was not measured and thus cannot be determined.

Future research is needed to expand our knowledge about those who volunteer in the natural environment; for example, how attitudes change over time, why individuals start/continue/drop out, and motivations for subgroups such as older adults (Pillemer et al. 2009–2010) or students (Seitz et al. 2012). More in-depth data collection is recommended to explore the complexity of volunteer motivations through qualitative techniques, such as focus groups or interviews. This study identified motivations of those who do volunteer. Research is needed to address the population of recreational anglers or other outdoor recreation participants who do not volunteer and find out how they can be recruited, which would be beneficial for voluntary associations and agencies, too.

As public agencies face budget challenges in years to come, they will rely more heavily on working with voluntary organizations to help protect and preserve our natural resources (Leslie et al. 2004). Understanding more about these types of partnerships is critical in fisheries research and management, because important conservation projects are in need of completion and public agencies rely on volunteer action. Agencies and voluntary associations need a better understanding of the factors that motivate volunteers so that volunteer programs can be structured to attract, maintain, and reward participants and encourage continued participation.

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RELATED AFS POLICY:

We don't have any policies on this issue but we do have two related to anglers and responsible use. AFS Policies #28 on "Special Fishing Regulations for Managing Freshwater Sport Fisheries" and #30 on "Responsible Use of Fish and Other Aquatic Organisms."

ARCHIVES FROM 100 YEARS AGO

MR. FEARING, of Rhode Island: Some years ago when I was going around the world, I was requested by Mr. Agassiz to make notes of any absolutely authentic cases of sharks attacking human beings. He believed that there is no shark known at the present time that will attack a living man and there is no shark known whose jaws are capable of biting a man's leg off.

I inquired wherever I went. In Singapore, where the sharks are thicker than in any other place I remember, except in Java in the very warm waters under the equator, I approached the English captain of the water police who had seen thousands of dead bodies that had been mauled and torn by sharks, he had never known, in all his experience, of a case where a shark had attacked a living person. In Aden I saw a boy who, it was said, had had his leg bitten off by a shark. On careful inquiry, however, it developed that he was drunk and was run over by an ox cart and injured so that his leg had to be amputated. That was the nearest to any actual case that I was able to discover on a trip around the world; however, Dr. Chas. H. Townsend has told me that he has absolute personal proof and that he has himself seen natives in the tropics grabbed by sharks and eaten.

Lewis Radcliffe (1914): Notes on some North Carolina Sharks and Rays, Transactions of the American Fisheries Society, 44:1, 37–40.

Q&A: The 2014 Emerging Leaders

The purpose of the Emerging Leader Mentorship Award (ELMA) Program is to develop future leaders of the Society, and the fisheries profession as a whole, by providing selected candidates an opportunity to participate for one year in activities of the Society Governing Board. Participants in the program are selected based on their level of involvement in AFS, as well as their potential for assuming leadership of Society units in the future. This year four emerging leaders were chosen: Patrick Cooney, Justin Davis, Cari-Ann Hayer, and Steve Midway. We interviewed them to find out their thoughts on what this position means to them.

Patrick Cooney

pcooney@smith-root.com
Certified Fisheries Scientist with Smith-Root, Inc.
Cofounder, www.thefisheriesblog.com

How did you get interested in leadership?

Everyone in AFS understands the role of being a leader, whether it is leading a research project or leading people to understand the value of conservation and stewardship. Therefore, leadership is part of the daily lives of every member. I became interested particularly in leadership through AFS when I understood that it is the ultimate way to serve the society that has served me so well for more than a decade.

Since I became an AFS member, I have met every subsequent boss and advisor at an AFS meeting.

What do you see as some of the challenges AFS faces that you, as the newer generation, can help conquer?

AFS members are leading experts in managing and conducting research on the number one source of global animal protein and the number two most popular outdoor recreational activity in the United States (freshwater, saltwater, and fly fishing), yet AFS is currently delivering information on these resources and activities almost exclusively to its members. Younger AFS members are accustomed to using evolving and innovative forms of communication and should be relied upon to help deliver and promote the research and scientific information of all AFS members to a wider audience.

Give your top three bulleted items from a list of what you hope to accomplish.

- Serve the society that has served me for a decade and explore additional avenues for leadership and involvement.
- Increase awareness among AFS membership and the AFS Governing Board members of additional communication avenues to further our scientific information.
- Empower underutilized members to contribute to, benefit from, and serve in AFS and encourage them to become AFS Certified Fisheries Professionals.

What do you hope this experience will do for you?

I hope this experience helps me further develop my leadership capabilities, extends my professional network, and widens my knowledge of ways to serve the society.

Why did you join AFS and, more importantly, what keeps you here?

I joined the American Fisheries Society when I realized that it was the best way to meet and learn from fisheries scientists and researchers from around North America and the world. Since I became an AFS member, I have met every subsequent boss and advisor at an AFS meeting. I remain a member of AFS to maintain professional relationships and foster new ones.

Justin Davis

justin.davis@ct.gov
Fisheries Biologist
CT DEEP Eastern District Headquarters

How did you get interested in leadership?

I got involved in AFS leadership through equal parts curiosity, optimism, and a pathological inability to say "no." Curiosity about what went on behind the scenes, optimism that I might be able to make a positive contribution, and then, when new opportunities arose, I just kept saying, "Sure, why not?" That's the great thing about AFS: if you want to get involved, there are absolutely no barriers—all you have to do is ask, "How can I help?"—and then just say "yes." It can be time consuming, but ultimately it's very rewarding and gives you the chance to create lasting relationships with other fisheries professionals.

What do you see as some of the challenges AFS faces that you, as the newer generation, can help conquer?

We live in a hyper-connected world. E-mail, smart phones, Facebook, Twitter, Instagram, Vine…there's probably some new thing that came out while I was typing this. Professional societies like AFS, which historically served as primary catalysts for information exchange and collegiality, are struggling to maintain relevance—particularly to younger people who have grown up online. Part of the solution is embracing new technologies so we're speaking to the next generation in their native tongue (something that I think AFS has made great strides toward over recent years). But the sales pitch should also stress the timeless benefits of Society participation: opportunities to interact in person with others in your field (no amount of e-mailing is a substitute for sitting down and talking with someone over lunch… or a beer!), opportunities to foster and display leadership ability (see first question), and the sense of belonging to a community.

Give your top three bulleted items from a list of what you hope to accomplish.

Over the next year in the ELMA program:

- Learn about new initiatives and projects that various AFS units are working on.
- Contribute to the Governing Board in any way that I can.
- Come up with at least one idea of how the ELMA program can be improved.

In life:

- Help conserve fish and the places they live for future generations.
- Raise my kids well.
- Catch a 60-pound striped bass … (probably in that order).

These days, I think of AFS meetings as my battery charger.

What do you hope this experience will do for you?

I hope it gives me a better understanding of how AFS governance works, opens the doors to new opportunities in AFS leadership, and gives me a chance to meet some new and interesting people.

Why did you join AFS and, more importantly, what keeps you here?

I joined AFS because on my first day of graduate school, my advisor said, "You absolutely need to join AFS. Now." So I did. It was some of the best advice I've ever been given. AFS has been instrumental to achieving my dream of a career in fisheries and has given me the opportunity to meet and form lasting relationships with other fisheries professionals. These days, I think of AFS meetings as my battery charger. I get a chance to discuss my work with other professionals and get their feedback, learn about interesting work that others are doing (some of which may give me new perspectives on what I am doing), and catch up with friends I probably haven't seen since the last meeting. I always walk away feeling reinvigorated, rededicated, and fortunate.

Cari-Ann Hayer

chayer@usgs.gov
U.S. Geological Survey
Columbia Environmental Research Center

How did you get interested in leadership?

I first started thinking about leadership when I was asked, "What is a leader?" in my oral comprehensive exams for my Ph.D. I then started pondering the idea when dealing with my technicians and anyone that I had to work with. At the time I did not think I was a leader, but now realize that some people look up to me professionally, which in a sense makes me a leader. I started serving on committees because I was interested and wanted to be involved in AFS but not because I wanted to be a leader. Since I am done with my doctorate, the "leader" topic has weighed on my mind quite a bit. John Quincy Adams once said, "If your actions inspire others to dream more, learn more, and become more, you are a leader." I am going to strive for this personally and professionally.

Inform student subunits of the Society and what it has to offer. Oftentimes the units don't even know that the Society or the Divisions of AFS exist!

What do you see as some of the challenges AFS faces that you, as the newer generation, can help conquer?

A major challenge facing AFS is recruitment, particularly undergraduate students and new professionals, which has been a topic at meetings I have attended over the past few years. Along with the Education Section and the Student Subsection of the Education Section, I have helped to chip away at this problem by awarding several undergraduate student travel awards to the Annual Meeting for the past three years (including this year). This award introduces undergraduates to the American Fisheries Society, maybe for the first time, and especially at such a high level, and hopefully will help to rein them in to AFS as my first meeting did to me! I remember seeing as many talks as I could and was in awe of all the interesting and smart research that was being conducted across the world. It was at my first Annual Meeting in Maryland that I decided to take the "fisheries path" and not the "wildlife path," which I had been on for some time. I hope that through travel awards, student activities, and future ideas we, as a Society, can help to engage students in AFS and help them realize the benefits and rewards of belonging to such a Society.

Give your top three bulleted items from a list of what you hope to accomplish.

- Help in continuing the undergraduate travel award through the Education Section (it is up for review this year).
- Inform student subunits of the Society and what it has to offer. Oftentimes the units don't even know that the Society or the Divisions of AFS exist!
- Continue to help with the committees that I am involved with.

