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Raising the Bar: Taking a More Strategic and Integrated Approach to AFS Communications!

Gwen White
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Why does AFS need a strategic communications approach? Since its founding in 1870, the American Fisheries Society (AFS) has served as the leading professional resource and networking organization for fisheries professionals. Its stature among the fisheries profession is second to none, and it is consistently cited as a source for the most accurate scientific information on fisheries management. Producing sound science is the first step in a sequence of events that gets the right information into the right hands to inform decision making and future research. Communications facilitates that knowledge transfer.

What can we learn from professional communications advice? At the 2014 Annual Meeting in Québec City, the Governing Board initiated a more strategic and integrated approach to how AFS uses the full capabilities of its existing communication channels. We need to deploy communications mechanisms that systematically meet the goals and objectives of AFS by establishing clearer guidelines and expanding AFS’s current approach to communications with its current and potential members (as a primary audience) and external stakeholders such as decision makers and reporters (as secondary audiences).

What is in the communications plan? Through a competitive contracting process, AFS engaged the services of a professional communications firm, the Potomac Communications Group (PCG), to develop a strategic communications plan based on their comprehensive review of AFS as an organization, the way AFS communicates, the needs of AFS members and other groups, its mission and messages needed going forward, and how AFS compares to other related organizations. Both the review report and the communications plan are online for your consideration and use: fisheries.org/strategic-communications-plan (password: essig).

As a result of their research and ongoing conversations with AFS’s management, PCG outlined communications strategies (in line with our AFS Strategic Plan - fisheries.org/afs-strategic-plan-for-2015-2019) and tactics designed to help AFS achieve its goals in the following areas:

1. Improve the consistency and quality of information being circulated to members, thus enhancing the value of AFS membership.
2. Better define AFS’s messages to the organization’s membership, potential members, and other targeted individuals and groups.
3. Reinforce AFS’s status as the primary and most beneficial membership society for fisheries professionals.
4. Increase AFS’s influence with external groups and individuals, such as policymakers and other important leaders and advocates.

How can you get involved? The PCG communications plan presents research findings and associated strategic recommendations for consideration by AFS. Some of the actions are already underway. Others are maybe too much of a reach for the foreseeable resources and capacity of our Society. That leaves a large set of actions that we need to prioritize. We anticipate that AFS will begin to implement high-priority actions contained in this plan as the Governing Board chooses to allocate resources into the future. The Board wants your help to sort through these potential communications actions and for you to tell us which directions you support.

The PCG plan is posted online for your consideration through September 15. Please take a look and discuss how you think these recommendations should be prioritized for Society-level action. In addition, you may find many of these actions would enhance communications approaches in your Sections and Units as well. The Governing Board will take your thoughts into account as they commit resources to improving communications through all the channels in the Society.

Tell us what you think. Go to fisheries.org/strategic-communications-plan (password: essig), read the plan, and answer the survey. And thank you for helping us raise the bar on AFS communications!

The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the U.S. Fish and Wildlife Service.
Wetlands Thrive on Connectivity

Thomas E. Bigford, AFS Policy Director

Finally, courtesy of a federal rule issued in late May, society can push the pause button on the long debate about wetland policy and science. While the central issue of what is and is not a wetland was addressed in the final Clean Water Act (CWA) rule released by the U.S. Environmental Protection Agency (USEPA) and U.S. Army Corps of Engineers (USACE), the issue will eventually resurface in the courts. In the interim, let’s celebrate the lull with a reminder of why this technical and policy matter is crucial to fish and AFS.

Wetlands provide a myriad of ecological and economic services across the time and space continuum. Those services are essential to life throughout the food web, including microbes and us. Those services are connected in every sense of the word. Waters flow, fish swim, pollutants flush, nutrients nourish, people admire, vessels ply, and so on. That connectivity is crucial since wetlands, especially thinking as a fish, generate limited value if there is no “significant nexus.” Those connections are often based on commerce and navigability, but we’ll take the liberty of approaching the issue as a paddlefish or freshwater mussel. Cobbled river bottoms, fringing marshes, and other wet places are not fish habitat if fish cannot get there. Since we’re all about fish, we will approach the issue with narrowed focus.

These concepts were highlighted at a special briefing for congressional staff on May 21, 2015, just days before the final CWA rule was released. The briefing was the brainchild of the Environmental Law Institute and the Consortium of Aquatic Science Societies (CASS), which AFS joined in 2014. Expert panelists discussed how wetlands serve in the “green” food web based on living tissues and the “brown” food web supported mostly by detritus entering a system from afar. Both inputs are vital, and both are part of the connectivity discussion.

The panel, moderated by Jane Rowan (employed by Normandeau Associates and a member of the Society of Wetland Scientists representing CASS), included three experts who covered wetland issues from well upstream to the estuaries. Robert Brooks, Ph.D. from Penn State University portrayed wetlands as the intersection of ecosystem functions moving up and downstream, sideways into floodplains, through the water column, and over time. The four-dimensional dynamics are complex yet intricate, representing the “significant nexus” coined by Justice Anthony Kennedy when these issues were argued before the 2006 Supreme Court in the Rapanos v. U.S. case (126 S. Ct. 2208) that led to the CWA rulemaking. Stuart Findlay, Ph.D. from the Cary Institute of Ecosystem Studies emphasized the importance of water flow to and through wetlands. Would you have guessed that three times the normal river channel water volume flows laterally into and from fringing floodplains? That movement carries nutrients, organic matter, and organisms, and is central to the services associated with healthy wetlands.

Denise Breitburg, Ph.D. from the Smithsonian’s Environmental Research Center extended the hydrologic cycle into our estuar-ies, where wetlands serve to trap nutrients that otherwise might trigger low dissolved oxygen events. Her presentation emphasized the watershed perspective that is central to any healthy wetlands debate.

Those scientific connections are highlighted in an USEPA (2015) report released in early 2015 that helped to chart the course for the final rule. I highly recommend at least a thorough skim of the detailed yet concise “Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence.” More than 1,200 references and hundreds of illustrations provided the necessary support to clarify what started as a vague notion of “nexus.”

The new USEPA-USACE rule promises to inspire scientific study, policy reviews, and educational efforts, all aimed at improved resource management. Findlay’s fact about floodplains could change the debate about protecting and restoring waterfronts that might have been filled, diked, or otherwise disconnected. Returning water flow, with resulting benefits from reinvigorated wetlands, will serve society, finfish, and shellfish well.

To create momentum, and to counter the inevitable legal and political responses, all of those working in fields related to wetlands would do well to:

- Quantify the economic and ecological connections central to these issues;
- Revisit policies and implement procedures to reflect those values;
- Evaluate the mix of protection and restoration that can enhance mitigation associated with regulatory decisions;
- Measure those options and timelines with respect to natural recovery that might be expected without human intervention;
- Decipher trends in wetland loss, especially along the coasts where loss rates are increasing, perhaps due to rising sea levels, increased storm and tide intensity, some quirk in wetland management, or some other factor—and in regions well beyond coastal Louisiana; and
- Invest in education so decision makers from local to national can take the best action for the long term.

These actions represent a tall order in a call to arms for wetland enthusiasts. I sense we’re ready for the challenge. Let’s lead the way toward clarity by affirming the importance of connectivity and quell debate along the way.

REFERENCE

Value Added by Being a Member of a Professional Society

Sean Lucey, AFS-AIFRB Liaison
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Professional societies come in all shapes and sizes. They foster cooperation and communication between people who are engaged in a profession, in our case fisheries science. Some focus on specific issues, while others are broader in scope. I have the pleasure of serving as the liaison between two well-established organizations, the American Fisheries Society (AFS) and the American Institute of Fisheries Research Biologists (AIFRB). Being a member of both organizations has been extremely rewarding, both personally and professionally. Although this article describes those two organizations, there is value added by being a member of any professional society (e.g., American Society of Ichthyologists & Herpetologists, American Elasmobranch Society, International Institute of Fisheries Economics and Trade, Coastal and Estuarine Research Federation, etc.).

The AFS is the world’s oldest and largest professional society for fisheries scientists. It was established in 1870 and has over 7,300 members worldwide. The strengths of such a large society include the publication of several top-rated journals in the field as well as a large multi-national Annual Meeting. In contrast to AFS, AIFRB is a medium-sized professional society with just over 600 members. As a smaller organization, AIFRB hosts major symposia on important topics in fisheries rather than meetings with multiple concurrent sessions. Both promote the conservation and utilization of resources in a sustainable way.

All professional societies are expected to provide value to their membership. The value of AFS membership includes a subscription to Fisheries magazine, discounted registration fees to the Annual Meeting, discounts on AFS publications (journals or books), and professional certification, which sets a standard across the field of fisheries science. A smaller society like AIFRB may not provide so many discounts but offers things like a pre-peer review of your manuscripts by a senior scientist within the organization and job placement services for students and young professionals. Both organizations provide travel assistance and recognize accomplishments through various awards.

In addition to tangible value, there is intangible value in being a member of a society. The biggest value added of membership is career development. This comes through networking, public speaking, and training. Most people recognize the importance of networking. Professional societies provide a forum for you to interact with some of the top people in your field. Networking can result in new and exciting collaborations. My entire Ph.D. dissertation was outlined at an AFS meeting over several pitchers of beer with my advisor. However, communication is just as important. As your career advances, you will be asked to disseminate your results and expert opinion via presentations. Participating in meetings and committees improves your public speaking. Local Chapter meetings of AFS are often the first professional presentation made by many of us. Both AFS and AIFRB offer training opportunities. Many of these opportunities are at the local or regional level rather than nationally.

Professional societies can also add value to each other. This issue of Fisheries is an example of the synergy that can be created between two organizations. The AIFRB recently sponsored a symposium at the AFS Annual Meeting in Québec City entitled, “Are we still fishing down the food web?” The AIFRB was able to leverage the AFS meeting to provide a venue bringing together experts from various disciplines. Most people recognize the term “fishing down the food web,” a phrase that describes fisheries systematically targeting fish species down the food web as higher trophic levels are depleted. The AIFRB brought together one of the original authors of this idea, Villy Christensen, and one of the chief opponents of this concept, Trevor Branch. Both have published high-impact papers on the subject, and their keynote presentations set the stage for an excellent discussion on the merits of fishing down the food web. The AFS has captured some of their thoughts in the subsequent pages (Branch 2015; Christensen 2015; both this issue). The AIFRB and AFS will continue their collaboration with further symposia. This year AIFRB has planned a symposium on the challenging topic of balancing conservation and utilization to sustain fisheries.

I encourage each of you to get involved with your favorite professional societies, either locally or nationally. There are many tangible reasons to join an organization, but it is your involvement that unlocks the value-added portion of your membership. Participation will help your own career development as well as strengthen the bonds of collaboration and move fisheries science forward.

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Douglas Austen, AFS Executive Director

Back on April 11, 2015, the New York Times (NYT) published an op-ed by Douglas Thompson on trout fishing and hatcheries that some AFS members found to include some truths but also a troubling amount of erroneous information and misrepresentations of facts. Until relatively recently, AFS has not been actively involved in placing articles or responses in major media outlets such as the NYT or focusing any significant attention on ensuring that the science of AFS members is appropriately linked to current policy decisions. That has been changing with the development of an AFS policy position (Tom Bigford), policy fellows, and interns. AFS has hosted several recent congressional briefings and is actively involved in the policy committee and working groups of the Theodore Roosevelt Conservation Partnership. So it was only reasonable in the policy committee and working groups of the Theodore Roosevelt Conservation Partnership.

The AFS process of defining a position is based upon the fundamental philosophy of ensuring that we present the best available science. Of course on any issue worthy of a policy debate, particularly one as broad reaching as hatchery fish production, the development of a position requires obtaining input and viewpoints from a broad spectrum of experts. So we did. We involved the Fish Culture Section, the Fisheries Management Section, the Fish Administration Section, and an angelic host of Officers, Management Committee, and others to develop a concise response that we submitted as an op-ed to the NYT. Keep in mind that we had to do this within the proscribed 400–1,200 word limit (nytimes.com/content/help/site/editorial/op-ed/op-ed.html), and we figured our response needed to be somewhat timely. We also realized that the likelihood of getting an AFS response published in the NYT was rather slim given the immense amount of material submitted daily to the paper. Nonetheless, by April 24, we had a final response that was submitted to the NYT, and we were feeling pretty good about ourselves for setting the record straight. Not so fast. The response from the NYT was blunt and unexpected. It turns out that it has a policy, which I might add is not on its website, of not printing op-ed type responses to op-eds. As it turns out, the only response that it accepts is a letter with a limit of 150 to 175 words. Also, the letter needs to be submitted within seven days of the article of reference being published. Missed that one. Using some connections that a staff member had with the NYT, we tried a submission on April 30 but were unsuccessful. Timeliness is critical. If the AFS leadership chooses to be engaged at this level we need to find more streamlined processes for defining positions.

The second lesson is that AFS could and possibly should consider actively identifying issues that we’d like to convey to a broader public through pre-emptive op-ed’s in outlets such as the NYT, Washington Post, or whatever would be appropriate. The membership, as indicated by multiple surveys, values the role that AFS can play in pushing fisheries science into public policy debates. Articles in Fisheries and on our Facebook page and website are nice, but they are simply preaching to the choir. If we want fisheries science to affect public opinion, it needs to be placed where the public can access it. This can be done through Bethesda or through the work of our 7,300 members and our Chapters, Divisions, and Sections.

Finally, we need to improve our relationship with the news media. Our current work with Potomac Communications Group and a special communications committee chaired by Gwen White on developing a new communications strategy specifically identifies this as an area of value and priority. AFS and its members have information that the public wants to know about, and their work is interesting and makes for great stories. We need to position AFS better to be a vehicle to help our members get out those stories in a way that will capture the interest and attention of the public as well as make a difference when it comes to improving the policies and laws that affect our aquatic resources. Stay tuned as the Governing Board grapples with these communication issues and others during its day-long meeting in Portland.

“The Cost of Trout Fishing,” a recent op-ed piece by Douglas Thompson in the New York Times (Thompson 2015), included several inaccurate statements and fundamental misunderstandings of fisheries management and aquaculture. As fisheries research and management professionals, the American Fisheries Society would like to set the record straight. The mission of the American Fisheries Society is to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science and promoting the development of fisheries professionals. We can fulfill that mission, in part, by addressing misinformation about fisheries science that appears in popular media, and helping the interested public to better understand the facts.

Native trout and our aquatic systems in general have been subjected to a wide variety of environmental degradations over the past two centuries or more. Widespread timber cutting, intense mining, dam construction, industrial pollution, invasive species and many other human activities, not fishing pressure as suggested by Mr. Thompson, resulted in greatly reduced fish populations, including trout, throughout the U.S. Only through strong water quality laws and other actions, in many cases advocated for by anglers, have many of our rivers, streams, and lakes recovered. Furthermore, anglers working with other conservationists have helped to ensure that our waters can sustain trout and other fish populations and support fishing.

Thompson suggested that hatchery fish create more problems than they address. Natural resource agencies stock fish to compensate for the inability of impaired ecosystems, especially in urban areas, to support self-sustaining fish assemblages and to meet perceived demands for fish by anglers. In the U.S., approximately 1.75 billion fish of all species are stocked annually to counter the effects of habitat loss, harvest, and other stressors affecting fish and fishing opportunities (Halverson 2008). Regarding trout specifically, if wild populations are strong and self-sustaining, they are generally no longer stocked; for streams where natural populations are absent, dwindling or unable to support angling pressures, resource managers weigh costs and benefits before approving a stocking program (Weber et al. 2010; Hyatt et al. n.d.).

Although some fish are raised in aquaculture systems to a catchable size prior to release, nationwide the majority of fish are stocked as juveniles. Collectively, stocked fish weigh just over 44 million pounds annually (Halverson 2008), meaning that the average size of the fish at release is less than half an ounce. These fish grow to support recreational fisheries that also produce economic benefits and provide a means for an increasingly disconnected population to become acquainted with nature. There are approximately 60 million U.S. anglers—more people than play golf or tennis combined—who contribute $62 billion dollars annually to the gross domestic product (GDP), generate $115 billion in total economic output, and support more than 828,000 jobs. Anglers also generate an additional $15 billion in state and federal taxes, a portion of which goes back into sport fish restoration (Southwick Associates 2013). It has been estimated that hatchery fish support about half of this economic activity.

Another concern suggested by Mr. Thompson is that hatchery production is supported by pellet feed derived from fish and that these fish populations are being devastated by the use of fish meal and oil. In fact, “reduction” fisheries—the ones that give us fish meal and oil—are some of the most carefully and aggressively managed in the world and are actually expected to support modest growth in the future (FAO 2014). Advances in fish nutrition have allowed soy, wheat, corn, and agricultural by-products to replace fish meal and oil in most fish feeds. In 2000, trout and salmon diets typically contained 30-40% fish meal and 15-25% fish oil; by 2010, estimated fish meal and oil inclusions were down to 17-25% and 8-15% (Tacon and Metian 2008). By 2022, half of the fish meal and oil will come from improved processing of seafood byproducts, and not wild fish (FAO 2014). What’s more, fish are strikingly efficient at turning feed to flesh. Terrestrial animals consume 2-8 pounds of feed or more for every pound of weight gained. For fish, it is routinely near 1 to 1, meaning that most of the feed going into a hatchery comes out “on the fin,” not as waste.

Fish hatchery effluents are regulated by the U.S. Environmental Protection Agency (EPA) and state water quality agencies in accordance with the National Pollutant Discharge Elimination System (NPDES) (EPA 2014). NPDES limits protect the quality of public waters, and hatchery effluents are subject to monitoring and enforcement of the permit’s conditions. To comply, hatcheries direct effluents through on-site wastewater treatment systems. Of more than 400 “hatchery” records in the EPA’s Enforcement and Compliance History Online database, only 7—less than 2%—are currently in violation of their permits (EPA 2015). Fish hatchery contributions to nutrient loadings are dwarfed by those from agriculture, other confined animal feeding operations, or municipal wastewater discharges.

Hatchery operations also must comply with U.S. Food and Drug Administration (FDA) oversight if they use any drugs in the course of fish production. Drugs are not approved for use until proven safe to the environment, safe to fish, and safe to people who consume fish. Regulatory authorities take a highly precautionary approach to such evaluations (Bowker and Trushenski 2015). In fact, the most common water treatments applied in hatcheries are low doses of hydrogen peroxide (a household antiseptic) and chloramine (the most common disinfectant for U.S. drinking water). As with nutrient discharges, the amount...
of these hatchery effluents is minor compared to pharmaceutical and personal care products that enter our nation’s waters via municipal and agricultural wastewater discharges.

Fish stocked to bolster wild populations have pedigrees to match that intent, and spawning in hatcheries is carefully managed to maintain the genetic integrity of the wild populations; however, genetic and behavioral factors remain serious concerns (e.g., Reisenbichler and Rubin 1999; Putman et al. 2014). Hatchery-origin and wild fish interact, sometimes with negative consequences (e.g., competition for resources (Daly et al. 2012), straying (Araki et al. 2007), ecological effects (Pearsons 2008)), and which must be taken into consideration. A few “conservation” hatcheries employ naturalized conditions to better condition fish for success in the wild (Maynard et al. 2004; Evans et al. 2014). For fish whose only destiny is the creel, breeding programs are relaxed, but are hardly a haphazard mingling of genes. In some cases, hatchery fish are sterilized to prevent reproduction in the wild (Kozfkay et al. 2006). In other cases, hatchery fish are managed to reduce the probability that they occur on the same spawning grounds as wild fish at the same time (HSRG 2014). Hatcheries can also conserve biodiversity. For example, Redfish Lake Sockeye Salmon Oncorhynchus nerka are slowly coming back from the brink of extinction because hatchery biologists managed to rescue and successfully breed the few remaining individuals, preserving the species as well as their genetic diversity (Kline and Flagg 2014). Recovery of Lake Trout Salvelinus namaycush—now considered self-sustaining in Lake Superior and on track in Lake Huron—is also attributable, in part, to hatchery support (Muri et al. 2012).

Fisheries managers often face conflicting mandates to recover and conserve wild populations while also creating fishing opportunities in the same waters. The most effective management strategies involving hatcheries incorporate all three “Hs”—harvest control, habitat protection or improvement, and hatchery supplementation. The American Fisheries Society has championed that approach and the use of sound science, holding forums every decade to refine recommendations for the best use of hatchery-origin fish in natural resource management (Trushenski et al. 2015). These issues are important and we encourage readers to learn more. The American Fisheries Society and the expertise of our membership are excellent places to start. Our collective efforts will succeed if we focus on the greatest threats to wild trout and other fish, including both habitat loss and introduced species.

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REFERENCES


Fisheries Classics: Ryder’s Morphoedaphic Index

Jeff Schaeffer | AFS Co-Chief Science Editor. E-mail: jschaeffer@usgs.gov

This work by Richard Ryder represents an important paper because it was one of the first widely accepted papers that promoted the idea that groups of freshwater lakes were comparable and that fish yields could be predicted based on physical and chemical attributes. The morphoedaphic index (MEI) was simple to calculate by dividing total dissolved solids ($T$, ppm) by mean depth ($D$, feet) and ranged from 0.12 in deep oligotrophic lakes to 20.8 in shallow eutrophic lakes. While not the first attempt to achieve this, this manuscript generated a lot of discussion at conferences, and many educators began to include discussions of MEI in their classes.

Since that time, advances in spatial ecology and computational techniques have produced far more refined models of fish production, but this was the paper that got the discussion started widely. Ryder’s model worked well in its time, was objective rather than subjective, and got a lot of people thinking about the idea that lakes with similar physical characteristics could be managed in similar ways. This was transformative because at that time many fisheries scientists viewed lakes as individual and unique and there was far less recognition of landscape-scale patterns in aquatic environments. This year is the 50th anniversary of his publication, but it is still a good read.

REFERENCE

Identifying Endocrine Disrupters as an Emerging Issue: Smallmouth Bass in the Potomac River

With this article, Vicky Blazer (U.S. Geological Survey, National Fish Health Research Laboratory) and her colleagues established clearly that endocrine disruptors were a potential issue for fish health, and not just in watersheds with high human population densities. They found a surprisingly high incidence of intersex condition in Smallmouth Bass Micropterus dolomieu collected from both densely and more sparsely developed watersheds within streams throughout both Virginia and West Virginia, with the surprising result that intersex conditions could be detected in areas that were considered more pristine. Their work was influential in that, although they were not the first group of researchers to examine the problem, their article made people realize that the effects of endocrine disruption were more widespread than thought previously and that it had potential effects on game species important to fishers. Additionally, they demonstrated that detection of intersex conditions was not simple and required adequate sample sizes, careful techniques, and consideration of seasonality when sampling. This widely read article (it is one of the most frequently cited in JAAH) led to the adoption of more thorough sampling techniques and broad discussion of endocrine disrupters as an important emerging issue.

REFERENCE

Avoiding Domestication of an Endangered Species: Conservation Culture of California’s Delta Smelt

This article highlights efforts to conserve Delta Smelt Hypomesus transpacificus, an endangered species threatened by habitat loss and drought in the Sacramento/San Joaquin Delta. This is an important topic because several social media communications have blamed Delta Smelt for exacerbating California’s current drought issues. This has made habitat conservation more difficult and raised the possibility that the species may need to be maintained in captivity for at least some time. This manuscript examined the intricacies of Delta Smelt spawning behavior and found that captive individuals of both sexes spawned naturally multiple times per season, but under free mating conditions, Delta Smelt did not prefer to mate with unrelated individuals. This resulted in a small but significant loss of genetic diversity in larvae and suggests that conservationists may have to pursue genetic diversity actively via avoidance of domestication. This is a linchpin for maintaining populations of cultured fish that are as close to wild fish as feasible and will greatly assist repatriation efforts if they are needed. This information was a top priority for Delta Smelt conservation, but the ideas are likely applicable to other species cultured for conservation.

REFERENCE
Oil Spill Impacts to Red Snapper in the Gulf

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In this study, Joseph H. Tarnecki and William F. Patterson of the Dauphin Island Sea Lab, University of South Alabama, examined the impact of the BP Deepwater Horizon (DWH) oil spill on the diet and trophic position of Red Snapper Lutjanus campechanus off the coasts of Alabama and Florida. This study is unique because the authors had 18 months of pre-spill data. A common problem that has plagued evaluations of oil spill impacts is the general lacking of baseline data needed for comparisons.

In their investigations, the authors found that Red Snapper diet and trophic position differed significantly before and after DWH. Following the spill, they observed a decline in the consumption of pelagic zooplankton, both at natural and artificial reefs, and hypothesized that zooplankton had been negatively affected by the oil and dispersants. As a result, Red Snapper, which tend to be generalist mesopredators (think broad diets), had to switch their diet to higher trophic level prey: decapods, cephalopods, stomatopods, and fish. Stable isotope analysis confirmed the increase in trophic level feedings observed from stomach analysis in addition to the switch to more benthic prey (due to loss of pelagic zooplankton). However, unlike stomach analysis, which only provides a snapshot of ingested food in the days prior to death, stable isotopes take months to be incorporated into the muscle tissue of fish, suggesting these shifts in diet were persistent for several months.

Look for more exciting DWH oil spill results from Patterson’s lab. He has two more articles ready for submission that follow on this paper. The first demonstrates persistent trophic shifts of Red Snapper and Tomtate Haemulon aurolineatum after the spill stable isotope analysis and describes shifts in size at age. The second article depicts reef fish oil exposure inferred from liver PAH concentrations and changes in reef communities from 2009 to 2014.

REFERENCE

Economic Impact and Value Data Can Be Used to Assess Policy Changes

Clifford Hutt (Mississippi State University, Human Dimensions and Conservation Laboratory) and his colleagues estimated both the economic impact (the monetary benefits of angling to the regional economy) and economic value (the value of a fishing trip above the angler’s actual costs; their net “willingness-to-pay” for the resource) of recreational fisheries for crappie Pomoxis spp. in Mississippi and showed how this data could be paired with exogenous variables (i.e., reservoir water level, water temperature) to assess the costs of different management actions. In the article, the authors specifically examined how changes in spring water levels affected the number of fishing trips taken, which affected total angler expenditures and economic value. They found that angling effort and economic impact and value peaked at intermediate water levels and declined at both low and high water levels. The authors state that information on the economic benefits of fisheries is important to fisheries management, especially in the face of competing demands and climate change. Research on climate change is too often narrowly focused on biological systems, ignoring fishers and how they respond to a variety of changing economic, institutional, and environmental conditions. This article shows how fishers can be incorporated into analyses and predictions in order to assess policy changes.

REFERENCE
What Not to Miss at the Annual Meeting (Including the Most Unique Symposium):

5 Questions with Program Co-Chairs, Jim Bowker and Nancy Leonard

1. How many symposia will there be in Portland, and why did you choose to not have a theme?
We will have 103 symposia, plus the Student Best Papers and Posters Session, and likely x contributed sessions and expect nearly 2,180 oral presentations, making this meeting larger than the 2011 AFS Annual Meeting held in Seattle, Washington, which was a record breaking meeting with 94 symposia and 35 contributed sessions. We’re being faced with some real challenges relative to the number of symposia and oral presentations and trying to figure out how to make everything fit into a finite number of days. Attendees will be challenged to decide which session(s) or presentations to attend. The decision to go theme-less was made by AFS President Donna Parrish because she did not want to limit the scope of the meeting. Although many of the symposia have a Pacific Northwest flavor, there will most certainly be something for everyone.

2. What will be the largest public issue addressed at the meeting?
We think that there will be more than one major public issue at this meeting. Hatchery fish, invasive species, and effectiveness of restoration actions are bound to be top topics at this meeting, not to mention advancement in technology that contributes to fisheries research and management, and a diversity of challenges being faced by fisheries managers, scientists, and stakeholders. Some of the symposia that will have the greatest number of presenters includes (1) Effects of Ocean Acidification in Wild and Cultured Marine Fauna, (2) Lamprey Biology and Implications for Fisheries Managers, (3) New Perspectives on Feeding Ecology of Fishes, (4) Frontiers in Otolith Chemistry, (5) Conserving Cool- and Cold-Water Lake and Stream Fishes Through a Warmer 21st Century, (6) Give a Fish its Due: Nongame Native Fish of the Western United States, (7) Methods for Monitoring Recreational Fisheries in Support of Stock Assessments and Fisheries Management, (8) What’s New with Western Native Trout?, (9) Exploring the Benefits of Collaborative Fisheries Research and Conservation Engineering to Reduce Bycatch and Bycatch Mortality, (10) Fish Deterrence and Guidance Technologies, and (11) Recent Advances in Establishing Fish-Habitat Relationships in Lotic Systems. In addition, there were 61 submissions for the America’s Fish and Fisheries – Shared through the Camera Lens – A 2015 AFS Film Festival.

3. What will be the biggest newsmakers as far as symposia goes?
Now that is an interesting question. Which topic makes the news will likely be dependent on the fact that we are in the Pacific Northwest and emerging topics that are of importance to that readership group. In the Portland, Oregon area, salmon and steelhead related activities are always great news items, including effects of toxins, climate change, predators, hatchery, harvest, habitat, and hydro systems. At a national and international level, we would think that the topic of ocean acidification and its impact on wild and cultured marine fauna could be a popular news item as well.

4. What do you think will be the most unique symposium and why?
We think the session on fisheries sustainability, crime, and enforcement and the session on managing data to meet shrinking budgets will bring to light new perspectives on topics we don’t frequently discuss but that impact our success at managing our fisheries resources. In addition, we will be hosting a film festival where films will be “looped” and shown over a two-day period. Meeting attendees will be able to come and go at their pleasure, and we’re sure that it’s going to be a hit.

5. What topics do you think attendees will be talking about the most after the final door closes in Portland?
From a technical standpoint, we think the perspectives on feeding ecology of fishes, the policy director’s panel on public institutional policy, and the frontiers in otolith chemistry will generate a lot of discussion both during and post meeting. From a meeting location standpoint, they’ll be talking about how great it was to explore Portland and the surrounding area and trying to discover everything that makes Portland unique and why one of the city’s motto’s is “Keeping Portland Weird.” Lastly, we hope folks will be talking about the size of this meeting, how easy it was to get from session to session, that common topical areas were grouped together in adjacent rooms, that using the MAX light rail and other public transportation was a breeze, and that the networking activities and locations were fantastic.

List of symposia: afs.confex.com/afs/2015/webprogrampreliminary/SYMP.html
Q&A: The Success Story of the Oregon Chub: An Interview with Paul Scheerer

Past president Bob Hughes says, “This project was a decades-long labor of love by some for a little unexciting fish to others.”

Why is it worth so much money and time to recover the little Oregon Chub – a fish most people do not even know exists?

The Oregon Chub Osetrornichthys crameri has been described as an indicator species of the health of Willamette River off-channel floodplain habitats. The work we have done to protect this chub has benefited countless other species of fish, birds, amphibians, and mammals that also depend on these off-channel habitats, including but not limited to, salmon and steelhead Oncorhynchus mykiss, otters, deer, elk, beavers Castor canadensis, western pond turtles Actinemys marmorata, red-legged frogs, herons, shorebirds, and ducks.

The collective effort by a very strong public-private partnership in the Willamette Valley clearly demonstrates that listed species can be recovered and delisted in a highly populated, working landscape. This illustrates one of the rare success stories for the Endangered Species Act (ESA), which just turned 40 years old last year. It is important to document success stories to show that the ESA is working and justify its value.

Why did you become interested in Oregon Chub in the first place?

My career focus has been on assessing the status, protection, and recovery of Oregon’s native nongame, often endemic, fishes, so I was asked to lead the monitoring effort of the Oregon Chub when biologists became concerned about its status—prompted in part by an Oregon State University study in 1989 that the species was listed as endangered under the ESA in 1993, downlisted to threatened in 2010, and successfully delisted February 19, 2015 (Federal Register posting).

What were the most challenging issues you confronted regarding Oregon Chub recovery?

The most challenging issues were how to recover a small floodplain fish threatened by altered flow regimes and nonnative predatory fishes, including Largemouth Bass Micropterus salmoides, Bluegill Lepomis macrochirus, bullheads, and Western Mosquitofish Gambusia affinis.

How did you and your team surmount those challenges?

Our main focus was to identify previously unknown populations of chub, protect the existing known natural populations, and to reduce the risk of the species’ extinction by conducting reintroductions into secure locations with no nonnatives or threats of invasion within their historical range.

To address the issue of altered flow regimes, we worked closely with the USFWS and the U.S. Army Corps of Engineers (USACE) to balance the protection of off-channel habitats and natural flow regimes with the USACE flood control objectives. The USACE also funded studies to assess the relationships between flows released from 13 tributary dams and conditions in off-channel habitats upon which chub rely (temperatures, water levels, connectivity) and fish assemblages (native/nonnative) in these habitats. One of the questions we hoped to answer was what characteristics of floodplain habitats allow native and nonnative fishes to coexist. There are several locations where chub and nonnative fish co-occur in floodplain habitats, but chub abundance is typically lower in these habitats, and nonnatives often dominate floodplain habitats that have been altered (e.g., abandoned gravel mining pits).

To reduce the risk of extinction and increase the distribution of the species, we initiated a reintroduction program with strict guidelines to protect the donor population and establish new populations with a sufficient number and diversity of donors to avoid genetic bottlenecks. To date, we established 21 populations through our reintroduction program, which was facilitated by working with the USFWS to develop a programmatic Biological Assessment for reintroductions and a programmatic Safe Harbor Agreement (SHA) for private landowners who agreed to allow us to introduce this listed fish on their properties.

How did you and your team manage to obtain the support of landowners, NGOs, and federal and state agencies in this recovery process?