What do you hope this experience will do for you?

First and foremost this experience will give me the chance to witness the highest levels of AFS in action. It will allow me to be a part of what goes on behind the scenes to not only keep the Society running smoothly but also to see how the decision process works.

Why did you join AFS and, more importantly, what keeps you here?

To quote Steven Chipps from South Dakota State University, the American Fisheries Society has become like a family to me. I have made many friends that will be with me for a lifetime. I believe in what the American Fisheries Society stands for and take pride in being involved in such a prestigious community. I joined because I had to, but I stay because I want to and am very passionate about it.

Steve Midway

srm30@psu.edu
Postdoctoral Research Associate, Pennsylvania State University
Cofounder, www.thefisheriesblog.com

How did you get interested in leadership?

My interest stems partly from seeing the great job that so many other AFS members do in leadership roles, in addition to wanting to better understand—and even assist with—the direction the Society takes in the future. Overall, my experience with AFS has been very positive, and I would like that experience to be repeated for new and future members.

What do you see as some of the challenges AFS faces that you, as the newer generation, can help conquer?

Honestly, I'm still learning what AFS sees as its list of priorities. Of course there is always importance in recruiting new members; however, assuming that our core mission is solid, it would be nice to think that our message will always be relevant to prospective members. The other challenge—perhaps the larger one—then becomes how do we improve the value of membership. We're a diverse society in many respects, and I think it will be challenging, but rewarding, to consider how we can continually create value for AFS products—from meetings, to publications, to the science we stand behind.

Give your top three bulleted items from a list of what you hope to accomplish.

As part of the Emerging Leaders program, my current goals are the following:

- Improve my understanding of how AFS prioritizes and makes decisions on the overall society direction.
- Understand what issues AFS may be dealing with 5 or 10 years in the future.
- Be able to contribute whatever insight and experience I have toward any relevant issues.

What do you hope this experience will do for you?

In addition to making decisions on the specific answers above, my overall hope is that I leave with a better understanding of how the Society approaches a variety of decisions. My sense is that there is a lot to learn when it comes to a large organization like AFS, so perhaps my overall expectation is to simply gain exposure and create a foundation from which I can better serve the Society.

Of my friends outside AFS, very few have anything professionally like we have.

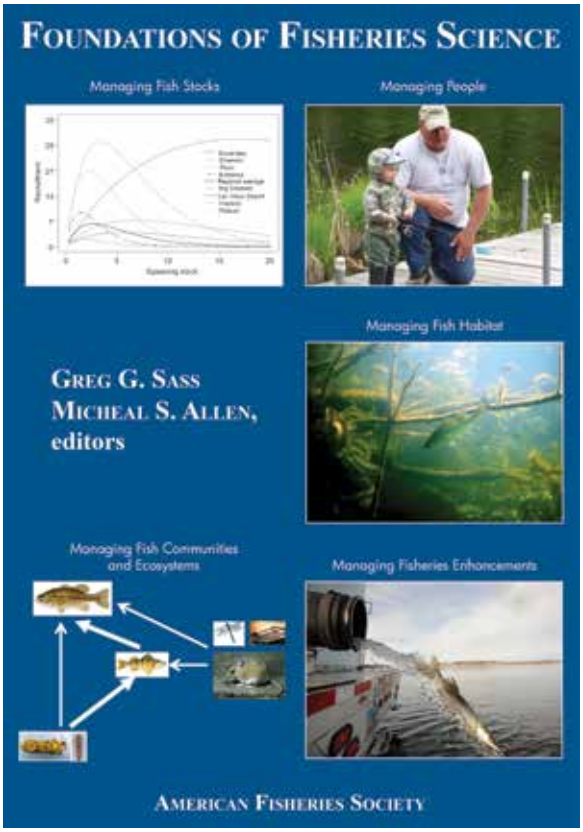
Why did you join AFS and, more importantly, what keeps you here?

At the time, joining AFS was simply what we did as graduate students in a fisheries science program. Shortly thereafter, however, the value as a student was obvious through the potential for travel awards, conference opportunities, and other society products. What's kept me here is partly how I've come to rely on the events, membership, and science that AFS provides. But the people also keep me here—the vast majority of AFS members that I work and otherwise interact with have created a great sense of community and purpose through AFS. Of my friends outside AFS, very few have anything professionally like we have.

Q&A: Book Editors

Foundations of Fisheries Science

Greg G. Sass and Micheal S. Allen



Foundations of Fisheries Science highlights the classic and critical works associated with fisheries management. With input from fisheries professionals and students from around the world, the editors selected 43 full-text articles along with 30 "honorable mention" citations (with associated abstracts) that have helped to mold the discipline of fisheries science. The selected articles were represented by 21 journals, ranging in discipline from fisheries, ecology, human dimensions, and others. In this issue of *Fisheries*, we have interviewed the editors to find out their motivation behind writing this book and more!

Why did you decide to write this book?

Mike invited me down to Florida to give a seminar in Spring 2010. In association with that visit and our mutual passion for fishing, Mike and I were talking while bass fishing when the idea for the book came about. As I recall, we were talking about marine and freshwater fisheries management, single-species versus ecosystem-based fisheries management, and then wondered out loud whether fisheries scientists from various subdisciplines were reading each other's research. I then asked Mike if he thought a foundational book on fisheries science similar to *Foundations of Ecology* would be useful for our field to address some of our discussion points. His answer was a resounding yes, we brainstormed ideas for the book during the rest of my trip, pitched the idea to Aaron Lerner at the AFS meeting in Pittsburgh, and then the production process started. It's been a fun project to work on together and also with our outstanding group of section editors.

Having these five subdisciplines and their associated foundational literature compiled in one place will allow readers to better understand the integration of these themes in fisheries management and the multidisciplinary nature of our field.

Allen and Sass tarpon fishing in Florida during May 2012. "This 100-pound tarpon was the 11th I had hooked in my life and the first that I had actually landed," said Sass. Photo credit: Bryan Matthias.

What will the reader learn from this book?

We feel that the reader will gain a firm grasp of the foundational literature in fisheries science revolving around five important themes in our discipline: (1) Managing Fish Stocks; (2) Managing People; (3) Managing Fish Habitat; (4) Managing Fish Communities and Ecosystems; and (5) Managing Fisheries Enhancements. We feel that having these five subdisciplines and their associated foundational literature compiled in one place will allow readers to better understand the integration of these themes in fisheries management and the multidisciplinary nature of our field. We also cannot stress enough how important our section editor syntheses of the reprinted articles are. Our section editors did a fabulous job in developing their summaries, and we feel that the knowledge gained from those will be really beneficial to students and professionals alike. Lastly, we hope that the reader will use the contents of *Foundations of Fisheries Science* to delve deeper into the literature of the various subdisciplines and appreciate the original authors and concepts provided in the book.

What other fisheries book has inspired you in your career and why?

Although not necessarily a fisheries management book, *Biology & Ecology of Fishes* by Jim Diana was probably the most inspirational to me. I do not have formal collegiate training in fisheries management as many of AFS's students, managers, researchers, and professors have. However, *Biology & Ecology of Fishes* taught me about how fishes interact and behave as individuals, within populations, within communities, and in the aquatic ecosystem as a whole. I used this training in fish ecology and my graduate research as a basis for conducting research on the interface of applied fisheries management and fish ecology, which has fueled my passion and interest in conducting and better understanding ecosystem-based fisheries management.

Mike's most inspirational fisheries book is *Computation and Interpretation of Biological Statistics of Fish Populations* by William Edwin Ricker. This book inspired him because it opened his eyes to quantitative fisheries science and showed lots of examples of how to assess fish stocks and estimate parameters.

Other inspirational books on our list would include *Fisheries Ecology and Management* by Walters and Martell, *Limnology* by Wetzel, and *Quantitative Fisheries Stock Assessment: Choice, Dynamics, and Uncertainty* by Hilborn and Walters.

What needed fisheries book do you feel hasn't been written yet?

We feel that there are several fisheries books that need to be written. As just a few examples, we would like to see a comprehensive book on the use of stocking in fisheries management that includes all aspects of this pervasive fisheries enhancement tool. We also feel that the growing literature relating fish physiology to applied fisheries management could certainly warrant a book. An applied fisheries ecology book using fish examples to highlight key concepts in ecology (e.g., competition, trophic dynamics, habitat use) would be an excellent addition to our discipline. A book addressing voluntary release in fisheries management is also needed in our opinion. Lastly, and highlighted in Robert Arlinghaus' synthesis of the "Managing People" section of *Foundations of Fisheries Science*, we would really like to see a book addressing all aspects of the human dimensions of fisheries management, upon which Robert was only able to touch upon in our book.

What's next on your plate?

Foundations of Fisheries Science was envisioned while Mike and I were fishing together. Thus, we've planned a fishing trip in northern Wisconsin in July 2014. Maybe another book project will result from our fishing trip but, if not, a tarpon or musky will do!

To purchase *Foundations of Fisheries Science*, visit: fisheries.org/shop.

Science and Social Media: How, What, and When to Share

Jeremiah Osborne-Gowey, AFS Social Media Guru
E-mail: jeremiahosbornegowey@gmail.com
Twitter: @JeremiahOsGo

How often do conversations hold your attention when the discussion is wholly one-sided or irrelevant or when the timing interferes with other priorities? Staying engaged in those types of conversations can be difficult. The same holds true for communicating on social media. Regularly engaging in online conversations, sharing content relevant to your audience, and communicating when your audience is most likely to be tuned in will help you develop and sustain a successful online presence.

Keep these three key conversation components in mind when determining how, what, and when to share.

- **Engage.** No one likes one-sided conversations. Once you join an online community, people expect you to engage in the conversation. After all, there are countless conversations going on all the time all over the world about things you care about, maybe even about you or your organization. Why would you not want to engage? You can help direct the conversations (or participants) to meaningful subject material, correct misinformation, or simply watch for appropriate times to weigh in on different topics. We are inherently social animals, and amazing things happen when you make connections with others. Engaging in electronic conversations is a natural extension of the face-to-face conversations most people yearn for.

- **Share relevant content** (and make it easy to reshare). Regardless of whether you or your organization are just getting started or if you have an established social media presence, share information that is relevant to your organization and your audience and that you are passionate about. I share content on a number of different social media sites for a number of organizations but typically share different things on each (e.g., aquatic-related content for the American Fisheries Society, beer-related for the homebrew association; longer posts on blogs, shorter posts [or links] on Twitter, moderate length posts on Facebook and Google+). Did an interesting new research paper just get published? Did you read a great blog post? Is your organization hiring? Did some relevant news just break? Is there something about your organization's business culture you think would resonate with others (can you personalize your organization)? Is there a trick you use that you find particularly helpful? These just scratch the surface but are all good ideas to share with your target audience. When you do post, don't forget to make your posts easy for others to share.

- **Post regularly. Post during peak times.** As with any relationship, online communications need to be regularly tended. Like gardening, you'll need to prepare the soil, pull weeds, plant seeds, water, and generally tend to them. Without doing so, the sprouting conversations get choked out by the other electronic chatter/clutter (the weeds) and wither and die. Your audience is eager to hear from you—and not just once a month. Post and repost items regularly. As a general rule of thumb, I try to engage (i.e., post and/or respond to something) *at least* once a day; ideally I try to post or respond to several items a day. Accounts that are posted to irregularly or infrequently will not garner an audience.

  To get the most eyeballs on or click-throughs from your posts, be aware that the timing of *when* you post is also important and varies by social media platform. FastCompany ran an article (http://ow.ly/wsoKd) about post timing on various social media platforms. You might also find this infographic useful (http://ow.ly/wsoZR). Regardless, being purposeful in when you post will help your messages reach more people. Research indicates that it's better to post just before or after the top of the hour when people are going to or getting out of meetings, around lunchtime, and near or just after the typical close of business. Keeping these points in mind is important for maximizing the reach of your message.

In a nutshell. Regardless of what you post on your social media channels, content that gains the most traction includes things that (a) are valuable, unique, or interesting; (b) are easily reviewed and understood; (c) contain interesting pictures, graphics, or links; (d) are easy to reshare with others; and/or (e) are connected with current events or memes. Engage your audience, share awesome content, and do so regularly. Your audience will thank you.

Drones—A Fisheries Assessment Tool?

Jeff Kopaska

Iowa Department of Natural Resources, 1436 255th St., Boone, Iowa 50036.
E-mail: Jeff.Kopaska@dnr.iowa.gov

Jeff Kopaska

Drones—perhaps you've seen what the fuss is all about. The topic has surfaced in popular culture, science and technology circles, and even on the pages of *Field & Stream*. In December, there were news articles about Amazon testing product delivery using drones (Unmanned Aerial System/Vehicle). January was more interesting, when Lakemaid Beer (which I very much enjoy) launched a YouTube campaign touting beer deliveries to ice anglers. Having experienced a beer shortage while ice fishing, I thought an excellent solution was at hand—until the Federal Aviation Administration stepped in and grounded the flights.

Hunters and anglers have started to use the technology in ways, perhaps, more sinister than beer delivery. The *Field & Stream* article by Michael R. Shea (2014) told of some Louisiana hunters who outfitted a drone with a thermal imaging camera and were soon targeting feral hogs with radio communications and night vision equipped AR-15s. On the fisheries side, they have been used to target Redfish and Speckled Trout on coastal flats. The ethical dilemma of fair chase is certainly in question here but, then again, how different is this technology from side-scanning and down-scanning sonar that can tell you which tree the crappies are stacked on?

The public has weighed in against the use of these devices. The Pew Research Center (2014) asked Americans about drone use, and 63% indicated that uninhibited personal and commercial drone use would represent a change for the worse. Politicians tend to follow public sentiment; thus, increased awareness of drones has resulted in numerous bills being introduced in various state legislatures seeking to limit their use. Between the 2013 and 2014 state legislative sessions, over 40 states introduced bills addressing drones. Federal regulations are already in place, with more under review. Most of the hubbub is about civil liberties, law enforcement, and the need for search warrants. So what does this have to do with fisheries science and management?

Many state and federal fish and wildlife agencies include a law enforcement arm. Some proposed legislation is loosely written and severely limits the use of drones by "law enforcement agencies." Passage of such a law could take away a new fisheries assessment and management tool before it can even be used.

Fisheries assessment and management tool? Yes, definitely. Natural resource agencies in both Texas and Nebraska have used fixed-wing drones to conduct in-channel habitat mapping during low water in the Guadalupe (Texas) and Niobrara (Nebraska) Rivers. Texas has also used this technology to locate isolated pools on the Blanco River during low flow conditions. They used the information to dispatch teams to remove nonnative Smallmouth Bass via electrofishing and seining, contributing toward efforts to repatriate Guadalupe Bass, the native form that had been extirpated from the system following the introduction and concomitant hybridization with Smallmouth Bass (Birdsong 2012).

A drone that can see through clear coastal water for Redfish and Speckled Trout can similarly see through clear lake water to delineate vegetation beds. Though habitat mapping is a great benefit, so is the near-real-time data. This could allow a manager to quickly assess vegetation growth and extent and outline a timely and accurate vegetation treatment plan.

In the fall of 2013, the University of Nebraska–Lincoln and the University of California–Berkeley were jointly awarded a nearly $1 million grant from the U.S. Department of Agriculture for developing drones that can take water quality samples from lakes, rivers, and streams (Abourezk 2013). The project is still in the developmental stage, but the helicopter-type drones can already be deployed to collect small volume water samples from remote areas and return the samples to people on the ground. Though questions of surface mixing and water-carrying ability remain, this is just an extension of manned helicopter water sampling that has occurred for decades.

At the 2014 Midwest Fish and Wildlife Conference, Tony Sindt reported on the 2012 Ohio River Angler Survey conducted by the states of Ohio, Kentucky, and West Virginia. The assessment team combined angler surveys with aerial pressure counts to complete the survey. I couldn't help but wonder whether this type of study might not be a great application for drones. Drones that can perform high-resolution videography could certainly provide the images to count boats and anglers. Or, as with drones that can pick out the thermal signature of a feral hog in a field, they can probably be used to pick out the thermal signature of an angler along a streambank or lake shore. Is it safer and less expensive for staff to be in the airplane or on the ground? The answer is potentially different for different agencies and situations, but it is important to at least ask the question. Let's hope that as technology progresses and laws are enacted, we are at least able to ask the question before the tool are taken away.

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Norman G. Sharber
1925–2013

Norman G. Sharber, 88, died at his home in Flagstaff, Arizona, on 28 October 2013. After graduating high school, Sharber enlisted in the Navy and served as a radio technician in the Pacific Theatre during 1943–1945. Following naval service, he married his childhood friend, Rayma Babbit, and thereafter they resided in the home they built on Havasupai Road in Flagstaff. Sharber successfully ran an oil distributorship, Arizona Trails, Inc., that operated throughout northern and eastern Arizona. He was active in his community and served on the Arizona Board of Regents for nine years.

With his background in electricity and electronics, Sharber was an entrepreneur and inventor. He became interested in electrofishing when approached by researchers at the Museum of Northern Arizona in 1977 to review their sampling methods for endangered fishes. With colleague Steven Carothers, he designed and built a unique fish-holding tank for electrofishing boats. Employing the Faraday principle, the metal-screen tank could be submersed from a boat into an electric field, protecting fish from electroshock while allowing them to recover in their ambient environment. To pursue his interest in electrofishing, Sharber purchased Coffelt Electronics in 1987 and moved the business from Denver to Flagstaff in 1990.

His largest impact on fisheries science was a 1988 AFS paper, with Carothers as coauthor, revealing that about half the large Rainbow Trout caught by pulsed DC electrofishing in the Colorado River had spinal injuries. Documentation of this problem was first published by the American Fisheries Society in 1949 but was largely ignored. The 1988 paper caused quite a stir because the culture of our profession had expanded its emphasis on exploitation to include conservation. At a conference in 1988, he told me of his surprise at the response to the paper; it had examined the effect of pulse shape on injury rate, but readers focused on the fact that all pulse shapes caused significant damage. As a result, many studies were undertaken in the 1990s to clarify the role of electrofishing in fish welfare. The Sharber-Carothers paper was a landmark in creating a need for balance between the methods and ethics of electrofishing.

Sharber did not stop at just documenting the fish injury problem. In 1994, he authored (with four coauthors) an AFS paper demonstrating the importance of lower pulse frequency (30 Hz or less) as a means to reduce spinal injury in Rainbow Trout (and other salmonids). He also demonstrated the value of dual-frequency pulsed DC (termed complex pulse pattern in the paper) in reducing spinal injury. In 1999, Sharber, with coauthor and daughter Jane Sharber Black, published a final paper proposing that electrofishing is a form of induced epilepsy. His hypothesis, supported by other research, maintained that electroshock affected fishes' central nervous systems, in contrast to the existing local-action theory that only the nerves and muscles of the peripheral nervous system respond to the stimuli. His theory of induced epilepsy was important and deserves further study.