Surprisingly, this was probably one of the easiest tasks. We had strong support of most of the relevant state and federal agencies from their early involvement in developing the Conservation Agreement in 1992 (prelisting). After listing, we gained additional support (including financial support) from federal agencies (USFWS, USACE, and the U.S. Forest Service [USFS]) in the process of fulfilling their obligations under the ESA. In many cases, NGOs, including land trusts and watershed councils, came to us to see how they could participate. We also had support from many landowners due to their involvement in the Farm Bill conservation programs and the focused activities of USFWS private lands biologists to encourage involvement in the chub reintroductions/recovery. As time progressed and we started to show progress towards downlisting and delisting, many more agencies and landowners joined in and contacted us to see how they could participate.

Did you have any sense of an anti-government or anti-conservation attitude among landowners? If so, how did you and your team allay those fears?

Not much. Part of that may be reflected in the liberal demographic in the Willamette Valley. Fortunately, the recovery of Oregon Chub had very little to no regulatory impacts on landowners. Existing laws (clean water, fill, and removal) were adequate to protect their habitats. To allay fears from landowners who voluntarily agreed to allow us to introduce chub onto their properties, we worked with the USFWS to develop the SHAs...
with landowners (individually, and later, as a programmatic agreement), which provided them with protections against future land use restrictions and an option to opt-out in the future (none opted-out).

**What role did the Oregon Chapter of the AFS play in Oregon Chub recovery?**

The Oregon Chapter of the AFS had no direct role, but was—and continues to be—very supportive in publicizing and recognizing our efforts and promoting the conservation of this and other native fishes in the Willamette River drainage. Many of the people responsible for the recovery and the delisting are members of the Oregon Chapter.

**Who else was instrumental in the Oregon Chub recovery?**

Brian Bangs of ODFW, who started as a seasonal field biologist on the project, took the lead role in the monitoring and recovery efforts when I shifted more of my focus on the recovery of other threatened, endangered, or rare fish species in the desert of southeastern Oregon and elsewhere in the state.

The USACE’s Greg Taylor, who has recognized the USACE’s legacy role in altering and impacting Oregon Chub and their habitats, worked to manage flows and temperatures to more closely mimic natural, pre-dam conditions, and provide substantial funding to conduct our detailed floodplain studies to improve our understanding of floodplain processes, the impacts of the project management, and the USACE’s relationship to the fish and wildlife that utilize these habitats.

Chris Allen, Rollie White, and Paul Henson (among others) with the USFWS played a large role in promoting/facilitating recovery efforts, protecting Oregon Chub habitats by guiding consultations via their staff, developing a programmatic Biological Assessment to facilitate chub introductions, developing the SHAs to streamline landowner agreements for introductions, providing funding for research and monitoring, and coordinating the annual Oregon Chub Working Group meetings.

Countless other agency personnel from USFWS (private lands biologists, refuge managers and staff, etc.), USFS, Oregon Parks and Recreation, Oregon Department of Transportation, National Resources Conservation Service, ODFW district biologists, Bonneville Power Administration, as well as NGOs (including watershed councils, McKenzie River Trust (who purchased large expanses of chub inhabited floodplain habitats in the McKenzie River drainage), tribes, and colleagues/collaborators at Oregon State University were fundamental in their support.

And certainly we want to acknowledge the numerous private landowners who granted permission for us to access their properties to search for chub, monitor chub if/when they were discovered, and to those who allowed us to introduce a listed fish on to their property.

**What university education components or experiences most prepared you for your career?**

I received a B.S. in wildlife management (fisheries option) from West Virginia University in 1980 and a M.S. in Fisheries from Michigan State University in 1982.

The broad course work I gained from these degrees gave me a comprehensive view of ecosystem processes and species interactions. I also gained the understanding that you need to step back and take a broad view of each situation, including the biological, social, and political aspects, in order to improve your chances of success. I learned the value of collaboration with individuals from diverse scientific backgrounds and the nuances of working together with private stakeholders (commercial fishermen for my M.S. thesis project and private landowners for various other projects) to instill their ownership/buy-in with the projects a fisheries professional or scientist needs to try to implement.

**What are the next fish recovery challenges in your sights?**

We (ODFW, BLM, the Nature Conservancy, and USFWS) are close to recovering the Foskett Speckled Dace *Rhinichthys osculus* ssp. in the Warner Valley of southeastern Oregon, and the Borax Lake Chub *Gila boraxobius* in the Alvord Basin (southeastern Oregon). The Foskett Speckled Dace population now exceeds 25,000 individuals, and the BLM has acquired the lands and restored open water habitats that they use. We have been monitoring the Borax Lake Chub for nearly a decade, and it was recently proposed for downlisting, from endangered to threatened. Additionally, we are working with private ranchers to improve passage at irrigation structures to reduce fragmentation of and work to recover the Warner Sucker *Catostomus Warnerensis* populations in southeastern Oregon.

We are also developing a decision support model, in conjunction with Jim Peterson (Oregon State University/U.S. Geological Survey), to prioritize future non-game fish research in Oregon. Ideally, we will identify at-risk species and can prevent them from becoming candidates for an ESA listing.

**What monitoring will be implemented to determine status and trend in Oregon Chub populations?**

We will continue to obtain mark-recapture abundance estimates for Oregon Chub for the next nine years as part of the USFWS Post Delisting Monitoring Plan. We will also continue to search for additional, previously unknown chub populations in the Willamette drainage. These efforts will be lead by Brian Bangs.

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**Oregon Chub** *Oregonichthys crameri* is a small, floodplain, minnow endemic to the Willamette River basin in Oregon. The species inhabits floodplain habitats including sloughs, backwaters, and beaver ponds. The Oregon Chub was listed as endangered under the federal Endangered Species Act (ESA) in 1993. More details regarding Oregon Chub recovery and other efforts to increase our knowledge and recover western native fishes will be presented at the Give a Fish Its Due: Nongame Native Fish of the Western United States Symposium at the AFS Annual Meeting in Portland, Oregon:

**Oregon Chub Recovery: An ESA Success Story**

Tuesday, August 18, 2015: 9:40 AM
B-116 (Oregon Convention Center)
Brian Bangs, Paul Scheerer, and Shaun Clements

**Influence of Demographic and Genetic Factors on Genetic Variation in Introduced Populations of Oregon Chub**

Tuesday, August 18, 2015: 10:20 AM
B-116 (Oregon Convention Center)
Patrick DeHaan, Brice Adams, Paul Scheerer, and Brian Bangs

**Effects of US Army Corps of Engineers Operations on Off-Channel Habitats Used By Oregon Chub and Other Floodplain Fishes in the Willamette Basin, Oregon**

Tuesday, August 18, 2015: 11:20 AM
D-135 (Oregon Convention Center)
Greg Taylor, Brian Bangs, Paul Scheerer, and Shaun Clements
Adventures of an Urban Angler

Christopher Moore
E-mail: mootopher@gmail.com

There’s not much finesse involved. Leave your dry flies at home, and try not to think in terms like pocket water or drift. When you’re hunting snakeheads in a shallow, urbanized stream, it helps to cover a lot of ground quickly. This means walking up and down the streambank looking for that bullet-shaped body. You can’t miss it in water that’s only a couple feet deep.

The Northern Snakehead *Channa argus* was discovered in a pond in eastern Maryland back in 2002. Since then, it has spread to most of our major rivers—even showing up in the Chesapeake Bay after periods of heavy rain have altered the salinity in its favor. The lower Potomac River has an especially robust population, and in the summer, they are on the move. Adults will look for shallow, grassy margins to shelter their newly hatched fry. Snakeheads are great parents—no doubt one reason for their phenomenal expansion—but this also makes them easy targets.

Just look for your loudest, ugliest, most obnoxious looking bass fly and have at it! It helps to focus on undercut banks or areas with overhanging vegetation or woody debris. I spotted one patrolling the slack water under a bridge spanning the Northeast Branch of the Anacostia River.

A popular jogging trail runs adjacent to the Northeast Branch, and the “snake monster” fish always brings a crowd. There is no catch and release permitted, but before dispatching it, I took the opportunity to demonstrate how this species cannot crawl over land, as had been mistakenly reported in the media. In fact, despite their fearsome appearance, the Northern Snakehead is reputed to be a tasty fish (gasp!), second only to Walleye *Sander vitreus* or Yellow Perch *Perca flavescens* for its mild flavor. I had reservations about eating this one, however, because of where it was caught; the Anacostia, unfortunately, is one of our nation’s most polluted rivers.

Speaking of eating, in the initial frenzy following the discovery of the Northern Snakehead in Maryland, people expressed concern for their pets and young children. To date, no cats or kindergartners have turned up while analyzing stomach contents; instead, Banded Killifish *Fundulus diaphanus* and Bluegill *Lepomis macrochirus* are two of the species most often reported. One angler I encountered showed me his cooler with five or six snakeheads, all between two- and three-feet-long, caught with small sunfish he’d collected earlier that day.

But even if a rogue fish developed a craving for human flesh, it would have a hard time leaving the water. *C. argus* is not flattened ventrally, and this makes “crawling” out of the question. Confusion on this point is understandable, however. Of the 29 species of snakehead found throughout Asia and tropical Africa, several are in fact capable of overland migration. Presumably this sort of adaptive behavior is advantageous in periods of drought or in areas with ephemeral stream channels. That being said, flood conditions are thought to contribute to the spread of *C. argus* in local waters. You won’t find it lurking in the shrubbery waiting to ambush the neighbor’s house cat, but you might find it in a drainage ditch or in a flooded field after periods of heavy rain.

Our own newly resident species, the Northern Snakehead, also benefits in other ways from its interesting physiology. Like gar, all snakeheads are obligate air breathers. This makes them
tolerant of warm, shallow, hypoxic water—summertime conditions—in other words, many of our urbanized stream systems. The *Channidae* are by and large a tropical or subtropical family of fishes. Lucky for us, the Northern Snakehead is the one species within the genus/family that can survive over-wintering in a temperate climate. Other species (e.g., *C. micropeltes*, the Giant Snakehead) have also been collected in area waters and throughout the northeastern United States but are thought to be incapable of establishing viable populations.

It is through human agency, of course, that these fish have been found so far from their native range. Aquarium releases pose a problem as do fish imported or captive bred for use in the live-food fish trade. Nevertheless, in a silver lining of sorts, the Northern Snakehead has reawakened an interest in the health of the Anacostia River and its watershed. Snakehead stories in the news are almost invariably packaged as “yet one more problem” for the river and its inhabitants. But it’s hard to think of a fish with more sex appeal, and this has people returning to the river. Historically, the Anacostia and its tributaries boasted huge runs of shad and herring. My ramblings throughout the watershed can attest to this; in exposed areas of the stream channel, I’ve found Native American net weights as well as nineteenth century lumps of cast iron used for the same purpose. Since then, the usual march of progress has turned what was once a river with an active floodplain into something resembling, in places, an enormous ditch. But it’s a ditch with an exotic fish, and I’m always pleasantly surprised to find folks fishing.

Growing up in North Carolina, I never really had the chance to tangle with too many esocids, other than Chain Pickerel *Esox niger*. Down south, it can seem like the Largemouth Bass *Micropterus salmoides* is the only gospel in town. Both fish will hit hard, but in my experience it’s over after a couple of short runs. The Northern Snakehead is different. If I had to compare it to some other species, I’d have to go with gar. A big Longnose Gar *Lepisosteus osseus* will fight you up and down the water column and then trash the boat for kicks. Common Carp *Cyprinus carpio* come to mind as well. This statement is tasteless (pun intended) and offensive—please no hate mail—but give a big carp room to run, and it’s on! Ask none other than the great Lefty Kreh himself. In his autobiography *My Life Was This Big*, Kreh calls the carp “one of the strongest and most challenging freshwater fish out there.” Big carp and snakeheads are cautious fish, and successful pursuit of either species requires planning and stealth. Sometimes it seems more like hunting than fishing.

The Northern Snakehead is probably here to stay, and interagency efforts are underway to monitor the species and track its expansion in the Potomac River basin. To its credit, Maryland Department of Natural Resources has done a great job getting the word out about this invasive fish. As of this writing, it has not been found above Great Falls—the fall line on the Potomac River—and officials are hoping to keep it that way. With that in mind, it is hoped that the angling community can play the role of apex predator and suppress the fish’s population growth. I met one family who traveled from over 90 minutes away for a chance to catch the fish. Keep in mind folks, this is not the beautiful Blackfoot River of *A River Runs Through It*. This is the Anacostia. And that’s worth thinking about.

For further reading on the Northern Snakehead *Channa argus* or snakeheads in general, the interested reader is encouraged to consult the following sources:

- fws.gov/northeast/marylandfisheries/projects/Northern%20Snakehead.html
- midatlanticpanel.org/resources/publications/Northern_Snakehead.pdf
- nas.er.usgs.gov/taxgroup/fish/northernsnakeheaddistribution.aspx

Christopher Moore posing with his catch. Photo credit: Mandy Rodrigues.

Two local anglers catching snakehead on the Anacostia River. Credit: Mandy Rodrigues.
Customers can view real-time information and see what is going on in the river at any time. Counts and charts available without having to download data and start a specific software. Automatic reports are available for any chosen period of time. Easy to share information. Easy to compare data.

Examine temperature records for a particular period. Analyze images of each fish and sort the fish in different groups. Users can easily edit data if needed. All data securely stored and accessible at any time.

The Riverwatcher is in operation to monitor fish migration patterns in over 300 rivers world-wide.

Know your River
www.riverwatcher.is
NOAA Fisheries At-Sea Volunteer Opportunities: Hands-On, Hard Work, and a Great Experience

Shelley Dawicki, Northeast Fisheries Science Center. E-mail: shelley.dawicki@noaa.gov

For decades, volunteers have played an important role in National Oceanic and Atmospheric Administration (NOAA) Fisheries at-sea research operations, working side by side with federal researchers during a variety of surveys throughout the year. These include spring and fall bottom trawl surveys; summer surf clam Spisula solidissima, ocean quahog Arctica islandica, and sea scallop Placopecten magellanicus dredge surveys; and fall Atlantic Herring Clupea harengus acoustic surveys. Most of the volunteers have worked with the Ecosystems Surveys Branch, based at the Woods Hole Laboratory of NOAA’s Northeast Fisheries Science Center (NEFSC), which conducts the majority of the NEFSC’s fishery assessment cruises each year.

The NEFSC bottom trawl surveys have been conducted since the mid-1960s and represent one of the world’s longest time series of standardized fishery-independent abundance indices for important fishery species. The scallop and clam surveys began in the late 1970s, and the fisheries acoustic surveys began in 1998.

“As far as I can determine, volunteers have participated on our surveys since the 1960s,” said Rob Johnston, who is chief of ecosystem survey operations at the NEFSC. “The volunteers are usually students, scientists, or educators with a specific interest in going to sea for a few weeks. It is not a cruise in the way the public thinks of a cruise, as a leisurely recreational activity or vacation. It is often hard, physically demanding work, requiring long hours on watch. The scientists and the volunteers work closely together.”

Surveys are conducted to monitor recruitment, biomass and abundance, geographic distribution, and changes in the ecosystem. They also collect biological data used to track maturity stages and feeding habits as well as environmental data useful in a variety of research. Much of this information, added to landings and other data supplied directly by fishermen, is used for fishery stock assessments and helps guide management decisions. “It is important work, critical to our mission to understand, conserve, and utilize in a sustainable way the living marine resources on the Northeast U.S. Continental Shelf,” Johnston said.

Volunteers are members of the scientific party and work the same shifts as the scientists. That means a 12-hour stretch on the spring and fall bottom trawl surveys aboard the 209-foot NOAA ship Henry B. Bigelow. The ship conducts multispecies finfish surveys throughout the U.S. Northeast Continental Shelf in four legs: Cape Hatteras/Mid-Atlantic, Southern New England, Georges Bank, and the Gulf of Maine. Each of the legs lasts two to three weeks. The spring 2015 survey began in early March and ran into early May. The fall 2015 bottom trawl survey will take place from early September through mid-November.

Given that there are only 15 berths for the science party on the Bigelow and 24-hour operations, every bunk needs to be filled with a qualified person. Working out the logistics is the job of Katherine Sowers, Ecosystems Surveys Branch cruise staffing coordinator since 2006.

“Volunteers are full-fledged members of the scientific party, and we place a great value on their participation to help us conduct the surveys and collect data,” said Sowers. “The demands of the schedule and the workload require that every member of the party be able to perform the duties required of a scientist during that leg of the voyage. Our biggest challenge is developing a well-balanced roster for each of the survey legs. Volunteers are important in that regard.”

Volunteers learn about the opportunities through the NEFSC website (nefsc.noaa.gov/femad/ecosurvey/mainpage), by word of mouth, or through e-mail alerts. Once they sign up, complete a questionnaire, and meet medical requirements, volunteers are on Sowers’ e-mail list will be notified about upcoming surveys. Staffing calls for the next season’s survey are issued three times a year: the end of January for the spring, the end of March for the summer, and the end of July for the fall surveys.

Sowers used to talk with many of the volunteers by phone, sometimes in person, but these days most of the communication is done by e-mail. “I get new candidates all the time, from all over the country and from all ages and backgrounds,” Sowers said. “Most of them have interest in or experience going to sea, are students who want or need the experience for degree requirements, or are educators who want to learn and then share the experience with others when they return, such as participants in the NOAA Teacher at Sea program. This spring, for example, we had volunteers on every leg from such places as the U.S. Coast Guard, Cornell University, and the University of Rhode Island.”