Sharber's natural curiosity and innate understanding of the research method demonstrated that formal training is not always a prerequisite to making valuable contributions to science in general and fisheries in particular. He and I did not always agree on electrofishing theory, and this resulted in some good debates. Nevertheless, we remained friends and colleagues always. I will miss him.

Jim Reynolds, Professor Emeritus
University of Alaska Fairbanks,
Spring Creek, Nevada

Global Conference on Inland Fisheries: Theme 3—Drivers and Synergies

The global conference "Freshwater, Fish, and the Future" convening in Rome in January 2015 includes four main themes. The **Biological Assessment** theme will explore and develop new approaches to assess the production and status of inland fish stocks and their fisheries. The **Economic and Social Assessment** theme will explore and develop new approaches to provide monetary and nonmonetary value to fisheries, including their importance to human health, personal well-being, and societal prosperity. The **Drivers and Synergies** theme will identify synergies between the services that can be made to increase societal gain while maintaining ecological integrity and allowing for the protection of aquatic biodiversity and fisheries production. Finally, the **Policy and Governance** theme will develop methods to assure that governance decisions take into account the contribution inland fisheries make to food security, human well-being, and ecosystem productivity. Each theme will conclude with a **Future of Fisheries** discussion forecasting various scenarios, along with recommendations for achieving the conference vision of a sustainable fisheries future.

Photo credit: Chuck Moravec.

THEME 3: DRIVERS AND SYNERGIES

The Drivers and Synergies theme panel chair is Anthony Cox from the Organisation for Economic Cooperation and Development in Paris. Doug Beard and Abby Lynch of the U.S. Geological Survey are acting as panel facilitators.

What are the drivers and synergies with other resource sectors? Inland fisheries are one of many ecosystems services provided by freshwater systems. Many sectors outside of fisheries, such as power generation, transportation, agriculture, industrial/human water use, tourism, and recreation, influence management and allocation decisions for freshwater systems and also affect the quality and magnitude of fish production. Management of sustainable freshwater systems requires making informed choices emphasizing those services that will provide sustainable benefits for humans while maintaining well-functioning ecological systems. The goal of this theme is to explore the drivers influencing inland ecosystems and their impact on the services provided by freshwater systems. This theme will identify conflicts between the services that can be addressed to increase societal gain, such as food production and poverty alleviation while maintaining ecological integrity and allowing for the protection of aquatic biodiversity. If synergies in freshwater systems are accounted for, development of aquatic habitat rehabilitation and protection programs, environmental flow regimes, or other management approaches can allow more sustainable production of ecosystem services across multiple sectors. These more ecologically and socially sustainable approaches, ultimately, will improve the health, well-being, and prosperity of fisheries-dependent communities.

CALL FOR PAPERS—ABSTRACT SUBMITTAL NOW OPEN

Abstract submission is now open for the Global Inland Fisheries Conference. Please see the guidelines and instructions at **www.inlandfisheries.org**. All abstracts are due by 10 August 2014. Some travel support for young professionals and presenters from developing countries may be available; see the website for more information and updates.

Keep up with all of the conference news on Facebook (www.facebook.com/inlandfisheries), LinkedIn (www.linkedin.com/groups/Global-Inland-Fisheries-Conference-7402542), and Twitter (@inlandfisheries).

Save the Date

National Workshop on Large Landscape Conservation

October 23-24, 2014

Ronald Reagan Building and International Trade Center, Washington, D.C.

Featuring keynote addresses by:
Secretary of the Interior Sally Jewell (invited)
Secretary of Agriculture Tom Vilsack (invited)

Conservation innovation is woven through our nation's heritage. It is today and will be for decades and centuries to come an essential element of our future. Large landscape conservation is a fresh approach to the conservation challenges of the 21st century, linking public, private, nonprofit, and academic resources in novel, strategic, and enduring ways.

Join conservation practitioners and policy makers from across North America at this two-day event to share ideas on the challenges and opportunities that lie ahead in implementing large landscape conservation, as well as the most effective tools, strategies, and science available today to inform large landscape initiatives.

Program details will be available soon on the National Workshop's website. In the meantime, be sure to mark your calendar for this important event!

Organizing Partners

• American Fisheries Society • American Ornithologists' Union • Amigos de Los Rios • Chesapeake Conservancy • Chicago Wilderness • Heart of the Rockies • Landscape Conservation Cooperatives • Lincoln Institute of Land Policy • Living Landscape Observer • Metropolitan Greenspaces Alliance • Practitioners' Network for Large Landscape Conservation • U.S. Department of Agriculture—Natural Resources Conservation Service • U.S. Department of Agriculture—Forest Service • U.S. Department of the Interior—Bureau of Land Management • U.S. Department of the Interior—Fish & Wildlife Service • U.S. Department of the Interior—National Park Service • U.S. Department of the Interior—U.S. Geological Survey

Schedule at a Glance

Friday, August 15			
Time	***Event***	***Location***	***Room***
8:00 AM–12:00 PM	AFS Officers' Meeting (Invitation Only)	Hilton Québec	1916
1:00 PM–5:00 PM	AFS Management Committee Meeting	Hilton Québec	Montmorency
Saturday, August 16			
Time	***Event***	***Location***	***Room***
8:00 AM–5:00 PM	AFS Governing Board Retreat	Hilton Québec	Beauport
8:00 AM–5:00 PM	AFS 2014 Command Post	Convention Centre	201C
10:00 AM–5:00 PM	Annual Exec. Business Meeting of AIFRB	Convention Centre	201B
11:00 AM–12:00 PM	AFS 2014 Operations Team Briefing	Convention Centre	201C
12:00 PM–6:00 PM	Registration	Convention Centre	Principal Hall**
5:00 PM–7:00 PM	AFS Governing Board Reception (Governing Board Members only)	Hilton Québec	1916
Continuing Education			
8:00 AM–5:00 PM	Beginning/Intermediate GIS for Fisheries Biologists	TBA	TBA
8:00 AM–5:00 PM	Introduction to Instream Habitat Modeling Using Meso HABSIM	Hilton Québec and off-site TBA	Plaines
8:00 AM–5:00 PM	River Morphology & Restoration	Hilton Québec	De Tourny
Sunday, August 17			
Time	***Event***	***Location***	***Room***
7:00 AM–8:00 AM	AFS 2014 Operations Team Briefing	Convention Centre	201C
8:00 AM–6:00 PM	AFS 2014 Command Post	Convention Centre	201C
8:00 AM–7:00 PM	Information Booth	Convention Centre	Principal Hall**
8:00 AM–7:00 PM	Registration	Convention Centre	Principal Hall**
8:00 AM–2:00 PM	Annual Exec. Business Meeting of AIFRB	Convention Centre	201B
12:00 PM–2:30 PM	AFS Journal Editors & *Fisheries* Magazine Luncheon	Hilton Québec	St-Louis
1:00 PM–5:00 PM	AFS Time & Place Committee Meeting	Hilton Québec	Salon Hilton
2:00 PM–6:00 PM	Trade Show Exhibitor Move-in	Convention Centre	Exhibit Hall
2:00 PM–8:00 PM	AV Loading	Convention Centre	201A
3:00 PM–5:00 PM	Poster set-up	Convention Centre	Exhibit Hall
6:00 PM–6:15 PM	Society Officers meeting with Québec Officials (Invitation Only)	Convention Centre	TBD
AFS Section and Chapter Meetings			
1:00 PM–2:45 PM	Fisheries Administration Section Meeting	Convention Centre	306A
2:45 PM–3:15 PM	Fisheries Admin. & Management Sections Joint Meeting	Convention Centre	306A
3:15 PM–5:00 PM	Fisheries Management Section Meeting	Convention Centre	306A
3:00 PM–4:00 PM	Mid Canada Chapter Meeting	Convention Centre	2105
3:00 PM–4:00 PM	Ontario Chapter Meeting	Convention Centre	2104B
4:00 PM–5:30 PM	Canadian Aquatic Resources Section Meeting	Convention Centre	201B
4:00 PM–5:30 PM	Fish Habitat Section Meeting	Convention Centre	2101

Time	*Event*	*Location*	*Room*
4:00 PM–6:00 PM	Estuaries & Marine Fisheries Sections Joint Meeting	Convention Centre	2104B
5:00 PM–6:30 PM	Water Quality Section Meeting	Convention Centre	2104A
5:00 PM–7:00 PM	Education Section Meeting	Convention Centre	2105
Continuing Education			
8:00 AM–12:00 PM	Leadership at All Levels in AFS	Hilton Québec	Beauport
8:00 AM–5:00 PM	Advanced GIS for Fisheries Biologists	TBA	TBA
8:00 AM–5:00 PM	Mapping Aquatic Habitat of Inland Freshwater Systems Using Side-scan Sonar	Hilton Québec	Dufferin
8:00 AM–5:00 PM	Introduction to Programming in R for Fisheries Scientists	Hilton Québec	Plaines
8:00 AM–12:00 PM	Introduction to Instream Habitat Modeling Using MesoHABSIM	Hilton Québec lobby off-site location TBA	Meet at Hilton Lobby
8:00 AM–12:00 PM	River Morphology & Restoration	Hilton Québec	De Tourny
1:00 PM–5:00 PM	New Media for Fisheries Science	Hilton Québec	Beauport
AFS Technology Workshop			
Date and time TBA	VEMCO Acoustic Telemetry Technology	Hilton Québec	TBA
Networking Events			
Pubs, Opening Hours	Pub Crawl	Old Québec	See Pub Crawl Passport
6:15 PM–8:00 PM	Welcome to Québec Networking Event	Convention Centre	Principal Hall**
Monday, August 18			
Time	*Event*	*Location*	*Room*
7:00 AM–8:00 AM	AFS 2014 Operations Team Briefing	Convention Centre	201C
7:00 AM–6:00 PM	AFS 2014 Command Post	Convention Centre	201C
7:00 AM–8:00 AM	Plenary Speakers Breakfast	Hilton Québec	Lauzon
7:00 AM–6:00 PM	AV Loading	Convention Centre	201A
7:30 AM–6:00 PM	Registration	Convention Centre	Principal Hall**
7:30 AM–6:00 PM	Information Booth	Convention Centre	Principal Hall**
8:20 AM–12:00 PM	Plenary Session	Convention Centre	200ABC
9:00 AM–11:00 AM	Trade Show Exhibitor Move-in	Convention Centre	Exhibit Hall
9:00 AM–11:00 AM	Poster Set-up	Convention Centre	Exhibit Hall
10:15 AM–10:45 AM	Break	Convention Centre	Principal Hall**
11:30 AM–8:30 PM	Trade Show Open	Convention Centre	Exhibit Hall
12:30 PM–2:30 PM	Plenary Speakers & Awards Luncheon	Hilton Québec	Lauzon
1:30 PM–5:20 PM	Symposia and Contributed Papers	Convention Centre	*
3:10 PM–3:40 PM	Break	Convention Centre	Exhibit Hall
3:30 PM–5:30 PM	AFS Journal Editorial Board Meeting	Hilton Québec	Courville
4:00 PM–5:00 PM	AFS Hutton Oversight Committee Meeting	Hilton Québec	Salon Hilton
AFS Section and Chapter Meetings			
2:00 PM–2:45 PM	Equal Opportunities Section Meeting	Convention Centre	201B
2:00 PM–4:00 PM	Fisheries Information & Technology Section Meeting	Convention Centre	302A
4:00 PM–5:00 PM	AIC Business Meeting	Convention Centre	302A
5:00 PM–6:00 PM	Northeast Division Business Meeting	Convention Centre	302A
5:30 PM–6:30 PM	Socioeconomics Section Meeting	Convention Centre	2104A
5:30 PM–6:30 PM	Genetics Section Meeting	Convention Centre	2104B
5:30 PM–6:30 PM	Fish Culture Section Meeting	Convention Centre	304A
Networking Events			
Pubs, Opening Hours	Pub Crawl	Old Québec	See Pub Crawl Passport
6:15 PM–8:30 PM	Trade show & Poster Networking Event	Convention Centre	Exhibit Hall

Tuesday, August 19			
Time	*Event*	*Location*	*Room*
7:00 AM–8:00 AM	AFS 2014 Operations Team Briefing	Convention Centre	201C
7:00 AM–6:00 PM	AFS 2014 Command Post	Convention Centre	201C
7:00 AM–6:00 PM	AV Loading	Convention Centre	201A
7:30 AM–5:00 PM	Registration	Convention Centre	Principal Hall**
7:30 AM–6:00 PM	Information Booth	Convention Centre	Principal Hall**
8:20 AM–12:10 PM	Symposia and Contributed Papers	Convention Centre	*
9:00 AM–6:00 PM	Trade Show Open	Convention Centre	Exhibit Hall
10:00 AM–10:30 AM	Break	Convention Centre	Exhibit Hall
12:00 PM–2:00 PM	AFS Past President's Luncheon	Hilton Québec	Courville/Montmorency
12:00 PM–3:00 PM	Best Student Paper & Poster Judge's Luncheon	Convention Centre	201B
1:30 PM–5:20 PM	Symposia and Contributed Papers	Convention Centre	*
2:30 PM–3:30 PM	Book Editorial Advisory Board	Hilton Québec	Lauzon
3:10 PM–3:40 PM	Break	Convention Centre	Exhibit Hall
4:00 PM–5:30 PM	World Fisheries Congress Planning Meeting	Hilton Québec	1916
AFS Section and Chapter Meetings			
9:00 AM–11:00 AM	Fisheries Information & Technology Section	Convention Centre	2104B
2:00 PM–3:00 PM	Student Subsection of the Education Section Meeting	Convention Centre	2103
5:30 PM–6:30 PM	International Fisheries Section Meeting	Convention Centre	2103
5:30 PM–6:30 PM	Bioengineering Section Meeting	Convention Centre	2104A
Student Events			
3:40 PM–5:40 PM	Student Career Fair	Convention Centre	Exhibit Hall
3:40 PM–5:40 PM	Student Speed Mentoring	Convention Centre	Exhibit Hall
6:30 PM–10:00 PM	Student Networking Event (Students Only)	La Ninkasi du Faubourg	–
Networking Events			
Pubs, Opening Hours	Pub Crawl	Old Québec	See Pub Crawl Passport
Wednesday, August 20			
Time	*Event*	*Location*	*Room*
7:00 AM–9:00 AM	Spawning run	Battlefield Park	–
7:00 AM–8:00 AM	AFS 2014 Operations Team Briefing	Convention Centre	201C
7:00 AM–6:00 PM	AV Loading	Convention Centre	201A
7:00 AM–6:00 PM	AFS 2014 Command Post	Convention Centre	201C
7:30 AM–5:00 PM	Registration	Convention Centre	Principal Hall**
8:00 AM–6:00 PM	Information Booth	Convention Centre	Principal Hall**
8:20 AM–12:10 PM	Symposia and Contributed Papers	Convention Centre	*
9:00 AM–2:00 PM	Trade Show Open	Convention Centre	Exhibit Hall
10:00 AM–10:30 AM	Break	Convention Centre	Exhibit Hall
12:00 PM–1:30 PM	AFS Award Recipients Luncheon	Hilton Québec	Courville/Montmorency
1:30 PM–3:10 PM	Symposia and Contributed Papers	Convention Centre	*
3:10 PM–3:40 PM	Break	Convention Centre	Principal Hall**
1:30 PM–3:30 PM	Private Meeting: Multistate Research Team NC1198	Convention Centre	201B
2:00 PM–4:00 PM	Poster Takedown	Convention Centre	Exhibit Hall
2:00 PM–5:00 PM	Exhibit Dismantle	Convention Centre	Exhibit Hall
3:40 PM–6:00 PM	AFS Business Meeting	Convention Centre	200C
Networking Events			
Pubs, Opening Hours	Pub Crawl	Old Québec	See Pub Crawl Passport
6:30 PM–10:00 PM	Grand Networking Event	Cruise Terminal Québec	Espaces Dalhousie
7:00 PM–10:00 PM	Pub Crawl Mysterious Fish Hunting	Old Québec	See Pub Crawl Passport

Thursday, August 21			
Time	*Event*	*Location*	*Room*
7:00 AM–8:00 AM	AFS 2014 Operations Team Briefing	Convention Centre	201C
7:00 AM–6:00 PM	AFS 2014 Command Post	Convention Centre	201C
7:00 AM–6:00 PM	AV Loading	Convention Centre	201A
7:00 AM–8:30 AM	AFS Incoming Governing Board Breakfast	Hilton Québec	Courville
7:30 AM–12:00 PM	Registration	Convention Centre	Principal Hall**
8:00 AM–12:00 PM	Information Booth	Convention Centre	Principal Hall**
8:20 AM–12:10 PM	Symposia and Contributed Papers	Convention Centre	*
10:00 AM–10:30 AM	Break	Convention Centre	Principal Hall**
12:00 PM–2:00 PM	Quebec City-Portland Handoff Luncheon	TBA	TBA
1:30 PM–5:20 PM	Symposia and Contributed Papers	Convention Centre	*
3:10 PM–3:40 PM	Break	Convention Centre	Principal Hall**
Networking Events			
Pubs, Opening Hours	Pub Crawl	Old Québec	See Pub Crawl Passport
10:00 AM–10:30 AM	Pub Crawl Raffle	Convention Centre	Exhibit Hall

* 200A, 200B, 202, 203, 204A, 204B, 205A, 205B, 205C, 206A, 206B, 207, 2101, 2103, 2104A, 2104B, 2105, 301A, 301B, 302A, 302B, 303A, 303B, 304A, 304B, 306A, 306B

** Please take note that the Principal Hall is on the fourth floor (principal floor of the Convention Centre)

Thank You to Our Generous Sponsors!

Fundraising is one of the biggest challenges in preparing for the 2014 Annual Meeting. The AFS 2014 Committee is grateful to the following companies, agencies, and university that so far have partnered with us to host this wonderful meeting. This meeting will be a great success because of them and other sponsors to come!

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Plenary Speakers' Abstracts for the 144th Annual Meeting

The Essential Contribution of Basic Science Towards Improved Fishery Management

Louis Bernatchez, Université Laval, Québec City

Economical and budgetary concerns are increasingly pushing government research funding toward utilitarian research with expected quick return for the industry at the expense of basic science. Investing in utilitarian research has obvious merits, yet this creates situations where science funding decisions are increasingly at risk of becoming politicized or where government policies are being established without considering the importance of basic scientific knowledge. This short-term view also assumes that innovation arises in a logical fashion from planned research. Yet, history teaches us that innovations in basic science that fuel utilitarian research often arise from unplanned sources. This means that the probability of scientific innovations follow a heavy-tail distribution, so as to allow consequential discoveries to occur once in awhile and unpredictably. Focusing only on directed utilitarian research simply will miss these heavy-tailed rewards. To get the most out of public money, it is thus crucial to maintain national funding strategies that will ensure an optimal balance between long-term basic research vs. short-term utilitarian research. I will discuss and illustrate from empirical work how this view applies to the conservation of aquatic biodiversity as well as improved fishery management.