Depending on the type of cruise, volunteers handle fish, scallops, and other species caught in nets or a dredge; sort the catch; sample specimens; and record data. In the process, they learn about various fish and shellfish species, how surveys are conducted, and the types of information collected and where it goes. Once processed, data are used in stock assessments, as guidance for resource managers, and for a wide range of research programs. The operations of the research vessel, how the catch is collected, and preparations for handling the catch aboard ship are all part of the learning experience. The at-sea volunteer opportunity can help students decide on career paths and is a positive addition to resumes.
Joseph Kunkel and Carol Glor represent the diversity of volunteers. Kunkel, a biologist and professor at the University of New England, has been a volunteer scientist since 1998 during spring and fall bottom trawl surveys aboard the NEFSC’s fisheries survey vessels Albatross IV, Delaware II, and now the Henry B. Bigelow. Glor is a middle school teacher from New York who teaches home and career skills and who was a 2014 NOAA Teacher at Sea. She joined the scallop survey aboard the research vessel Hugh R. Sharp in July 2014 as a first-time volunteer.

The type and timing of the surveys makes a difference. There are more volunteer opportunities for students and teachers on the summer clam and scallop surveys, which tend to have shorter legs. The clam surveys, to determine the distribution and abundance of Atlantic surf clams Spisula solidissima and ocean quahogs Arctica islandica, are conducted aboard a chartered commercial vessel in three legs in late July and August, each leg lasting about five days. Since 2012, about one-third of the resource is surveyed annually from the Delmarva Peninsula to Georges Bank.

The sea scallop surveys are conducted between May and July aboard the 146-foot research vessel Hugh R. Sharp, operated by the University of Delaware as part of the University—National Oceanographic Laboratory System research fleet. The 2015 integrated benthic/sea scallop survey used an eight-foot dredge and “HabCam,” a towed underwater imaging vehicle, to determine the distribution and abundance of scallops from the Mid-Atlantic Bight to Georges Bank. A number of volunteers, from college students to high school teachers, worked with NEFSC staff aboard each of the three legs, which range from 11 to 14 days each.

At the end of their experience at sea, each volunteer completes an evaluation, and Sowers speaks with the watch chiefs to get their input. “The science crew enjoys meeting new people from different backgrounds and interests, and the volunteers come away with an appreciation of life at sea and the work involved in the surveys,” Sowers said. “It isn’t for everyone, as the workload can be tough and dealing with seasickness is not something you want to do. But the experience is usually a positive and memorable one.”

Some of the positives of life aboard ship come when volunteers are not on watch. The galley is popular because food is always available there, and the ship’s lounge is a place to relax with a book, watch movies, play cards, or chat with shipmates. Some do handwork they have brought, and with 24-hour Internet, everyone can stay in contact with family and friends ashore via their laptop. Out on deck, volunteers can observe the variety of seabirds, sometimes rare sightings, or catch glimpses of whales, dolphins, and other marine mammals. And then there are the picture postcard sunrises and sunsets at sea—there is nothing like it.

One recent fall bottom trawl survey volunteer said of the experience: “I had worries that as volunteers, we will get small, maybe unnecessary jobs, but that was not the case at all. We were actually doing the work. Awesome!”

**RELATED LINKS**
NEFSC cruise volunteer information: nefsc.noaa.gov/femad/ecosurvey/mainpage/welcome_aboard.html
Other volunteer opportunities at NOAA: volunteer.noaa.gov

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**My Adventure Volunteering on NOAA Ships**

**Joseph Kunkel**

Department of Marine Science, University of New England, Biddeford, ME 04005

My grandfather had sailed as a young man on four-masted barks and in World War II captained a junk cargo ship that was scuttled at Omaha Beach in Normandy as a breakwater for the D-Day invasion. My brother became a navigator in the U.S. Navy and served in the Naval Reserve. I became a land-oriented insect research biologist, even though I did yearn to live close to the sea.

Perhaps in an attempt to have more to say to my marine-oriented relatives, I started doing some research funded by NOAA’s National Marine Fisheries Service on Winter Flounder Pseudopleuronectes americanus. That led to NOAA funding to study cod fish immunology, and that led to my first time as a volunteer scientist on the Northeast Groundfish Survey, better known as the spring and fall bottom trawl surveys. My intention was to collect samples of cod serum and epidermal mucous to test for vitellogenin, which would indicate whether the cod fish was maturing to adulthood and provide a nonlethal method for checking for maturity in cod stocks—a method that did not interfere with the normal processing of cod by the fisherman.

Well, the cod-slime project did not work out, but I fell in love with going to sea on the NOAA ship Albatross IV and working in the roles of “cutter” or “data recorder” in the twoperson teams that gathered data on the trawl bounty. I got to know many of the species of the northeast coastal shelf, working mainly on legs three and four of the survey. Over 17 years, I have been on 24 legs, in fall, spring, or both, and have never been on a leg in which I have not seen a new species to add to my life-list of marine organisms.

After several years of volunteering, I thought about preparing for my eventual demise by planning to have my ashes returned to the sea from the working back deck of the Albatross IV. Then NOAA retired the Albatross IV and provided a new ship, the Henry B. Bigelow, a wonderful addition to the NOAA fleet, which soothed my pain on the loss of the Albatross. I got to be included in the history of the Albatross IV, in the list of volunteers with sizeable service, an honor I cherish.

I keep a photo gallery of the pictures I have taken of organisms from the trawl net (bio.umass.edu/biology/kunkel/fish/Kunkel_Fish_LifeList.html). Each addition brings excitement.

Compared to my first days going to sea on the Albatross IV, life on the Bigelow is relatively luxurious. I am able to keep in touch with my students (and with family) onshore with the Bigelow’s 24-hour Internet access; on the Albatross, we depended on e-mail service sent by satellite phone twice a day, which often resulted in a day or two turnaround in conversations with those ashore. The food has always been great, whatever ship I was on. The new 12-hours-on, 12-hours-off duty schedule is very livable and very different from the old 6-hours-on, 6-hours-off schedule, which never gave you quite enough sleep in one stretch. I almost yearn for the inevitable rough sea patches on the life on the Albatross IV, when after getting your sea legs after a few days at sea you suddenly were on a roller-coaster that was as exciting a ride as you could get at Coney Island. The Bigelow, on the other hand, is very steady and rocks you to sleep most nights with the gentle
The NOAA ships are always an experience in new technology. Every leg I have been on has involved the introduction and testing of something new. I remember fondly my experience working on the open deck of the Albatross sorting fish that were just released from the trawl net onto the sorting table—wind blowing, waves washing over the deck, and music blaring from the chief bosun’s stereo. That was some experience! Pairs of scientists, cutter and recorder, would then work up the catch in semi-open workstations, where a wave might catch your basket of fish and slide it over the deck to the workstation opposite, and vice versa. Data were recorded in pencil on water-resistant paper sheets, to be tallied ashore in a process that took months. Now, the Bigelow’s on-deck computers with touch screens and data connections to weighing scales have automated a major part of the data input. The NOAA data managers are on the ship preparing the information for transfer to shore as we are collecting it. Wow, what a difference! It takes multiple legs over years to gain perspective on the progress.

I would not have missed the experience at sea as a volunteer scientist on the groundfish survey for anything. You see old friends and meet new ones. Everyone makes an effort to relate to one another, and there are great opportunities to share stories. If it sounds interesting, all you need to do is volunteer.

Joseph Kunkel is a research professor at the University of New England in Biddeford, Maine, and a professor emeritus at the University of Massachusetts Amherst, where he conducted research and taught for 42 years. He grew up on a tidal salt marsh on Long Island, spent his early years collecting insects, and majored in zoology in college and continued his interest in insect development in graduate school. His research interests include developmental biology, cell physiology, biometry, and pattern formation and development. Kunkel has been a volunteer scientist since 1998, during spring and fall bottom trawl surveys, aboard the Northeast Fisheries Science Center’s fisheries survey vessels Albatross IV, Delaware II, and now the Henry B. Bigelow. He completed his 25th leg as a volunteer this spring on the Bigelow.

A Voyage That Changed the Way I Thought about Life at Sea
Carol Glor
West Genesee Middle School, Camillus, NY 13031

On July 5, 2014, I embarked on a voyage that would change the way I thought about life at sea. The research vessel Hugh R. Sharp sat at the end of the NFSC dock in Woods Hole, Massachusetts, awaiting a various assortment of science staff, crew and volunteers. As a member of NOAA’s Teacher at Sea program, I was the odd man out. In addition to being a volunteer, I also had the daunting task of absorbing and documenting every aspect of the ship and its research activities for the Teacher at Sea program.

An online training program prior to the cruise was very helpful in preparing me for life aboard the ship and how I would write and publish my blog from sea. In reality, most of my learning came from my experiences on the Sharp. There were 20 people aboard as we left the dock and ventured out into stormy seas. Hurricane Arthur moved on and our trek out to Georges Bank was a rough one. Most of the first-time sailors were prepared with seasick patches, which seemed to do the trick.

Life on board the ship settled into an easy routine. It seemed that our past lives took a break, and we were able to experience what it must be like to work at sea as the crew who does this for most of the year.

Sleeping quarters for the science staff were below deck. Four people shared a cabin that consisted of two sets of bunk
about the fishing industry and willingly give up time with their families to conduct important research. The crew members made it easy to feel at home with their concern for safety and comfort needs. The chef provided delicious meals to rival any restaurant, and the galley was always open for snacks and beverages.

I am more determined now to promote the study of ocean science as part of my home and career skills curriculum. The future of our existence on land depends on the protection of our seas. I feel honored that I have done my small part to help keep our oceans alive for future generations.

A teacher for 17 years, Carol Glor currently teaches home and career skills to sixth-, seventh-, and eighth-graders at West Genesee Middle School in Camillus, New York. The scallop survey was her first hands-on field experience. In an interview in the local newspaper, Eagle Observer, shortly after she returned home, Glor said, “The NOAA scientists really assumed that I was able to take on any of the tasks that they were doing as well. I was definitely an equal. They encouraged me to try everything that they were doing, whether it was setting up computer systems to get ready to launch their dredging equipment or actually piloting the camera system. They were great about letting me have first-hand experience that I could take back and share with my students.” Glor said she would not hesitate to return for another voyage and would recommend this experience to any teacher of any subject area.
University of Southern Mississippi–Gulf Coast Research Laboratory: Interview with Jim Franks

The Gulf Coast Research Laboratory (GCRL) is a marine/coastal research and education enterprise sited in Ocean Springs, Mississippi, and is a unit of the University of Southern Mississippi’s College of Science and Technology.

Jim Franks is possibly the most recognized and recognizable GCRL scientist. The still-practicing biologist has been the public face of GCRL at local fishing tournaments for decades and is frequently asked to interpret what’s going on in the marine environment to the general public. Franks has over 35 years experience as a fisheries biologist with research interests ranging from life history studies of Gulf of Mexico offshore fishes such as Cobia, tunas, billfishes, and sharks to pioneering research the floating seaweed *Sargassum*, an offshore essential habitat for many fish species. He has been involved in the development of cutting edge technologies for the laboratory culture of key marine species such as Cobia and tripletail. At heart Franks is a marine conservationist and has quietly had a major impact on marine environmental conservation the Mississippi Gulf Coast and waters beyond. In this article we document and expand on his contributions to both science and conservation of the marine environment.

What are some of the projects at GCRL that you are currently working on?

I am a co-principal investigator on several projects here at GCRL. One of those, sponsored by the Louisiana Department of Wildlife and Fisheries (LDWF), is a life history study of Yellowfin Tuna *Thunnus albacares* in the northern Gulf of Mexico and that is with co-PIs Eric Saillant, Nancy Brown Peterson, and Jill Hendon. We are looking at reproduction strategies, genetic-molecular profiles, and feeding ecology. Other aspects of the project that are being conducted by LDWF involve satellite tagging and acoustic tagging. So it is rather large study, a three-year study, and we are in our last year. My role is overseeing the feeding ecology section of the study and some of the field sampling efforts. We go to various docks and fishing tournaments and get a lot of our samples there. Currently, we are in the process of analyzing those samples, and the final report should be submitted by this fall. This is the first time Yellowfin Tuna resources in the northern Gulf of Mexico (NGOM) have been examined in that detail. Of course, it is an extremely valuable fishery both commercially and recreationally, and we are trying to better understand the population. The genetic aspect of that is looking at Yellowfin Tuna, not only in the Gulf, but the Atlantic and Caribbean, so it is a much broader look at the molecular structure of Yellowfin Tuna in the western Atlantic but are other tasks are focused primarily in the northern Gulf. We are finding that Yellowfin Tuna are very diverse in their diet. Soon, LDWF will have some fantastic information on their movements and migrations, which has never been done before in the Gulf. This will be very exciting.

Another study that is of great interest to us is the Tarpon *Megalops atlanticus* life history work we are doing here in the northern Gulf. It is really the first study of its sort, looking at age, spawning, and larval habitat. This project is funded by the Mississippi Department of Marine Resources. Tarpon biology was really something that had not been exam-
leptocephalus, that drifts at sea for quite a long time and then transforms into a juvenile once it reaches the coastline. We are collecting some of those just as they are beginning to transform, and the interesting part of that is we have been able to age them. We know how many days old they are and one way of helping to document that Tarpon are actually spawning off of Mississippi is to take the age of the larvae and plug it into some of our ocean models and go back in time. We back track ocean currents and the movements of those larvae for the number of days old they are, and it sort of takes us off into the Gulf south of us, so it is helping document that they came from here and not drifted on currents from Mexico or south Florida, traditional Tarpon spawning locations.

Can you tell us about some of your shark studies?

I am collaborating with Jill Hendon here who is really our shark biologist. She is in charge of our shark surveys and the Whale Shark *Rhincodon typus* tagging program (being conducted in conjunction with LWDF). We have been doing the Whale Shark study for about six or seven years. We first found these big aggregations of Whale Sharks in south Louisiana a few years ago; prior to that very little had ever been done. We reported that they were aggregating to feed on the spawn of certain species of fish that gather over the domes and the banks in the NGOM and that they time their movements across we think in conjunction with those spawning events because they have to feed. And if you are that big, you eat a lot. One of the spawning events is so well documented that the team now knows where to go on what day and month to encounter it. We are going to see if that holds true this July. It is a special spawning event that occurs there during a particular moon phase, and two years ago over 100 whale sharks gathered there at one time. Some of those sharks are satellite tagged, and those results are still coming in. We think some of them might even stay in the Gulf over winter, which was previously unknown. I think we have four or five more tags to deploy this summer and then that will be up in the neighborhood of 40 or 50 whales sharks that we have tagged. They are just remarkable animals. We are also getting DNA samples to compare with tissue samples taken around the Caribbean and the Atlantic. We think they are moving all over. Interestingly, we think most of these are juveniles, even at their large size. We have no idea where the little guys are; they have never been seen in the Gulf, the extremely young ones. We don’t know where they give birth. We are not aware of any of that so that is still a big unknown, but we have aerial surveys that are conducted to go out and spot the whale sharks for us and then the boats go to those areas. It is just a lot more practical that way.

We have some really neat acoustic tagging that is underway, tagging sharks, reef fishes, trout, and those smaller species in the estuary. We are trying to understand their relationship with artificial reefs. Jill and I are involved in that study. We are interested in sharks, Red Drum *Sciaenops ocellatus*, small snappers, and groupers. It something we began a few years ago, and next year we plan to conduct a rather large study on one of the bays examining habitat use of small recreational juvenile fishes and young sharks. We hope to expand it one day to the whole Mississippi Sound. We envision it like wiring the whole Sound with an entire array of acoustic receivers and then picking up all sorts of activity.

I am very interested in sargassum. We are still conducting research on pelagic sargassum in the Gulf and all of the associated...
We have made some rather good progress in our studies of undergraduate and graduate students alike, and in our successes of programs that we offer, in our educational opportunities for direction. I think we are unique in our location, in our diversity; we have made great progress and continue to move in that vessel. Under the guidance and leadership of our administration, we have great captains and crews. Recently, we received a new funding. We have a great fleet of boats, both small and large, and we are doing satellite tagging of big offshore sharks and hopefully the GOM and its marine life. We now have 50 graduate student here who are working in all aspects of marine science, and essentially all of those students are involved in a project because this is the way they get their funding through the projects. It's not necessarily a fellowship; they have to work, so they are deeply involved in those research programs, and aspects of those programs become their research topic for their thesis or dissertation. It is a very active graduate program.

A lot has happened since 1947. I first came here as a student in the summer field program in 1963 and that just changed my life. It was just an eye opener for me. I came from Tennessee, and I was interested in freshwater things and that just sort of changed my mind. I came back the next year and took more classes—marine invertebrates and a few other things. The third year summer year I was a senior and was the TA in the ichthyology class and then began my graduate work at University of Mississippi and through GCR L. So I have been a part of this place for over 50 years. It is kind of my home. In fact, everybody tells me I should get a little bunk bed and put it in my office and live there. It is very special and when I first came here there were 12 people, so I have seen it evolve through many things, including two major hurricanes: Katrina and Camille. The lab was really hammered by both of those storms, but we have come back from them, and we are growing and getting stronger. We are going to have a new marine education center shortly, and we have the new field studies building, so things are looking up.

The lab has been here for many decades, since 1947. In my opinion, it's been a leader in marine science in the Gulf of Mexico. It has gone through a number of transformations, initially looking at local oyster and shrimp populations and has grown into a really significant education, research, and outreach institution. I think we offer some of the best opportunities here for students to learn fisheries science through our Department of Coastal Sciences and our Center of Fisheries Research and Development. We work collaboratively in many ways, and I think that is key to the success of the fisheries work here. We are always out looking for funding opportunities because the majority of our funding comes from outside. We have to go find our money, grants, and our students' support, so we are always actively proposing ideas and looking all around for collaborative opportunities. We have been considerably successful in that, but I think we are unique in that we are positioned. We are right here in the NGOM, and our programs have now extended from the coastal estuaries to offshore to where we do work with the loop current. We examine offshore fish populations. We are doing satellite tagging of big offshore sharks and hopefully billfishes down the road, so we work all the way from the marsh edge all the way out to the deep Gulf; that's a big area to cover. And there is so much yet to learn. We have so many good people here at this institution and so many good ideas, and we work very well together. We have good support from our administration. We have a great fleet of boats, both small and large, and we have great captains and crews. Recently, we received a new vessel. Under the guidance and leadership of our administration, we have made great progress and continue to move in that direction. I think we are unique in our location, in our diversity of programs that we offer, in our educational opportunities for undergraduate and graduate students alike, and in our successes. We have had made some rather good progress in our studies of
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Thanks to AFS Member Dirk Miller for much of the information listed above.

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Research experience can powerfully ignite students’ curiosity, expose them to potential career paths, and ultimately prepare them for the world of science. Unfortunately, as a biology undergraduate with a strong passion for marine science in the landlocked state of Tennessee, it is difficult to apply my education and gain practical field experience. However, thanks to the Summer Field Program at the University of Southern Mississippi’s Gulf Coast Research Laboratory (GCRL) in Ocean Springs, Mississippi, I was able to get my feet wet.

In the summer of 2014, I participated in a long-line survey research project concerning the Atlantic Sharpnose Shark *Rhizoprionodon terraenovae* with my Elasmobranch Biology class. The project aimed at understanding certain physiological parameters relating to stress. The research we conducted was incredibly fascinating. However, this study was just a small part of the course. We spent plenty of time in the classroom and lab learning about anatomy, taxonomy, ecology, behavior, etc. Throughout the four-week class, we jetted out to sea multiple times to try our luck at catching sharks.

From our fieldwork, we caught multiple species, including Atlantic Sharpnose Shark, Blacktip Shark *Carcharhinus limbatus*, Great Hammerhead Shark *Sphyrna mokarran*, and even Bull Shark *C. leucas*. We used a one-mile longline, bearing 100 circle hooks baited with mackerel, deployed for one hour. At the midpoint of the longline, we measured water quality parameters (e.g., dissolved oxygen, temperature, salinity). Individual captured sharks were measured, weighed, and tagged before release. We also extracted blood from a subsample of 14 male *R. terraenovae* individuals for hematological analyses of lactate and glucose levels.

The lactate and glucose levels, along with the rest of the data collected, were utilized for further individual interpretation. Using these hematological measurements, we observed correlations between the lactate and glucose levels that varied according to the length and mass of the individuals. Overall, larger individuals had higher lactate levels and lower glucose levels in their bloodstream.

The process we were measuring was stress-induced anaerobic glycolysis. Stress-induced anaerobic glycolysis occurs when glycogen is used in white muscle cells to produce adenosine triphosphate in the absence of oxygen. Lactate production is catalyzed when this occurs (Klimley 2013). Over time, lactate production and buildup can cause severe health issues, including blood acidosis (Skomal 2007; Frick et al. 2012). Stress-inducing events such as reproduction, long-line capture, and predation can cause this phenomenon to occur.

Our results indicated a positive correlation between body size and lactate levels. From these data, we inferred that the larger individuals were on average older than the smaller ones, suggesting lactate buildup over time. Older individuals have had more time to experience stressful encounters, perhaps causing their bodies to accumulate lactate more than younger, less experienced individuals. Lactate accumulation in some species of large pelagic fishes can cause negative long-term effects such as internal physical trauma, homeostatic disruptions, and abnormal physiological function (Skomal 2007).

Long-line and rod-and-reel capture can negatively affect sharks’ health, causing them to undergo stress and expend considerable energy during capture and handling. Reducing stress is paramount in minimizing lactate accumulation; however, recreational and commercial shark fishing is a part of human culture worldwide. Recent research suggests that we are contributing to the demise of several elasmobranch species, not only in this way, but also in many other ways: shark fin soup, tourism, habitat degradation and loss, and bycatch (Dulvy et al. 2014).

My class members collaborated to brainstorm unique interpretations of the data. The project gave us experience out in the field as well as at our computers, where we learned the meticulous process of scientific writing. Most of all, it gave us the freedom to explore the various ranges of data interpretation from research.

The class and the people I worked alongside throughout last summer impacted me in a profound way. It firmly reassured me that marine biology was the path for me. More than anything
else, I gained a priceless perspective on the coast that I would not have gotten otherwise in Tennessee.

The memories of my charmingly geeky coastal summer will forever be some of my favorites: full of stress, yet full of excitement; full of seasickness (unfortunately), yet full of discovery. I implore any aquatic biology fanatic to explore their options on further education outside of their home institution. It’s your education; take control of it. Broadening your scientific experiences beyond the classroom and beyond your backyard can only be beneficial for you as a fledgling scientist in this field. As for me, I am here in Ocean Springs again this summer as an intern, broadening my horizons and developing connections far away from my landlocked home. So let me ask you: what are you doing next summer?

REFERENCES


Measuring an Atlantic Sharpnose Shark Rhizoprionodon terraenovae captured by longlining. Photo Credit: GCRL.
Exploring the Wonders of the Arctic from a Lab Bench

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Like many ecologists, I have a love of fieldwork and a passion for being witness to the ecosystems I study. The field is where I make connections and develop hypotheses to explain observations of organisms in their natural environment. I have often cringed at the thought of spending all my time in a lab or pouring over data on a computer. Then I accepted a graduate position at the University of Manitoba, working with Jim Roth, Gary Anderson, Steve Ferguson, and Gregg Tomy on a project that used archived samples to examine whether cortisol levels were higher in threatened Beluga Whale Delphinapterus leucas populations when compared to healthy populations. The use of archived samples meant that I wouldn’t get into the field to collect my own samples. I accepted the position, despite the absence of a field component, because I felt that it was important for me to gain strong laboratory skills hoping that I might be sent to the field at least once, maybe twice, as an assistant on someone else’s research. I learned far more in the lab than just becoming better about enduring the lab. I learned that spectacular science can occur at a lab bench. Lab work is not for the faint of heart; it can be just as challenging as working in the elements. To answer questions about cortisol differences among populations, we first needed to extract cortisol, a known stress hormone, from Beluga Whale blubber. We had to develop new methods because this process had never been done. I processed hundreds of blubber samples that had been collected during subsistence hunts by northern communities over the past 30 years and tried a variety of simple cortisol extraction methods, none of which yielded results. Then I discovered two publications where testosterone and progesterone had been extracted from blubber. With some slight alterations of those methods and after several attempts, I finally identified cortisol in blubber samples. While processing samples, I also noticed that blubber consistency changed with blubber depth and among samples, depending on the quality of the sample after storage. I recorded the condition of the blubber samples and prepared a subset of samples to examine cortisol with blubber depth. These seemingly small observations in the lab led to major findings, with some beautiful data illustrating the effect of blubber depth and degradation from long-term storage on cortisol concentrations. What was originally a side note in my thesis became my first publication (Trana et al. 2015). I found that observation and speculation leading to testable hypotheses could happen just as easily in the lab as in the field. So for others who are field oriented, I encourage you to embrace opportunities in the lab, which can also be intellectually stimulating and highly rewarding.

REFERENCE

Beluga Whales in the Churchill River estuary. Photo credit: Marci Trana.

Beluga Whale blubber extraction in progress. The lipid layer (light yellow) and interstitial tissue (dark yellow) pelleted against the bottom of the vial. Photo credit: Marci Trana.

A section of Beluga Whale blubber removed for use in cortisol extraction and analysis. The skin (white) is against the table surface, the dark layer at the top is muscle, and in between these layers is blubber. Photo credit: Marci Trana.
Fishing Down through the Food Web

Villy Christensen
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Villy Christensen is a professor at UBC, and he leads the development of the Ecopath with Ecosim (EwE) modeling approach and software, which is coordinated through an international consortium with 25 institutional members. His research is focused on modeling the future ocean.
“Fishing Down Through the Food Web”—What was I thinking when I dreamed up that title for the American Institute of Fisheries Research Biologists symposium at the 2014 American Fisheries Society Annual Meeting? Given the raging debate on whether we’re fishing down, up, or through the food web (Branch 2015, this issue), it seems an indecisive compromise—but it actually reflects what I think about the debate: we’re doing it all.

Let me explain: the “fishing down the food web” process was defined as follows: “In unfished areas we can expect ecosystems to be in some sort of balance, often with relatively high abundances of predatory fish. Initially, fisheries may target the larger, predatory, and often higher-priced species. Gradually, the fishing pressure will make the larger species more scarce, and fishing will move towards the smaller species” (Christensen 1996, p. 429). The definition describes an evolutionary process that explains what happens over time as an ecosystem is exploited. For coastal marine ecosystems, this is a process that has taken place over millennia, in deeper waters over decades (Pauly et al. 2003).

Fishing down the food web was thus conceived to imply a gradual reduction in the abundance of large, long-lived, high-trophic-level species and a replacement by smaller, short-lived, low-trophic-level, more productive species for both catches and ecosystems. Based on this, I speculated, “We may expect potential catches to increase if we fish out the predators and fish on their prey instead. If the prey is one trophic level below the target fish species, might we be able to increase the catches by a factor of 10?” The factor of 10 comes in because productivity increases by close to an order of magnitude by trophic level, given that the average trophic transfer efficiency between trophic levels is around 0.1 (Pauly and Christensen 1995).

Empirically, the factor of 10 is not far off. Based on a suite of ecosystem models, I found that ecosystems in which fisheries were operating one trophic level lower on average had eight times higher catch (Figure 1). So, there is a gain to be obtained by fishing down or through the food web, at least with regard to food quantity.

Evaluation of the fishing down the food web process was made operational in a study that used the Food and Agriculture Organization of the United Nations’ catch statistics to show that the mean trophic level of fishery catch (or “mean trophic level of catch”) had declined globally and regionally since 1950 (Pauly et al. 1998). In some regions, notably the heavily exploited Northeast Atlantic, the catches increased over the first part of the time series while mean trophic level of catch decreased, but later on both the catches and mean trophic level of catch decreased. The resulting “backward-bending” time series curves were interpreted as bad news for the ecosystem because fewer and smaller fish being caught is alarming.

Since then, many studies have used time series of mean trophic level of catch to evaluate whether fishing down the food web was occurring for a wide range of ecosystems globally (e.g., Stergiou and Christensen 2011). The results have diverged. Sometimes you see it, sometimes you don’t. There are indeed a number of associated biases, as initially pointed out by Caddy et al. (1998), and since then by many others (discussed by Branch 2015). One important bias is that fishing strategies may change because of incentives.

Fishing strategies most certainly change, and it is no surprise to me. My father would shift between catching tuna, shrimp, cod, herring, and plaice, among others, all based on season and market conditions. Still, I am convinced that the long-term process that is involved in exploiting natural ecosystems is based on fishing down the food web because ecological history tells us so. It happened in terrestrial ecosystems when hunting was a way of life, and it happens in aquatic systems as a rule. It’s a rule, though, not a law, and market forces and management can certainly change the trajectory. We see this happening now in the parts of the world where fisheries management is effective (Hilborn and Ovando 2014) and fishing pressure is being reduced to the sustainable level. That is good news.

Not all parts of the world have good management or reporting systems in place, and we do need information about what is happening in ecosystems. We need indicators, and the mean trophic level of catch is a candidate indicator. It is not perfect—not even close—but it is easy to estimate from catch statistics and available information. Furthermore, it is easy to understand, and it is widely accepted. Combined, this almost makes it a “pretty good” indicator (sensu Hilborn 2010).

The mean trophic level of catch has been adopted by the Convention on Biological Diversity (CBD) as a key indicator (known as the Marine Trophic Index) for evaluating the conservation status of marine ecosystems globally. This means that close to 200 countries are obligated to report trends in mean trophic level of catch to the CBD. It encourages the countries to evaluate their catch statistics and consider ecological connections as part of their involvement in the CBD, and this by itself holds a promise of progress.

Is reporting mean trophic level of catch meaningful on its own? Not really. There can indeed be numerous explanations for trends in mean trophic level of catch, as is often the case with indicators. Temperature is an example. No doctor would diagnose a patient solely on body temperature. We cannot expect that any...
single indicator will provide a complete picture. It is necessary to consider more indicators, even though this makes communication to non-scientists less clear.

For evaluating trends, a pretty good accompanying indicator to mean trophic level of catch is the fishing-in-balance indicator (Pauly et al. 2000), which evaluates whether a change in catch is matched by a corresponding change in mean trophic level of catch, the logic being that if the mean trophic level of catch decreases, then catches should increase correspondingly if fishing is “in balance.”

Two indicators are much better than one, especially when they are easy to estimate and understand and contribute to the conclusions that can be drawn. Still, they are only indicators: indicators of a process, which for unmanaged systems is on a trajectory toward loss of biodiversity but for which smart management systems can change the future.

ACKNOWLEDGMENTS

With thanks to the American Institute of Fisheries Research Biologists for organizing and supporting the “Are We Still Fishing Down the Food Web?” symposium at the 144th Annual Meeting of the American Fisheries Society in Quebec City. Special thanks to Sean Lucey, Steven Cadrin, and Dick Beamish for the organization and follow-up and to Trevor Branch for good and constructive discussions before, during, and after the symposium. I also thank the two anonymous reviewers for suggestions that improved the manuscript. Funding from NSERC is also acknowledged.

REFERENCES

Fishing Impacts on Food Webs: Multiple Working Hypotheses

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Fisheries impact every part of marine food webs from the upper-trophic-level tunas and sharks to lower-trophic-level oysters and abalone. Although there are multiple ways in which fisheries develop, the dominant paradigm today is that we are “fishing down marine food webs”; first depleting top predators, then successively depleting species lower and lower in food webs (Christensen 1996; Pauly et al. 1998). The evidence for fishing down was declining mean trophic levels in global catch (Pauly et al. 1998), although declining mean trophic levels can result from several alternative scenarios (Figure 1), and mean trophic-level patterns in catches often do not match patterns in the ecosystem (Branch et al. 2010). Regardless, new data show that mean trophic level of catch has steadily increased since the mid-1980s (Tacon and Metian 2009; Branch et al. 2010; Butchart et al. 2010; Butchart et al. 2010; Tacon et al. 2010), unlike declines in all other global biodiversity indicators (Butchart et al. 2010). Additionally, if fishing down the food web is prevalent, top predators should be more likely to collapse, but data show that lower trophic-level species like abalone and oysters are more likely to collapse (Pinsky et al. 2011). Finally, there is no underlying economic reason for fishing down marine food webs: fisheries developed first not for predators but profits, targeting abundant, high-priced, and shallow-water species (Sethi et al. 2010). Thus, fishing down marine food webs is not occurring globally.

There is evidence of fishing down in many ecosystems, although this evidence is confounded by studies that only report a decline in mean trophic level after adjusting data to exclude regions (Freire and Pauly 2010), remove large predators (Bhathal and Pauly 2008), exclude the most abundant species (Arancibia and Neira 2005), calculate declines only from years with declines (Bhathal and Pauly 2008), or remove all species below trophic level 3.25 or 3.5 (Pauly and Watson 2005; Pauly and Froese 2012). When tested at a global scale, removing all species below 3.5 initially resulted in a decline in mean trophic level (Branch et al. 2010; Pauly and Froese 2012); this turned into an increase (Branch 2012) when the Atlantic Cod Gadus morhua trophic level was updated in FishBase and has subsequently turned into a stable trend following the most recent Atlantic Cod update (Figure 2).

Recently, the argument for fishing down has shifted to fisheries expansion as the primary reason why declining mean trophic level in catch has not yet been detected in all areas of the world (Pauly and Palomares 2005; Bhathal and Pauly 2008; Kleisner et al. 2014; Grüss 2015). The basic premise is that fisheries first fished down low-trophic-level nearshore species and then expanded to offshore predators like tunas, and this is argued to mask the evidence for fishing down. Fisheries expansion has certainly occurred (Morato et al. 2006; Swartz et al. 2010), but shifting from low to high trophic levels over time is evidence for fishing up marine food webs, not fishing down marine food webs. This is confirmed by trends in mean trophic level by bins of latitude and distance from the coast (figure 3 in Kleisner et al. 2014), which over 1985 to 2004 show increases for 74% of all bins, with more increases than decreases at every distance from the coast.