Patterns in Riverine Fish Diversity: A Macroecological Perspective

Thierry Oberdorff, Muséum national d'Histoire naturelle, Paris

Here I develop a conceptual framework that views contemporary riverine fish diversity as a product of a series of filters operating at different spatial and temporal scales and combining different processes, the heart of which is the drainage basin. The approach aids breaking diversity patterns into structures and processes that are specific to each scale, thereby more easily generating hypotheses concerning links between the observed structures and the processes involved. This framework should help us answer questions such as: What should be done to slow the spread of non-native species, and what will be the effects of global changes on maintaining aquatic biodiversity?

Leveraging Local Experience to Improve Sustainability of Global Fisheries: It Is Not about Tools but Processes

Ana Parma, Centro Nacional Patagonico, Puerto Madryn, Chubut, Argentina

The quest for management approaches to achieve sustainable fisheries has often led to prescriptions of technical fixes and tools for assessment, harvest control, and regulation of access privileges, without due regard to local context and relevant socio-ecological fishery attributes. Strengthened legal mandates introduced to curb overfishing in several regions, while successful on many accounts, have also forced specific management approaches, restricting the range of acceptable options. It is increasingly recognized, however, that the efficacy of different approaches varies with the fishery, and that the success of any generic tool, no matter how adequate in principle, depends on the details of its implementation, and on the existence of enabling institutions and effective governance. The diversity of possible approaches can be illustrated by small-scale coastal fisheries, where the spatial dimension of both resources and fishing communities opens up a diverse spectrum of possibilities for harvesting strategies and regulating access. Experience with a collection of cases illustrates that local successes cannot be scaled up simply by replication. Whereas lessons still emerge to leverage local results, they emphasize process and involvement of stakeholders in the identification of solutions rather than the specific tools applied in each case.

Systemic Distortion

David Bella, Oregon State University, Corvallis

I have been asked to succinctly convey some lessons involving two related problems not well addressed in your educations. First, distortion of information emerges on vast scales. Second, reductionism—reducing the character of wholes to the character of their parts—misperceives such distortions. Together, these two failures combine to produce the proliferation of blame that dumbs down our minds, polarizes our discourse, and allows systemic problems to continue. Of course there are "bad people," but that is not the issue that concerns me. The real issue is this: Systemic distortions are emergent outcomes, properties of wholes (organizational systems) that cannot be merely reduced to the properties of parts (people, individuals). Systemic distortions emerge through the behaviors of competent and well-intended people (like you and me), busy at countless tasks within the contexts of organizational systems. I will show how this occurs with a simple sketch. And I will discuss some radical implications of this view.

A. E. Wood State Fish Hatchery, San Marcos, Texas

What is the name of your facility, how did it get that name, and how long has it been in operation?

A. E. Wood State Fish Hatchery is located in central Texas along the banks of the San Marcos River, in San Marcos, Texas. The A. E. Wood State Fish Hatchery was originally built in 1949. It was named for A. E. Wood, who served on the Texas Game and Oyster Commission, a forerunner of the Texas Parks and Wildlife Department. The hatchery was a mainstay of warmwater fish production for Texas until 1984, when it was closed for renovation. After 4 years and $14 million, primarily from Federal Aid in Sport Fish Restoration, Texas Parks and Wildlife Department reopened one of the most modern fish hatcheries in the United States.

What fish do you raise and approximately how many?

The hatchery is responsible for raising millions of fish each year for stocking into the public waters of Texas. Species raised include Largemouth Bass (about 85,000 fingerlings per year), Florida strain Largemouth Bass (about 4 million fingerlings per year), Guadalupe Bass (about 175,000 fingerlings per year), Striped Bass and Hybrid Striped Bass (about 6 million fry per year), Channel Catfish (about 1 million fingerlings and 90,000 catchable fish per year), and Bluegill (about 75,000 per year). A. E. Wood also participates in a state-wide winter (December–February) Rainbow Trout stocking program where commercially farmed Rainbow Trout are purchased and redistributed to over 40 sites around the state. Koi are spawned, and fry (about 35 million per year) are distributed to the other Texas Parks & Wildlife Department Inland Fisheries hatcheries where they are grown to fingerling size to be used as forage to support captive brood fish populations.

How big is your facility?

The facility encompasses about 120 acres, including riparian lands along the river. There are 50 culture ponds, a 9.5-acre storage reservoir, a zooplankton culture pond, two wastewater retention ponds, two solids settling ponds, and a water treatment plant. In the Robert J. Kemp Jr. Fisheries Center building (33,000-ft^2 facility), there are 8 culture raceways and 22 shipping and holding troughs. The incubation room houses two McDonald jar racks, one holding 128 jars, the other 54 jars. There are 18 feed-training troughs and 16 circular tanks. The building also houses a complete laboratory capable of water quality testing, genetic identification, fish disease diagnosis and treatment, and law enforcement forensic analysis. Water for the facility is obtained from the spring-fed San Marcos River.

An A.E. Wood employee uses a feather to carefully mix Striped Bass milt and eggs. Photo credit: Rob Schmid, Texas Parks and Wildlife Department.

What is the biggest challenge facing your facility today? What challenges do you foresee in the future?

Current challenges include limited budgets and potential future budget cuts. These situations make planning and executing long-range production goals difficult. Another current critical challenge for Texas is the ongoing drought. Much of our state is suffering a prolonged drought with little relief in sight. If weather patterns and water use patterns change and water becomes more limiting in Texas, we will be forced to develop new culture methods and create new management plans that conserve and stretch natural resources.

Any recent successes or news you can share?

Developing successful, production-level spawning and larval rearing techniques for Guadalupe Bass (the Texas state fish) is an achievement we're proud of. A. E. Wood and the Texas Department of Transportation have set up a cooperative project to use the A. E. Wood State Fish Hatchery as a refuge to hold freshwater mussel species of concern during a bridge construction project.

In one sentence, why is fish culture important?

Part of the mission of A. E. Wood and the Inland Fisheries Division is to provide the best possible angling for present and future generations of Texans while protecting and enhancing freshwater aquatic resources.

How can people reach you?

E-mail: Rob.schmid@tpwd.state.tx.us

Website: www.tpwd.state.tx.us

We thank Rob Schmid at A. E. Wood State Fish Hatchery for answering our questions and providing photos. To see the complete "Better Know a Hatchery" on A. E. Wood as well as other featured facilities, visit the Fish Culture Section website at fishculturesection.org and click on the "Better Know a Hatchery" tab. You can also visit the Fish Culture Section on Facebook to see more photos from this and other facilities.

A bank of hatching jars containing Striped Bass eggs. Photo credit: Rob Schmid, Texas Parks and Wildlife Department.

Juvenile Guadalupe Bass raised at A.E. Wood. Photo credit: Rob Schmid, Texas Parks and Wildlife Department.

Scaling Up Conservation

Doug Austen, AFS Executive Director

AFS Executive Director Doug Austen can be contacted at: dausten@fisheries.org

It has seemed intuitive for quite some time to view fisheries conservation and management from a scale larger than a stream reach, individual lake, or single marine habitat. Scientists and managers have recognized the obvious linear nature of streams as corridors for the movement of animals, materials, and energy. Similarly, they have embraced watersheds at a variety of levels for decades as the stage upon which the character of a water body is defined. From a management context, this is reflected in the structural organization of some agencies, using watersheds as opposed to counties or some other geopolitical map to define management boundaries. We also have basin commissions (e.g., the Susquehanna River Basin Commission) and large-scale restoration efforts delineated by watershed boundaries (e.g., the Chesapeake Bay Program). Larger scales similarly have been embraced in the management of other taxa such as flyways for waterfowl, range-wide management for species such as the southern longleaf pine, and large landscape needs for species such as grizzly bear and wolf. With the added impacts of climate change and other ecological stresses that operate on large scales, this perspective on conservation is increasingly important. In fact, this will be the focus of an innovative national workshop on large landscape conservation set for 23–24 October 2014 in Washington, D.C. (www.largelandscapenetwork.org/2014-national-workshop/).

AFS is an organizing sponsor of this event, and it only makes sense that fisheries science and aquatic conservation are key components of any discussion of landscape conservation. Not only can we contribute substantively to the discussion but we can benefit from the work of others and develop new and necessary collaborative approaches. AFS is also a science leader in these discussions. In addition to numerous articles in our journals, AFS has published key books that have helped to advance the watershed and ecosystem approach. For example, Williams et al. (1997) compiled key approaches to developing and implementing a watershed approach and Hughes et al. (2006) defined landscapes as key impact factors on stream quality and fish biodiversity.