I assert that instead of focusing on one hypothesis about how fishing affects marine food webs, we should be following the method of multiple working hypotheses. Instead of focusing on one hypothesis about how fishing affects marine food webs, we should be following the method of multiple working hypotheses (Chamberlin 1965). Chamberlin (1965:755) warns that “The search for facts, the observation of phenomena and their interpretation, are all dominated by affection for the favored theory until it appears to its author or its advocate to have been overwhelmingly established. The theory then rapidly rises to the ruling position.” To avoid the “blinding influence” of such affection, Chamberlin urges that multiple working hypotheses be kept in mind when weighing evidence.

Figure 1. Four scenarios of catches of predators (blue) and prey (red) that all result in declining mean trophic level. Declining mean trophic level can result from either fishing down marine food webs (a), (d), characterized by declining predator catches or from fishing through marine food webs (b), (c), when predator catches are stable or increasing, but catches of their prey expand over time.
In this instance, there are at least five working hypotheses available to explain how fishing affects food webs, which are not mutually exclusive and may vary in space and time:

1. **Fishing down marine food webs** (Christensen 1996; Pauly et al. 1998).
2. **Fishing up marine food webs**: fishing first targets lower trophic levels and then shifts to predators (Essington et al. 2006; Erlandsen et al. 2009; Litzow and Urban 2009).
3. **Fishing through marine food webs**: catches on top predators stay high or increase, but fishing also expands on lower trophic levels (Essington et al. 2006).
4. **Balanced exploitation**: fishing expands over time on all species, regardless of trophic level (Branch et al. 2010; Zhou et al. 2010; Garcia et al. 2012).
5. **Fishing for profits**: fisheries developed based on profit rather than trophic levels, first targeting abundant, highly priced, and easily accessible species, before expanding to other less profitable species (Sethi et al. 2010).

To reliably assess how fisheries affect marine food webs, we must first lay out plausible hypotheses, then examine the evidence for each, and finally decide which hypotheses can be discarded and which ones remain. Following this approach, Essington et al. (2006) found that fishing down occurs in 9 ecosystems, fishing up in 18 ecosystems, and fishing through in 21 ecosystems. As Chamberlin (1965:759) put it, we need “…to balance all available evidence fairly, and to accept that interpretation to which the weight of evidence inclines, not that which simply fits our working hypothesis or our dominant theory.” Moreover, by probing the circumstances that favor particular hypotheses, we are likely to identify which management actions result in different impacts of fishing on marine food webs.

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**REFERENCES**


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ARE WE CATCHING WHAT THEY EAT?

Moving Beyond Trends in the Mean Trophic Level of Catch
The mean trophic level of fisheries catch is commonly used to describe and assess temporal trends in fisheries. Though its value as an indicator to evaluate the relative health of fisheries in marine ecosystems has been hotly debated, the metric calculated is clear. We applied this indicator along with a relatively new indicator, the mean trophic level of predator consumption, to 40 Ecopath models around the world. Together, these measures were used to detect where fisheries and marine predators may be targeting similar trophic levels of prey. Globally, the mean trophic levels caught by all fisheries and finfish fisheries were similar to those consumed by marine mammals but significantly higher than those consumed by seabirds and large predatory fish. We found no significant differences between the median trophic levels targeted by forage fisheries and predators. These indicators can inform ecosystem-based management, especially when information on predators and fishery interactions are limited or unavailable.

¿Estamos pescando lo que ellos comen? Más allá de las tendencias del nivel trófico medio de la captura

El nivel trófico promedio de las capturas pesqueras se utiliza comúnmente para describir y evaluar las tendencias de las pesquerías a través del tiempo. Si bien su utilidad como indicador de la salud relativa de las pesquerías en ecosistemas marinos ha sido un tema de intenso debate, el cálculo de esta métrica es claro. En el presente artículo se aplicó este indicador junto con uno nuevo, el nivel trófico promedio del consumo de los depredadores, a 40 modelos Ecopath alrededor del mundo. Juntas, estas dos medidas fueron utilizadas para detectar dónde las pesquerías y los depredadores marinos pueden estar incidiendo en niveles tróficos similares de las presas. De forma global, los niveles tróficos promedio capturados por todas las pesquerías de escama fueron similares a aquellos consumidos por mamíferos marinos, pero sensiblemente más altos que aquellos consumidos por aves marinas y grandes peces depredadores. No se encontraron diferencias significativas entre los niveles tróficos que utilizan las pesquerías de peces forrajeros y los depredadores. Estos indicadores pueden aportar información útil para el manejo de las pesquerías basado en el ecosistema, especialmente cuando la información sobre los depredadores y las interacciones con las pesquerías es limitada o no está disponible.

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INTRODUCTION

Fisheries can impact marine ecosystems in a variety of ways that are not always apparent or straightforward (e.g., Coll et al. 2008; Roux et al. 2013). For this reason, indicators are often used by scientists and managers to assess the status of marine ecosystems and aid in the decision-making process (e.g., Link 2005; Shin et al. 2010). A variety of ecological indicators exist, operating at many levels of biological hierarchy (i.e., from organisms to landscapes) and varying in scope and complexity (Dale and Beyeler 2001).

In marine ecosystems, indicators for both fished and untargeted species cover a range of theoretical backgrounds and approaches, from size, biomass, or species-based indicators to trophodynamic indicators (e.g., Cury et al. 2005; Link 2005; Shin et al. 2010). Though many of these indicators have been used to evaluate the state of marine ecosystems or the status of fish and fisheries for decades, their application and utility need to be understood in order to support management decisions (Rice and Rochet 2005; Methratta and Link 2006).

The mean trophic level of fisheries catch (mTLC), which was popularized by Pauly et al. (1998), is a commonly used ecosystem-level indicator. This simple metric was proposed to evaluate the relative health of fisheries in ecosystems by assessing whether humans were “fishing down” or sequentially depleting large, long-lived species before targeting smaller, lower trophic level species in food webs over time (Pauly et al. 1998). Since Pauly’s publication, the use of the mTLC has received significant attention and debate within the fisheries literature (e.g., Essington et al. 2006; Branch et al. 2010; Pauly et al. 2013). Much of the controversy about trends in this indicator has been centered on two major themes. The first is that mechanisms other than “fishing down” (i.e., “fishing through” [Essington et al. 2006] or “up” [Litzow and Urban 2009] or economic considerations [Sethi et al. 2010], etc.) may better explain temporal trends in the mTLC across the globe. The second is that the mTLC does not always adequately represent impacts to the entire community (i.e., both the fished and nontargeted species); therefore, it is not an appropriate indicator of ecosystem biodiversity (Branch et al. 2010). Despite these concerns regarding the difficulty in interpreting trends in the mTLC, it remains commonly used in fisheries science (e.g., Moutopoulos et al. 2014), largely because it is simple to calculate with typically available fisheries catch data (Branch et al. 2010; Pauly et al. 2013).

The mTLC has been sparsely used for purposes other than to evaluate trends in marine ecosystems over time. Morissette et al. (2012) used the mTLC and derived a new indicator, the mean trophic level of marine mammal consumption, to evaluate the trophic levels targeted by fisheries with those consumed by marine mammals in several ecosystems. This approach is intriguing because elucidating the direct and indirect interactions between fisheries and marine predators is of great interest to fisheries scientists and managers globally (e.g., Read 2008; Wagner and Boersma 2011). In this way, these indicators may be useful in screening for ecosystems or latitudes where there may be a potential for conflict among predators and fisheries for similar prey items.

In this study, we calculated and analyzed the mTLC and the mean trophic level of predator consumption (mTLPc) to evaluate (1) the potential overlap between marine predators (i.e., marine mammals, seabirds, and large predatory bony [LPB] fish) and fisheries for similar prey items and (2) the dietary preferences of these marine predators. We explored the potential use of these indicators as a screening tool for marine predator and fisheries interactions across latitudes and globally, using data from a variety of Ecopath food web models. Finally, the potential utility of using the mTLC and the mTLPc indicators is discussed, particularly for ecosystems with limited data on marine predators.

MATERIALS AND METHODS

Synthesis of Ecopath Models

We obtained data from a total of 40 Ecopath models representing fished marine ecosystems around the world (Table 1). Ecopath models were used because they are among the most popular ecosystem modeling software globally (Fulton 2010; Colléter et al. 2013); hence, they are readily available for analysis. Data from models were obtained from an existing database (n = 38; Pikitch et al. 2014) or directly from model publications (n = 2; Northern Gulf of Mexico [Geers 2012] and Delaware Bay [Frisk et al. 2011]; Table 1). All models met the requirements established in Pikitch et al. (2014; i.e., they recently represented a marine or estuarine ecosystem, had all necessary data and parameters freely available, and included at least one fished forage fish model group), with the additional requirement that they included at least one of each of the major predator groups (i.e., seabirds, marine mammals, and LPB fish, >90 cm maximum total length). Sharks were excluded from the LPB fish group because they were not present in all ecosystem models and, when present, were often grouped with other elasmobranchs with different trophic habits (i.e., batoids and chimeras).

Most models were from the Atlantic Ocean basin (20 out of 40) followed by the Pacific Ocean basin (n = 14), Arctic Ocean (n = 2), Southern Ocean (n = 2), and Mediterranean Sea (n = 2). Models were primarily located in the Exclusive Economic Zones of countries (37 out of 40) with the exception of the Eastern Subtropical Pacific Ocean, Antarctic Peninsula, and Central Atlantic Ocean models. For comparison purposes, models were allocated to one latitude group (i.e., tropical/subtropical [n = 11], temperate [n = 13], or high latitude [n = 10]) based on their geographic locations, as in Pikitch et al. (2014; Table 1). Models that represented eastern boundary current upwelling ecosystems were grouped into a separate upwelling ecosystem group (n = 6).

In addition, six of the models included both a recent snapshot of their ecosystem and one from the past (i.e., 1960s or before; Table 1). These models were used to examine the potential changes in trophic-level indicators between present and past ecosystem states.

Models were published in peer-reviewed journals (n = 13) or grey literature (i.e., academic, governmental, industrial reports, and working papers; n = 27). The majority (17 out of 27) of models from grey literature were from the Fisheries Centre Research Report series published by the University of British Columbia (Vancouver, Canada), which undergoes an internal review process (D. Pauly, University of British Columbia, personal communication). Pedigree scores, which provide a measure of Ecopath model quality (Christensen and Walters 2004), were available for 13 of the 40 models and ranged from 0.240 to 0.675 with a mean and median score of 0.495 and 0.462, respectively. These scores are similar to those found in other studies (Morissette 2007; Pikitch et al. 2014) and are considered acceptable (Christensen and Walters 2004). Diet data for the majority of predator groups (73%, or 263 out of 359) were of good quality (i.e., either derived from diet studies in the model area or from a surrounding or similar region) based on the scoring methods in Essington and Plagányi (2014).
Table 1. List of all 40 Ecopath models used in this study. PI = Pedigree index. Full model citations can be found in Colléter et al. (2013).

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*Forty-eight-group model.
*Models with past and present data.
*Pre-oil spill model.
*Post-oil spill model.
*ETP7 model.
*La Nina model.
*El Niño model.
*1990 model.
*1995 model.
*1990 model.
Data on predator diet habits, consumption rates, and biomasses were compiled for all seabird (n = 57), marine mammal (n = 118), and LPB fish (n = 184) model groups. Because the detail of predator model groups varied substantially between ecosystem models, ranging from model groups of species with age structure to highly aggregated groups of species (Essington and Plagányi 2014), we aggregated similar predators into a single predator category group (i.e., a seabird group, a marine mammal group, and a LPB fish group) in each model for our trophic-level indicators. This produced 40 values for each of the three major predator groups (i.e., one value for each specific predator category in each Ecopath model in this analysis). However, dietary preferences were evaluated for each of the 359 predators individually.

The majority (83%) of Ecopath models had data on total catch (i.e., landings plus discards) of fisheries. The remaining 17% (7 out of 40) of the models only included landings data with no estimates of discards. Discards were assumed to be zero for these seven models in the analysis. Thirty-five percent (14 out of 40) of models included landings and discards data, and discards accounted for approximately 12% of the total catch of these models on average, ranging from 1% to 43%. This is within the range of discard estimates for fisheries globally (Davies et al. 2009). We calculated the mTLQ using total catch data when available.

Overlap between Commercial Fisheries and Marine Predators

The mTLQ was calculated using equation (1), as the sum of multiplying the incremental trophic level of each caught model group g (TLg) by the proportion of the catch (1 km² year⁻¹) of model group g (Cg) to the total catch of all species combined in that ecosystem (ΣC) for all species g (Paul and Watson 2005; Morissette et al. 2012). We calculated the mTLQ in several ways in a given ecosystem to assess the differences in this indicator when (1) all fished model groups were included (henceforth “all fisheries”), (2) only fished finfish and cephalopods model groups were included (henceforth “all finfish fisheries”), and, finally, (3) only fished forage fish model groups were included (henceforth “all forage fisheries”). Forage fish model groups were defined according to Pikitch et al. (2014), which included krill as a forage species, but not cephalopods, shrimp, or fish that do not serve as forage throughout their life cycle (e.g., North Pacific Hake Merluccius productus, Blue Whiting Micromesistius poutassou, etc.).

\[
mTLQ = \frac{\sum_{g} g \left( TLg \cdot \frac{Cg}{\Sigma C} \right)}{\Sigma C}
\]  

(1)

We calculated the mTLQ for each major predator group in our models using equation (2) (Morissette et al. 2012).

\[
mTLQ = \sum_{i} Ti \left( TLi \cdot \frac{\sum_{j=1}^{n} Q_{ij} / \sum_{j=1}^{n} Q_{ij}}{\sum_{j=1}^{n} Q_{ij}} \right)
\]  

(2)

The mTLQ of each predator group (i.e., seabird, marine mammal, and LPB fish) was found similarly to the mTLQ (equation 1), except that the incremental trophic levels (TL) were multiplied in this case by the proportion of consumption of prey item i by predator j (Qi,j) to the total consumption of predator j (Qi). We calculated a weighted average of the mTLQ for predators in a given ecosystem model belonging to the same predator category (i.e., seabirds, marine mammals, and LPB fish). This is a modification of the methods of Morissette et al. (2012), who gave equal weights to all predators of a certain category when calculating the mTLQ which does not allow for the mTLQ values of individual predator groups with higher biomass in an ecosystem to be more pronounced compared to those with scant biomass. Trophic levels of predator and prey groups are based on the incremental trophic level concept of Odum and Heald (1975), which is used to calculate TL in Ecopath models (Christensen et al. 2008). The mTLQ and the weighted mTLQ values for each of the predator categories were analyzed together and then by latitude groups. In addition, we assessed the differences between the mTLQ for all predator categories and the three estimates of the mTLQ in each ecosystem. This allowed for closer examination of which predator categories and in which latitude groups the overlap between trophic levels consumed by predators and the trophic levels pursued by fisheries was greatest.

To determine if median values of the mTLQ and the mTLQ for groups were significantly different from one another, we first graphically analyzed the data using notched box plots, in which nonoverlapping notches indicate pairwise significance (McGill et al. 1978). We then utilized Kruskal-Wallis rank sum tests at an alpha of 0.05. If significant differences were found, pairwise comparisons were conducted using the Nemenyi test followed by a sequentially rejective Bonferroni test for multiple comparisons (Holm 1979). All statistical analyses were conducted using the R statistical software (CRAN R, version 3.1.1, R-project.org) with a pairwise multiple comparisons of mean rank sums package (package PMCMR).

Dietary Preferences of Marine Predators

In order to determine which prey items were most preferred by seabirds, marine mammals, and LPB fish in our ecosystem models, we calculated an index of electivity derived from Chesson (1983) for each predator (n = 359). This provided an ecological context to inform which specific prey items were preferred by predators, which is not possible with the mTLQ indicator alone. To allow for comparisons between models, prey model groups were combined into the following categories: forage fish (FF), nonforage fish (NFF), cephalopods (C), noncephalopod benthic invertebrates (INV), zooplankton (Z), seabirds (SB), marine mammals (M), fishery discards (D), and other (O; i.e., detritus and macroalgae). This allowed for prey items in each ecosystem model to be similarly aggregated. We used the standardized forage ratio (Si,j) as an index of electivity because it is independent of prey availability in an ecosystem and commonly used in Ecopath software (Chesson 1983; Christensen et al. 2008). Values for this index range from 0 (relative avoidance) to 1 (exclusive feeding) and can be found using equation (3), where Dij is the proportion of prey group j in predator group i’s diet, and Bij is the proportion of prey i’s biomass in the entire ecosystem. The denominator represents the sum of these ratios for all prey items of predator j, where n represents the number of prey groups in the model. Values of Si,j greater than 1/Bn indicate selection for the prey type, and values less than or equal to this indicate selection against the prey or random feeding. For this electivity analysis to be considered conservative, we only examined the most preferred prey item (i.e., largest Si,j values greater than 1/Bn) for each predator group.

\[
Si,j = \frac{\left( D_{i,j} / B_i \right)}{\sum_{i=1}^{n} D_n / B_n}
\]  

(3)
RESULTS

Mean Trophic Level of Commercial Fisheries Catch and Marine Predator Consumption

Globally, we found that the median trophic levels of prey consumed by seabirds and LPB fish were significantly lower than the median values for species targeted by all fisheries and all finfish fisheries (Kruskal-Wallis: chi-square = 43.2035; df = 5; P < 0.004). No significant differences in the median trophic levels consumed by marine mammals and those caught in these fisheries were found (Figure 1). In addition, there were no significant differences between the median trophic level caught by forage fisheries and those consumed by any predator (Figure 1). Marine mammals consumed prey of higher trophic levels (median = 3.19, 95% confidence interval [CI], 3.08–3.30) than did seabirds (median = 2.87, 95% CI, 2.78–3.00) and LPB fish (median = 2.87, 95% CI, 2.73–2.99); however, these differences were not statistically significant following Bonferroni adjustments. The mTLC for all fisheries (median = 3.24, 95% CI, 3.10–3.46) and all finfish fisheries (median = 3.3, 95% CI, 3.20–3.53) was similar to each other, but the mTLC for forage fisheries (median = 3.05, 95% CI, 2.83–3.10) was significantly lower than all finfish fisheries (Kruskal-Wallis: chi-square = 43.2035; df = 5, P = 0.002; Figure 1).

Significant differences amongst median values for the mTLC and the mTLO were detected in tropical/subtropical (Kruskal-Wallis: chi-square = 14.5867; df = 5; P = 0.01), temperate (Kruskal-Wallis: chi-square = 20.6065; df = 5; P = 0.001), and high latitude (Kruskal-Wallis: chi-square = 13.4145; df = 5; P = 0.02) groups; however, post hoc pairwise comparisons could not reveal which groups were different (Figure 2). In addition, no statistically significant differences were found between the mTLC for any predator category and the mTLC for fisheries groups in upwelling ecosystems (Figure 2).

Although statistical tests could not be conducted due to the low sample sizes (Mundry and Fisher 1998), we analyzed the differences between the mTLC and the mTLO values in each model and across all latitude types to get a rough evaluation of how closely fisheries and marine predators were targeting similar trophic levels. In general, we found a similar pattern between the mTLO for seabirds and LPB fish and the mTLC for all fisheries or all finfish fisheries, with the smallest differences in trophic levels targeted generally occurring in upwelling ecosystems, whereas the largest differences were found in high latitudes (Figure 3). Differences between the mTLC for seabirds or LPB fish and the mTLC for all forage fisheries were small or sometimes nonexistent across all latitude groups (Figure 3). However, marine mammals generally consumed prey at higher trophic levels compared to the mTLC for fisheries across all latitudes.

We explored the temporal changes in the mTLC and the mTLO using the six Ecopath models for which we had past and present data snapshots of the ecosystems. We found that the smallest changes in trophic levels occurred in the mTLC for forage fisheries (≤0.14 units) and the mTLC for seabirds (≤0.10 units). Across models, differences in the mTLO values for LPB fish and marine mammals were ≤0.29 and ≤0.72 units, respectively (Table 2). Differences were greater and more variable for all other categories, ranging from −0.94 to 0.40 trophic level units (Table 2). Additionally, the differences between the mTLC and the mTLO in each model were evaluated temporally. Differences between past and present time periods for these indicators ranged from −0.4 to 1, with positive values indicating that differences between

Figure 1. Mean trophic level of catch (mTLC) and predator consumption (mTLO) for all 40 Ecopath models combined. Lines inside notched box plots represent the median values, and the left and right segments represent the 0.25 and 0.75 quartiles, respectively. Whiskers represent the smaller of either the full range of the data or 1.5 times the interquartile range, and open circles represent data outliers (Crawley 2007). These are defined as points more or less than 1.5 times the right or left quartile segments, respectively, using the R statistical software.

Figure 2. Notched box plots of the mean trophic level of catch (mTLC) and predator consumption (mTLO) in (a) upwelling, (b) tropical/subtropical, (c) temperate, and (d) high latitude groups. Lines inside box plots represent the median values, and the left and right segments represent the 0.25 and 0.75 quartiles, respectively. Whiskers represent the smaller of either the full range of the data or 1.5 times the interquartile range, and open circles represent data outliers (Crawley 2007). These are defined as points greater than or less than 1.5 times the right or left quartile segments, respectively. Box plots with notches extending beyond the quartile ranges indicate that sample sizes were too small or had high within-sample variance (Crawley 2007).
Figure 3. Notched box plots showing the differences between the mean trophic levels of predator consumption ($mTL_Q$) and catch ($mTLC$) for (a) all fisheries, (b) all finfish fisheries, and (c) all forage fisheries by latitude groups (i.e., upwelling [U], tropical/subtropical [TROP], temperate [TEMP], and high latitude [HL]). Values to the right of the dashed vertical lines indicate that predators are consuming trophic levels of prey greater than what fisheries are catching, and those to the left of the dashed vertical lines indicate that predators are consuming trophic levels of prey less than those caught by fisheries. Whiskers represent the smaller of either the full range of the data or 1.5 times the interquartile range, and open circles represent data outliers (Crawley 2007). These are defined as points greater than or less than 1.5 times the right or left quartile segments, respectively. Box plots with notches extending beyond the quartile ranges indicate that sample sizes were too small or had high within-sample variance (Crawley 2007).

Table 2. Differences in the mean trophic level of fisheries catch ($mTLC$) and predator consumption ($mTL_Q$) between past and present data in six Ecopath models. Positive values indicate a decrease in $mTLC$ over time, and negative values indicate an increase. MM = marine mammal. LPB fish = large predatory bony fish. SB = seabird.

<table>
<thead>
<tr>
<th>Model (past, present)</th>
<th>Difference in $mTLC$</th>
<th>Difference in $mTL_Q$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All fisheries</td>
<td>Finfish</td>
</tr>
<tr>
<td>Icelandic shelf (1950, 1997)</td>
<td>−0.29</td>
<td>−0.32</td>
</tr>
<tr>
<td>Newfoundland (1900, 1995)</td>
<td>−0.94</td>
<td>−0.28</td>
</tr>
<tr>
<td>Central Atlantic Ocean (1950, 1990)</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Eastern Bering Sea (1950, 1980)</td>
<td>−0.13</td>
<td>0.08</td>
</tr>
<tr>
<td>Hecate Strait, N. BC (1950, 2000)</td>
<td>−0.18</td>
<td>−0.05</td>
</tr>
<tr>
<td>Northern California Current (1960, 1990)</td>
<td>0.14</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Table 2. Differences in the mean trophic level of fisheries catch ($mTLC$) and predator consumption ($mTL_Q$) between past and present data in six Ecopath models. Positive values indicate a decrease in $mTLC$ over time, and negative values indicate an increase. MM = marine mammal. LPB fish = large predatory bony fish. SB = seabird.

the $mTLC$ and $mTL_Q$ were greater in the past than the present, whereas negative values indicate the opposite (Table 3).

Dietary Preferences of Marine Predators

Globally, forage fish and cephalopods were the preferred prey items for most seabirds (70%; 40 out of 57), marine mammals (70%; 83 out of 118), and LPB fishes (60%; 111 out of 184) in our models. Strong selection for these prey groups (i.e., selection by ≥45% of predators) was found in each latitude group for all predator categories, with the highest percentage of selection occurring in upwelling and high latitude ecosystems (Figure 4). In particular, 88% of seabirds in upwelling (i.e., 7 out of 8 seabird model groups) and high latitude (i.e., 14 out of 16 seabird model groups) ecosystems selected forage fish or cephalopods as their most preferred prey item (Figure 4).

DISCUSSION

In this study, we used data and output for diet, biomass, consumption, and catch from published Ecopath models in order to calculate a variety of indices. In this way, these models served as repositories of ecological information (Colléter et al. 2013; Pikitch et al. 2014). In particular, our study expanded the initial work and scope of Morissette et al. (2012) in three major ways. by (1) extending the application of the $mTL_Q$ to include seabirds and LPB fish, (2) including other estimates of the $mTLC$ (i.e., all finfish fisheries and all forage fisheries), and (3) analyzing additional models.

Using a synthesis of models, we explored the relationships between the mean trophic level of fisheries catch and predator consumption. By pairing the commonly used ecosystem indicator, $mTLC$, with the $mTL_Q$ indicator, we were able to characterize the trophic overlap for prey targeted by these fisheries and marine predators. Importantly, we found that the trophic levels targeted by forage fisheries, seabirds, marine mammals, and LPB fish were not significantly different from each other, suggesting that these groups may be competing for similar trophic levels of prey. In addition, our electivity analysis confirmed that these predators preferred forage fish and cephalopods primarily.
We demonstrate that the mTLC can be used for purposes other than assessing fisheries trends or biodiversity, when it is paired with the mTLQ indicator in marine ecosystems.

Using the mTLC and the mTLQ as Indicators in Marine Ecosystems

The mTLC for all fisheries and all finfish fisheries was significantly greater than the mTLQ for seabirds and LPB fish globally but not the mTLQ for marine mammals. This suggests that fisheries analyzed in these models were targeting trophic levels that marine mammals were consuming but not necessarily seabirds and LPB fish. Across latitude groups, the largest differences in trophic-level units between the mTLC of these fisheries and the mTLQ for marine predators were found in high latitudes. This was largely due to generally higher mTLC values of commercial fisheries compared to other latitudes. We found no significant differences between any of these indicators in upwelling ecosystems, and the differences between the trophic levels targeted by fisheries and marine predators were low (Figure 3). This was expected because >54% of the total catch in these ecosystem models (i.e., in 5 out of 6 upwelling models) was from forage fish, with the exception of the Northern California current model, where forage fish only represented less than 1% of the total catch. Although statistically significant differences were found in tropical/subtropical, temperate, and high latitude groups, we were unable to determine which indicator groups were significantly different from each other by the multiple comparison procedures used. This may be due to the low sample size of models in these latitude groups. It is also important to note that relationships between these indicators are likely not static (Table 3) because the mTLC may change as fisheries expand/contract or target new species (Branch et al. 2010; Essington et al. 2006; Pauly et al. 1998). Similarly, exploring whether the mTLQ has changed over time would also be useful. For instance, centennial scale declines in the trophic levels of some seabirds have already been shown using stable isotope techniques, suggesting that they are now feeding on lower trophic levels of prey (Becker and Beissinger 2006; Bond and Lavers 2014).

For the six models analyzed across time periods, we found that the largest changes in the mTLC were among all fisheries and all finfish fisheries but not forage fisheries (Table 2). In terms of changes in the mTLQ, seabirds and LPB fish were consuming similar trophic levels of prey in the present day compared to the past, with LPB fish to a much lesser degree. However, marine mammals were consuming higher trophic levels of prey compared to the past. This suggests that the mTLC for forage fisheries and the mTLQ for seabirds may not have changed substantially in the past half century.

### Table 3. Differences in the mean trophic level of fisheries catch (mTLC) and predator consumption (mTLQ) between past and present data in six Ecopath models. Positive values indicate a decrease in the difference between these mTL indicators over time, and negative values indicate an increase. MM = marine mammal. LPB fish = large predatory bony fish.

<table>
<thead>
<tr>
<th>Model (past, present)</th>
<th>All fisheries</th>
<th>Finfish fisheries</th>
<th>Forage fisheries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SB MM LPB fish</td>
<td>SB MM LPB fish</td>
<td>SB MM LPB fish</td>
</tr>
<tr>
<td>Icelandic shelf (1950, 1997)</td>
<td>0.32 0.46 0.33</td>
<td>0.36 0.50 0.37</td>
<td>0.04 0.18 0.05</td>
</tr>
<tr>
<td>Newfoundland (1900, 1995)</td>
<td>1.00 0.81 0.76</td>
<td>0.34 0.15 0.10</td>
<td>0.20 0.01 0.04</td>
</tr>
<tr>
<td>Central Atlantic Ocean (1950, 1990)</td>
<td>-0.40 -0.45 -0.31</td>
<td>-0.40 -0.45 -0.31</td>
<td>0.00 -0.05 0.09</td>
</tr>
<tr>
<td>Eastern Bering Sea (1950, 1980)</td>
<td>0.03 0.26 -0.15</td>
<td>-0.18 0.05 -0.37</td>
<td>-0.05 0.18 -0.23</td>
</tr>
<tr>
<td>Hecate Strait, N. BC (1950, 2000)</td>
<td>0.27 0.89 0.24</td>
<td>0.15 0.77 0.12</td>
<td>0.09 0.72 0.07</td>
</tr>
<tr>
<td>Northern California Current (1960, 1990)</td>
<td>-0.18 0.15 -0.16</td>
<td>-0.13 0.20 -0.11</td>
<td>-0.04 0.29 -0.02</td>
</tr>
</tbody>
</table>

### Figure 4. Percentage of most preferred prey types by (a) seabirds, (b) marine mammals, and (c) large predatory bony fish predators in each latitude group. Prey types include forage fish (FF), cephalopods (C), nonforage fish (NFF), zooplankton (Z), noncephalopod benthic invertebrates (INV), marine mammals (M), seabirds (SB), fishery discards (D), and other prey types, including detritus and macroalgae (O).
precautionary, ecosystem-based approaches to their management and a focus on the tools needed to aid management implementation (Pikitch et al. 2012; Peck et al. 2014). For instance, the examination of direct and indirect interactions that may occur between forage fisheries and marine predators is a consideration of ecosystem-based forage fisheries management (Pikitch et al. 2012; Peck et al. 2014). In this regard, we found that seabirds and LPB fish were feeding closest to the trophic levels that forage fisheries were targeting. These predators also commonly selected forage fish and cephalopods as their most preferred prey and not other prey items of similar trophic levels to forage fisheries.

The results presented in this research are consistent with the dietary importance of these prey items to predator groups (e.g., Young et al. 2013; Pikitch et al. 2014). In addition, there is a growing body of empirical studies demonstrating the preferential selection of forage fish species by a variety of seabirds (e.g., Burke and Montevuece 2008), marine mammals (e.g., Spitz et al. 2012), and LPB fish (e.g., Spitz et al. 2013). In the majority of these studies, the authors state that forage fish were selected because of their availability in the ecosystem (i.e., spatially and temporally) or their high nutritional quality relative to other prey items (e.g., Österblom et al. 2008) or both. Therefore, changes in the availability of these nutritious prey species have had important consequences for some predators (e.g., Österblom et al. 2008). We also note that forage fish selection observed for harp seals Pagophilus groenlandicus in the Newfoundland and Barents Sea Ecopath models were consistent with empirical studies for those regions (Lawson et al. 1998; Lindstrom et al. 1998).

CONCLUSIONS

The overall findings indicate that forage fisheries are catching what marine predators prefer and consumed based on trophic-level indicators. Because these indicators are relatively straightforward to calculate, we contend that this approach can be a useful tool for scientists and ecosystem managers interested in investigating whether or not fisheries and marine predators are targeting similar trophic levels of prey. In particular, our results provide summaries of these indicators at ecosystem, latitude, and global scales. This information may be useful in informing ecosystem-based fisheries management, especially in circumstances where ecosystem managers do not have adequate information on these marine predator groups.

ACKNOWLEDGMENTS

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REFERENCES


CHARACTERIZING THE HUMAN DIMENSIONS OF A HIDDEN FISHERY: RIVERINE TROTLINE FISHERS
Hidden fisheries include catfish harvesters who use trotlines and are seldom surveyed. We examined trotline fishers to describe fishing habits and techniques, trotline fishing knowledge, recreational motivations, and opinions of the fishery, regulations, and conflicts with other river users. Trotline fishers on the New River, Virginia, were secretive and solitary, and some were socioeconomically disadvantaged. They placed high importance on catch- and harvest-related factors, in contrast to many other angler groups who use highly specialized methods. They relied on harvesting catfish for varying degrees of sustenance to their diet or income. Trotline fishing appears to be part of a larger “way of life” for some rural individuals, who may also hunt, trap, and garden as part of activities to supplement their diet or income. New River trotline fishers strongly believed that participation in trotline fishing had declined significantly in the New River Valley due to improving socioeconomic status of the region, changing recreational values (such as focus on catch-and-release fishing and paddle sports), increasing recreational boat traffic and law enforcement presence, and decreasing participation in trotline fishing by younger generations.