This national workshop is, in itself, somewhat unique in the variety of partners that have gathered to design, construct, and implement the event. For example, AFS is partnering with the Chesapeake Conservancy (chesapeakeconservancy.org) to help manage the finances, arrangements, and event design. The Landscape Conservation Cooperatives (lccnetwork.org) are working with members from the Harvard Forest (harvardforest.fas.harvard.edu), American Ornithological Union (www.aou.org), Chicago Wilderness (www.chicagowilderness.org), and many other partners, including AFS, to develop programs and sessions. The Lincoln Institute of Land Policy (www.lincolninst.edu) has led an effort to identify keynote speakers and other panelists, who will likely include Agriculture Secretary Tom Vilsack and Interior Secretary Sally Jewell. It is important to note that many federal agencies are also actively involved in event development and sponsorship, including the U.S. Forest Service, Natural Resources Conservation Service, Bureau of Land Management, National Park Service, and the U.S. Fish and Wildlife Service.

Though this national workshop will have a broad range of topics addressed, a few key questions will receive particular attention and be the focus of discussion panels and keynote presentations:

- How can **"mitigation at the landscape scale"** foster land conservation and economic development?
- How can we effectively **invest for measurable results and environmental resiliency** in the context of climate change?
- How can we, **across the continuum from urban areas to wilderness areas**, engage diverse communities in the green spaces outside their doors?
- How can we **leverage advanced technologies and innovative financing tools** to dramatically advance the practice of large landscape conservation?

We will focus on knowledge building and sharing of specific practices, tools, policies, and capacities that facilitate the startup, management, and assessment of successful large landscape conservation efforts. Through a series of plenary sessions, smaller symposia and workshops, as well as carefully constructed and facilitated dialogues on key topics, participants will experience the full breadth of large landscape programs, science, governance structures, performance measures, and education and outreach and get a better sense of the challenges and opportunities ahead. This will be a landmark event in the development of landscape conservation. I invite you to check it out.

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JOURNAL HIGHLIGHTS

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Volume 76, Number 2, April 2014

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Critical Thermal Maxima of Two Geographic Strains of Channel and Hybrid Catfish. *Heather A. Stewart and Peter J. Allen*. 76:104–111.

Investigating the Utility of Measuring 11α-Ketotestosterone and Vitellogenin in Surface Mucus as an Alternative to Plasma Samples in Assessments of the Reproductive Axis of White Bass. *Nicholas A. Barkowski and Alf H. Haukenes*. 76:112–118.

The Influence of Dietary Lysine on Yellow Perch Maturation and the Quality of Sperm. *Karolina Kwasek, Konrad Dabrowski, Joanna Nynca, Michal Wojno, and Macdonald Wick*. 76:119–126.

[Technical Note] A Simple Cultivation Method for Chesapeake Bay *Ulva intestinalis* for Algal Seed Stock. *Ji Li, Patrick Kangas, and Daniel E. Terlizzi*. 76:127–129.

Effects of Dietary Protein and Fish Density on Performance and Production Economics of Golden Shiners in Pools. *R. T. Lochmann, H. Phillips, D. Weldon, N. Stone, and C. Engle*. 76:130–137.

[Communication] Size and ATP Content of Unfertilized Eggs from Farmed and Wild Atlantic Salmon in Newfoundland. *Lynn Lush, Kimberley Burt, Dounia Hamoutene, Nancy Camarillo-Sepulveda, Juan Carlos Perez-Casanova, Sharon Kenny, Pierre Goulet, Ross Hinks, and Clyde Collier*. 76:138–142.

Plasma Components and Hepatic Insulin-like Growth Factor Expression Indicate Nutritional Status in Yellowtail *Seriola quinqueradiata*. *M. Kawanago, S. Takemura, R. Ishizuka, and I. Shioya*. 76:143–152.

[Technical Note] Methods and Accuracy of Sexing Sockeye Salmon Using Ultrasound for Captive Broodstock Management. *Deborah A. Frost, W. Carlin McAuley, Bryon Kluver, Mike Wastel, Desmond Maynard, and Thomas A. Flagg*. 76:153–158.

[Technical Note] Decline in Feeding Activity of Female Cultured Delta Smelt Prior to Spawning. *Tien-Chieh Hung, Kai J. Eder, Alireza Javidmehr, and Frank J. Loge*. 76:159–163.

Effect of Stocking Density on Growth and Survival of the Prawn *Macrobrachium tenellum* Cultured in a Cage-Pond System. *Fermín López-Uriostegui, Jesús T. Ponce-Palafox, José L. Arredondo-Figueroa, Mario A. Benítez-Mandujano, Manuel García-Ulloa Gómez, Sergio Castillo Vargasmachuca, and Héctor M. Esparza-Leal*. 76:164–169.

Stress Responses in Pallid Sturgeon Following Three Simulated Hatchery Stressors. *Lucas R. Nelson and Brian C. Small*. 76:170–177.

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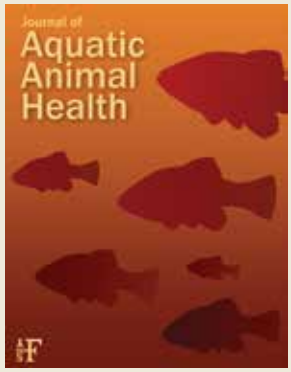
Volume 26, Number 2, June 2014



Relationship between Permeability Glycoprotein (P-gp) Gene Expression and Enrofloxacin Metabolism in Nile Tilapia. *Kun Hu, Gang Cheng, Haixin Zhang, Huicong Wang, Jiming Ruan, Li Chen, Wenhong Fang, and Xianle Yang*. 26:59–65.

Investigation of the Link between Broodstock Infection, Vertical Transmission, and Prevalence of *Flavobacterium psychrophilum* in Eggs and Progeny of Rainbow Trout and Coho Salmon. *Amy Long, Douglas R. Call, and Kenneth D. Cain*. 26:66–77.

[Communication] Susceptibility of Koi and Yellow Perch to Infectious Hematopoietic Necrosis Virus by Experimental Exposure. *Alexander D. Palmer and Eveline J. Emmenegger*. 26:78–83.

Risk Factors Associated with Enteric Septicemia of Catfish on Mississippi Commercial Catfish Farms. *Fred L. Cunningham, S. W. Jack, David Hardin, and Robert W. Wills*. 26:84–90.

[Communication] Development of a Nonlethal Health Assessment for Wild Red Drum Using a Health Index. *Carla M. Bourtis, Ruth Francis-Floyd, Eric A. Reyier, Roy P. Yanong, and Louis J. Guillette Jr.* 26:91–95.

[Communication] Comparative Susceptibility of Channel Catfish, Blue Catfish, and their Hybrid Cross to Experimental Challenge with *Bolbophorus damnificus* (Digenea: Bolbophoridae) Cercariae. *Matt J. Griffin, Stephen R. Reichley, Lester H. Khoo, Cynthia Ware, Terrence E. Greenway, Charles C. Mischke, and David J. Wise*. 26:96–99.

Association of Mitochondrial Dysfunction with Oxidative Stress and Immune Suppression in Blunt Snout Bream *Megalobrama amblycephala* Fed a High-Fat Diet. *Kang-Le Lu, Wei-Na Xu, Wen-Bin Liu, Li-Na Wang, Chun-Nuan Zhang, and Xiang-Fei Li*. 26:100–112.

[Communication] The Endemic Copepod *Calanus pacificus californicus* as a Potential Vector of White Spot Syndrome Virus. *Fernando Mendoza-Cano, Arturo Sánchez-Paz, Berenice Terán-Díaz, Diego Galván-Alvarez, Trinidad Encinas-García, Tania Enríquez-Espinoza, and Jorge Hernández-López*. 26:113–117.

Susceptibility of Fish and Turtles to Three Ranaviruses Isolated from Different Ectothermic Vertebrate Classes. *Roberto Brenes, Debra L. Miller, Thomas. B. Waltzek, Rebecca P. Wilkes, Jennifer L. Tucker, Jordan C. Chaney, Rebecca H. Hardman, Mabre D. Brand, Rebecca R. Huether, and Matthew J. Gray*. 26:118–126.

CALENDAR
Fisheries Events

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

DATE	EVENT	LOCATION	WEBSITE
July 30–August 3, 2014	American Society of Ichthyologists and Herpetologists Annual Conference	Chattanooga, TN	asih.org/meetings
August 3–7, 2014	International Congress on the Biology of Fish	Edinburgh, United Kingdom	icbf2014.sls.hw.ac.uk
August 14–15, 2014	International Muskellunge Symposium	Ottawa, Canada	www.muskiescanada.ca/whats_new/symposium.php
August 16–20, 2014	AFS Annual Meeting 2014	Québec City, Canada	afs2014.org
August 16–20, 2014	38th Annual Larval Fish Conference (AFS Early Life History Section)	Québec City, Canada	larvalfishcon.org
August 31–September 4, 2014	AFS-FHS – International Symposium on Aquatic Animal Health (ISAAH)	Portland, OR	afs-fhs.org/meetings/meetings.php
September 15–19, 2014	ICES Annual Science Conference 2014	A Coruña, Spain	ices.dk/news-and-events/asc/ASC-2014/Pages/default.aspx
September 26–30, 2014	Aquatic Resources Education Association Conference	Traverse City, MI	www.areanet.org/conferences.htm
October 14–17, 2014	Aquaculture Europe 2014	San Sebastian, Spain	www.marevent.com
October 23–24, 2014	National Workshop on Large Landscape Conservation	Washington, DC	http://www.largelandscapenetwork.org/2014-national-workshop/
December 3–4, 2014	14th Flatfish Biology Conference	Westbrook, CT	http://nefsc.noaa.gov/nefsc/Milford/flatfishbiologyworkshop.html
January 21–23, 2015	Texas Aquaculture Association–45th Annual Conference & Trade Show	Kemah, TX	www.texasaquaculture.org
January 26–30, 2015	Global Inland Fisheries Conference	Rome, Italy	inlandfisheries.org
February 19–22, 2015	Aquaculture America 2015	New Orleans, LA	www.marevent.com
May 26–30, 2015	World Aquaculture 2015	Jeju Island, Korea	www.was.org
July 26–31, 2015	World of Trout	Bozeman, MT	
August 16–20, 2015	AFS Annual Meeting	Portland, OR	
February 22–26, 2016	Aquaculture 2016	Las Vegas, NV	www.marevent.com
February 19–22, 2017	Aquaculture America 2017	San Antonio, TX	www.marevent.com

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ARCHIVES FROM 100 YEARS AGO

MR. MARSH: I would not say that the food is the cause of the tumor, it is only the predisposing factor. It enables the real active agent to act more readily and on more fish. The fish were kept in ponds larger than the ordinary ponds used at hatcheries—perhaps half an acre in extent. They were fed no insects, nothing but flour of a low grade, that was not quite white. It is not whole wheat ground up, but it has a small amount of the hull of the grain.

MR. TITCOMB: Was the flour cooked, and do you think it would be advisable to mix raw flour with liver?

MR. MARSH: The flour is cooked. I asked there fish culturist about mixing the food, but he thought there would be a mechanical difficulty in giving the mixture the proper consistence to feed the fish.

PRESIDENT WARD: It is probable that the raw flour would be absolutely indigestible.

MR. HAYFORD, of New Jersey: The newspapers have given so much publicity to certain scientific articles that our correspondence files show that there has been considerable alarm over the possibility that fish might be a cause of human cancer. Consequently, it is pleasing to be reassured that there is a strong improbability that cancer of human beings can be derived from hatchery-bred trout.

M. C. Marsh (1914): The Feeding of Trout in Relation to Thyroid Tumor, Transactions of the American Fisheries Society, 44:1,13-19.

Continued from page 293 (Policy)

the next best means to communicate within our professions and with those we seek to represent and influence. Reflecting Gordon Robertson's passion for recreational fishing, FishNet approached fish issues from that angle. I have yet to identify a group or network that cuts across commercial fishing sectors, but their interests and voices need to be part of the exchange. Ditto for science and management, natural and social sciences, Capitol Hill concerns and regional needs, and other aspects of our professional diversity. AFS hesitates to serve this role, but we plan to be very supportive with information, a steady stream of publications, and members who could become subscribers to what will certainly be an electronic network. Such an e-network could be a natural extension of an existing structure such as the National Fish Habitat Partnership, a regional partnership in the Landscape Conservation Cooperative, or an interstate river commission.

Another common but increasingly useful approach is networking between programs. Through Past-AFS President Stan Moberly, AFS has been very involved in the National Fish Habitat Partnership (fishhabitat.org/partnerships), a network of 19 regional partnerships working to protect and restore fish habitat nationwide. Their work and turf overlap with efforts such as the inland-facing Landscape Conservation Cooperatives managed by the U.S. Fish and Wildlife Service (www.fws.gov/landscape-conservation/lcc.html) and the more marine regional planning bodies to conduct coastal and marine spatial planning (e.g., Mid-Atlantic Regional Planning Body, www.boem.gov/mid-atlantic-regional-planning-body/). Together, a combination of networks covers the nation, from headwaters to blue waters, and for fish and wildlife. The overlap offers opportunities to merge data sets, integrate maps, and compare priorities.

Another nice trend is toward webinars on science topics and with invitations to broad audiences that encourage creative partnerships. Last year the U.S. Forest Service hosted a series of webinars on place-based research and management, comparable to the landscape conservation cooperatives cited above but across nearly every federal agency with a natural resource mandate. Dozens of programs were featured. The latest foray is into science briefings, again with hopes to share ideas with others. I attended two briefings in May, both on new sampling protocols based on DNA samples left by fish in rivers rather than traditional means such as nets, electroshocking, or observing. The U.S. Forest Service's leadership on webinar technology and information sharing is simply awesome.

Finally, there's the policy leadership provided by the Theodore Roosevelt Conservation Partnership, which chairs a policy council with members from across the fish and wildlife communities. Their leadership, and dedicated commitments from many nonprofit groups such as AFS, offers an interdisciplinary venue for debate and learning.

These ideas are but a few of the inspirations crossing my desk since February. I look forward to continuing along my steep learning curve, learning more about our business, and sharing observations with you.

Continued from page 319 (Digital Revolution)

For additional information and links visit this installment of the "Digital Revolution" at: www.fishdata.org/blog/digital-revolution-drones

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ARCHIVES FROM 100 YEARS AGO

Fish culturists are continually receiving letters from people who want to know how to raise fish. Without assuming to give advice to anyone, we would like to drop a long distance hint to such people. First, we would refer them to bulletins and other literature published by fish culturists; and, second, we would say, that in our judgment, if one desires to know how to raise fish and become a fish culturist, it is almost necessary to make an all day and all night—in fact, an all year and an all lifetime study of the subject, and especially of the spawning and food habits of the kind or kinds of fish that one desires to produce.

Prof. L. L. Dyche (1914): Notes on the New Kansas Fish Hatchery and the First Year's Output, Transactions of the American Fisheries Society, 44:1, 5-12.

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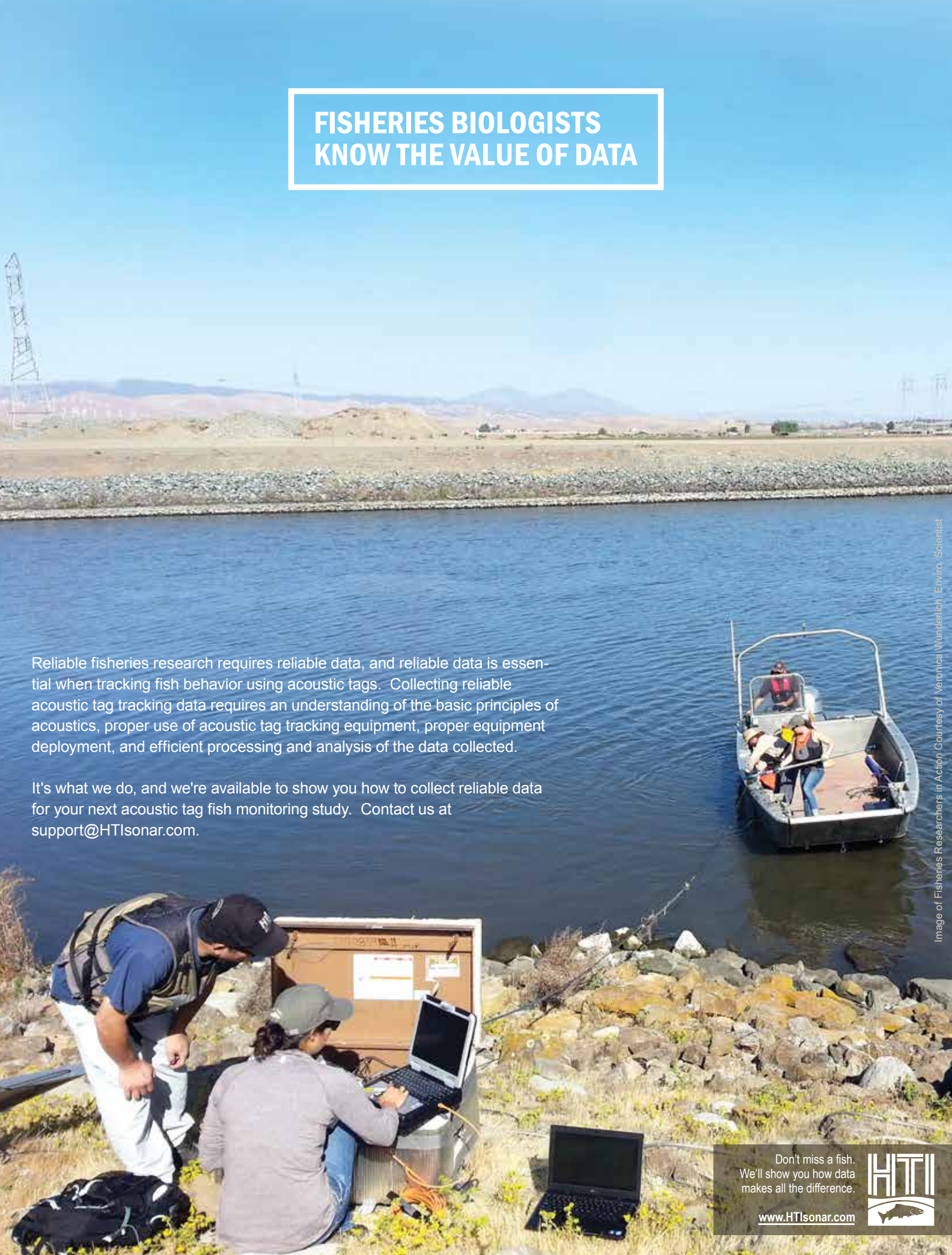

Reliable fisheries research requires reliable data, and reliable data is essential when tracking fish behavior using acoustic tags. Collecting reliable acoustic tag tracking data requires an understanding of the basic principles of acoustics, proper use of acoustic tag tracking equipment, proper equipment deployment, and efficient processing and analysis of the data collected.

It's what we do, and we're available to show you how to collect reliable data for your next acoustic tag fish monitoring study. Contact us at support@HTIsonar.com.

Image of Fisheries Researchers in Action Courtesy of Veronica Wunderlich, Enviro. Scientist

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