**INTRODUCTION**

Catfish (Ictaluridae) fishers have historically been poorly represented in fisheries management processes and in many places may be characterized as “hidden” from public awareness. Poor representation results from the difficulty in making contacts via traditional methods and/or the existence of few catfish fishing clubs (Bray 1997; Michaletz and Dillard 1999; Schramm et al. 1999). Catfish fishers generally are rural, middle-aged, male, low-tech fishers who fish from shore at night and are more harvest-oriented than other angler groups (Michaletz and Dillard 1999; Schramm et al. 1999; Wilde and Ditton 1999; Reitz and Travnichek 2004). Catfish fishers strongly believed that participation in trotline fishing had declined significantly in the New River Valley due to improving socioeconomic status of the region, changing recreational values (such as focus on catch-and-release fishing and paddle sports), increasing recreational boat traffic and law enforcement presence, and decreasing participation in trotline fishing by younger generations.

**Caracterización de las dimensiones humanas de una pesquería escondida: pescadores fluviales de palangre artesanal**

Las pesquerías escondidas incluyen a los pescadores de bagre quienes usan el palangre artesanal pero que rara vez son contabilizados. En este artículo se examinan a los pescadores de palangre artesanal con el fin de describir sus hábitos y técnicas de pesca, el conocimiento existente sobre pesca con palangre artesanal, motivaciones recreativas, opiniones sobre la pesca y conflictos con otros usuarios de los ríos. Los pescadores de palangre artesanal en New River, Virginia, mostraron ser reservados, solitarios y algunos estuvieron en condiciones socioeconómicas desventajosas. Ellos consideran muy importante la captura y factores relativa sobre ésta, en contraste con otros grupos de pescadores que utilizan métodos altamente especializados. Así mismo, dependen de la captura de bagre en grado diverso para el sustento de su dieta o de su ingreso. La pesca artesanal de palangre parece constituir parte de un modo de vida más general para algunos individuos rurales, quienes también pueden cazar, atrapar y hacer jardinería como parte de actividades suplementarias para mantener su dieta e ingreso. Los pescadores de palangre artesanal de Nuevo River creen firmemente que la participación en este tipo de pesquería ha declinado significativamente en el Valle de New River debido al incremento del estatus socioeconómico de la región, al cambio en los valores recreativos (tales como la pesca enfocada a captura-recaptura y deportes de remo), el tráfico creciente de botes, presencia del poder judicial y a una reducción en la participación de las generaciones más jóvenes en la pesca artesanal de palangre.
this regard, trotline fishers also share similarities with another small, sometimes controversial catfish fisher group: hand-fishers, also called “noodlers” and “hand grabblers” (Baker 2009). Sixty-seven percent of hand-fishers in Missouri also fished with trotlines (Morgan 2008), although hand-fishers appear to be less harvest-oriented than catfish fishers in general (Morgan 2006; Baker 2009). Both groups are predominantly male, rural fishers who rely on social networks to pass on their preferred fishing technique (Reitz and Travnichek 2004; Morgan 2008). Trotline fishers and hand-fishers may practice their activity clandestinely to avoid conflicts with other user groups.

Individuals who emphasize harvest-related experiences over noncatch aspects, such as relaxation and socialization, could begin to approximate subsistence or commercial fishers, despite participating in a recreational fishery (Wilde and Ditton 1999). Distinguishing between subsistence and recreation may be difficult in rural communities (Glass et al. 1990) but may have significant implications for managers trying to regulate trotline fishing, particularly when fisheries with a potential subsistence component exist in waters managed primarily for recreational fishing. Fisheries managers increasingly recognize that they must identify and include many stakeholders, including specialized fishing subcultures (Morgan 2006), and often they seek to satisfy multiple groups, each with their own set of values and expectations (Hahn 1991). Therefore, fisher satisfaction must be central to decision-making processes of fisheries management agencies (Wilde and Ditton 1999); otherwise, agencies may fail to provide the variety of fishing opportunities needed to meet stakeholder demands (Fedler and Ditton 1994).

We selected the New River, Virginia, as the study area because the focus of fisheries has shifted dramatically from a harvest orientation in the 1960s (Photo 1) to a focused management for quality Muskellunge Esox masquinongy, Smallmouth Bass Micropterus dolomieu, and Walleye (Copeland et al. 2006). Some New River anglers and fishing guides disparage trotline fishers and believe that trotlines are not acceptable recreational fishing gears, though trotline fishers may view them as important and traditional fishing methods. Trotline fishers are largely hidden in this study area and likely differ from other angling groups in their opinions on management and values and attitudes regarding harvest, fish consumption, and cultural and traditional fishing methods. Therefore, we posed several questions for this study:

1. Is trotline fishing in the New River and elsewhere mainly a subsistence fishing activity, a heritage activity, a recreational sport, or combination of these and other factors?
2. Who are the people who use these passive fishing gears, and what does trotline fishing mean to this group of people?
3. Is trotline fishing declining in popularity?
4. How much conflict (both real and perceived) occurs among user groups?

Given the hidden nature of the population under study, we used qualitative approaches (focus groups and interviews) to provide an excellent exploratory base from which to advance research (Mitchell 1999). Qualitative techniques were judged to be cost-effective for surveying relatively rare, hard-to-define social groups with no defined sample frame (Biernacki and Waldorf 1981; Baker 2009). In the fisheries field, individual interviews of fishers can provide valuable information such as fisher habits, gear use, long-term efficiency trends, and catch rates (Neis et al. 1999). Using qualitative nonprobability sampling to explore fishing habits and catch-related attitudes among different fisher groups serves as a platform for further research (Baker 2009; Steffen and Hunt 2011); such information has the potential to improve management decisions and acceptance by fishers (Neis et al. 1999).

Grounded theory methods were selected for improving understanding of the human dimensions of a small, relatively unstudied population, such as trotline fishers. Grounded theory methodology is an inductive inquiry known as “interpretative interactionism,” in which the investigator engages with subjects to develop an understanding of their values, perceptions, and social processes (Denzin 2001). Using interpretive methodology, we collected data concurrent with development of hypotheses and theories, in contrast with deductive scientific methodology (Babtie 1991; Polit and Hungler 1997). Grounded theory and interpretive interactionism seeks to explain peoples’ behavior in the context of the subject’s worldviews and perceptions (Glaser 1992; Denzin 2001), rather than from context derived from values and beliefs of the researcher.

**METHODS**

We contacted individuals encountered during our initial exploratory surveys of New River trotline fishing, from marked trotlines discovered in the field and from trotline fishers known to Virginia Department of Game and Inland Fisheries biologists. We contacted interviewees by phone or in person and asked whether they would participate in a short interview regarding trotline fishing. Before each interview, we explained the study purpose and assured participants confidentiality. We did not record interviews because of concerns that it might inhibit obtaining consent of individuals already hesitant to speak. Upon consent, the senior author engaged them in a semistructured interview lasting approximately 30–45 minutes. Interviews flowed as a conversation rather than strictly following the survey instrument, which allowed interviewees to answer many questions with their own context, rather than being asked a scripted question. At the conclusion of the interview, each individual received a custom baseball cap and were asked whether they knew other trotline fishers. In this way, we built a “snowball” sample expanded from the known trotline user network. The Virginia Tech University Institutional Review Board approved our methodology (#10-454) prior to the interview process.

The survey instrument and interview framework contained 35 questions. We began with simple and open-ended questions...
so that interviewees would feel comfortable talking about fishing and trotlines before delving into potentially sensitive issues. These initial questions focused on trotline fishing habits, such as preferred bait type, number of hooks per line, frequency of use and preferred months, and catfish catch rates. These mostly quantitative questions were designed for use in estimating trotline effort and catch in conjunction with a creel survey; results from this question subset are reported in Dickinson et al. (in review). A set of closed-ended questions explored species and gear preferences and overall avidity of trotline fishers: interviewees checked off fish species targeted, the proportion of fishing time spent pursuing each species, and the respective gears with which they were targeted. To investigate motivations for trotline fishing, a short section asked interviewees to rank various motives for using trotlines on an ordinal scale. Another set of questions assessed the social aspect of using trotlines, exploring the means by which interviewees learned to use trotlines, whether they had taught others to use trotlines, and whether they knew other trotline fishers. To investigate the subsistence nature and harvest preferences of trotline fishers, we asked what size catfish they preferred to harvest, how many meals of New River fish they ate, and whether they were aware of any consumption advisories. We also gathered opinions regarding regulations, conflict, and status of the fishery and several demographic characteristics.

During and after each interview, the first author and an assistant recorded answers to questions and each made notes on their overall impression of the interviewee (including but not limited to how truthful they believed the interviewee to be, observations about their lifestyle and knowledge of fishing, fish identification, and interesting quotes or other observations) in addition to noting important concepts and themes from the interview. Interview data and notes were analyzed for common themes using the grounded theory approach: comparing interviews using coded terms and phrases and using these codes to develop concepts and link them together to synthesize and explain human dimensions of trotline use. As such, the results presented below are not typical of quantitative studies. They rely on answers and quotes supplied by subjects and theories developed from linking important phrases and concepts that arose throughout the interview process.

**RESULTS AND DISCUSSION**

Trotline users were difficult to track down. Many lived in seasonal campsgrounds, and some had no listed phone number or mailing address. Additionally, many of the referring individuals only knew the referred individual by a nickname and did not actually know the person’s full name or place of residence. We interviewed 39 trotline users: 24 active trotline users and 15 lapsed users (had not used trotlines in the previous two years). Active trotline users averaged 50 years of age (range 19–80, SD = 19); lapsed users were older, averaging 60 years old (range 48–68, SD = 7). Trotliners had typical levels of education: only 5 people out of 39 had less than a high school education (Table 1). New River Valley anglers (n = 124) surveyed in 1999 and 2000 had similar levels of education, with 41% holding a high school diploma equivalent or lower (B. O’Neill, Virginia Tech University, unpublished data), suggesting that trotline users may not differ in education level from other New River Valley anglers.

Many of the trotline users were very proud of their outdoors-oriented lifestyle, in large part because of the traditional nature of their activities and the satisfaction of being self-reliant. “Trotline fishing is a way of life” was a recurring phrase during interviews. Participation in subsistence or sustenance activities provides psychological, social, and cultural values, which may be similar to noncatch motivations of other anglers (Glass et al. 1990). Many individuals referred to using trotlines as a part of a lifestyle focused on subsistence activities such as gardening, hunting and gathering, and canning and preserving food at home.

Trotline users were very harvest-oriented. Of the 39 trotline users interviewed, 30 said they chose to use trotlines instead of fishing by rod and reel because they could catch and harvest more fish (Table 2). Active trotline fishers also ranked catch- and harvest-related factors highly when asked for their motivations to go trotline fishing (Table 3). Such a trend is well-documented for catfish anglers: they often rank noncatch motivations similar to other anglers, yet rank catch and harvest motivations higher and often are less-supportive of restrictive regulations than other angler groups (Fedler and Ditton 1994; Wilde and Riechers 1994; Schramm et al. 1999; Wilde and Ditton 1999). Trotline fishers are known to be even more harvest-oriented than catfish anglers (Quinn 1993; Boxrucker and Kuklinski 2008). Active trotline fishers reported eating an average of 29 catfish meals per year (SD = 33), ranging from a minimum of 2 meals/year to a maximum of 125 meals/year. Yet, many were unaware of consumption advisories for New River fish, which is cause for some alarm given that some consume fish far in excess of the advised levels. Therefore, alternative outreach and education about consumption advisories may be necessary.

Trotline fishing appears to be motivated by both catch-related and non-catch-related factors. Despite being very harvest-oriented, New River trotline fishers reported obtaining satisfaction from the thrill of the catch. Two users likened the anticipation of catching their trotlines to unwrapping presents on Christmas morning, and 12 users mentioned the thrill and enjoyment of checking their trotlines (Table 2), particularly when targeting large Flathead Catfish. Differentiating between subsistence and recreation can be difficult in rural communities, where residents may rely on hunting and fishing to enhance their economic well-being and reduce their reliance on the cash economy (Glass et al. 1990). Trotline fishers who fish often, harvesting and subsequently eating large numbers of catfish from the New River, could be considered subsistence fishermen, despite being governed by recreational fishing policies. Interviews with older trotline users indicate that trotline fishing was in part driven by subsistence or sustenance needs earlier in their lifetimes. Although the most common reason provided for using a trotline was for catching and harvesting catfish, trotline users still ranked noncatch motivations highly (Table 3), indicating that trotline fishing is not a purely subsistence-oriented activity. Fishers who rate noncatch motives highly cannot be considered subsistence fishers because they seek the same fundamental benefits of fishing as other anglers, such as experiencing nature, thrill of catching a fish, relaxation, and so forth (Wilde and Ditton 1999).

### Table 1. Highest education level achieved by trotline fishers (n = 39 total) interviewed in 2012.

<table>
<thead>
<tr>
<th>Education level</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than high school</td>
<td>5</td>
</tr>
<tr>
<td>High school/GED</td>
<td>15</td>
</tr>
<tr>
<td>Some college</td>
<td>6</td>
</tr>
<tr>
<td>Vocational/associate degree</td>
<td>7</td>
</tr>
<tr>
<td>4-Year degree</td>
<td>5</td>
</tr>
<tr>
<td>M.S. degree</td>
<td>1</td>
</tr>
</tbody>
</table>
Trotlines have a well-established family tradition in the New River Valley. Comments regarding the family tradition of using trotlines included the following:

Most guys that done it have passed on.

Trotlining was just our way of life. All people I knew that did it are gone.

I don’t care for game wardens and the law. They locked all my fishing buddies up. One of ’em got 22 years for meth and guns.

All the guys I know that did it are 6 feet under.

Trotline use in the New River appeared to be an extremely localized endeavor, which may explain why users did not know many other trotline fishers. Most users traveled very short distances to use trotlines: 16 of 24 active trotline users traveled less than one mile, and 32 of 39 interviewees traveled less than 5 miles. Only one individual had ever used a trotline outside the New River. Most of those interviewed grew up in the New River Valley, and their narratives suggested that many had never lived outside their current county of residence. It appears that most dedicated trotline fishers live near or on the river itself and fish trotlines in only a small section of river, rarely interacting with other trotline users.

Alternative recreational pursuits of new generations may have precluded developing social fishing networks through sharing techniques, fishing spots, or fishing time with nonfamily members. Other individuals indicated that they used to know several trotline fishers, but those individuals have since died or, in two cases, were incarcerated. Many trotline fishers appear to have aged and/or died and have not been replaced with new participants. Comments made by interviewees who were unable to refer us to other trotline users included the following (grammar not corrected to preserve authenticity of the statements):

Although New River trotline fishers were not directly “living off the land” in the true subsistence sense, a better term might be “sustenance,” because they supplement their diet in a significant way with wild-caught fish and game (Hunt and Grado 2010).

Despite the tradition of learning trotline fishing from a family member, trotline use on the New River appears to be a rather solitary activity for many individuals. Many (15 of 24) active trotline users reported fishing primarily alone, although several others fished occasionally with one friend or family member when they needed help catching bait or setting a line. Despite such a large proportion of solitary trotline fishers, only 5 of 24 active users said that family recreation was somewhat unimportant or very unimportant when fishing with trotlines. Such a result suggests that at one point family recreation was important to their trotline fishing experience, but they fished alone at the time of the interview. Most (28 of 39, 72%) trotline fishers learned to use trotlines from a close family member, usually a father, grandfather, uncle, or combination thereof. Many interviewees specifically mentioned the family tradition of using trotlines. Family members, particularly fathers, uncles, and grandfathers, are known to be important in both recruitment and retention of outdoor recreation such as hunting, fishing, and shooting (Responsive Management and National Shooting Sports Foundation 2008), and New River trotline fishers are no different. Active trotline users who learned to use trotlines from a family member were more likely to teach others to use trotlines. Of the nine active users who had taught another person to fish with trotlines, eight had learned to use trotlines from a family member themselves. In contrast, of the 11 active users that had not taught others to use trotlines, only three were taught by a family member; the remaining eight users were self-taught or learned from a friend. Clearly, the tradition of trotline use is largely reliant on being passed down within a family. Trotline users may be similar to hand-fishers in this respect, passing their folk tradition down orally within the family from generation to generation (Salazar 2002).

New River trotline fishers appear to lack well-developed social networks with other trotline fishers. Most trotline fisher interviewees knew of only one other trotline user or none at all. Although both hand-fishers and trotline fishers pass down their traditions through familial units, hand-fishing is a socially centered activity performed in groups (Salazar 2002; Morgan 2008; Brown 2011), unlike New River trotline fishing. Hand-fishing may involve lifelong partnerships between fellow hand-fishers, potentially a result of the inherent danger and necessity for teamwork when locating and capturing large catfish by hand (Salazar 2002). Salazar (2002) attributed declining participation in hand-fishing for catfish in part to ongoing failure to transmit folk traditions from one generation to another. The same phenomenon appears to have happened or is happening with trotline fishing in the New River. Individuals interviewed nearly unanimously agreed that trotline use has declined significantly in recent years and felt strongly that failure to transmit the tradition between generations is in large part responsible for this perceived decline of trotline use in the New River Valley.

Table 3. Mean scores 1–5 (very unimportant, somewhat unimportant, neutral, somewhat important, very important, respectively) reported by active trotline anglers when asked what motivated them to go trotline fishing.

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Mean score</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To be outdoors</td>
<td>4.67</td>
<td>0.64</td>
</tr>
<tr>
<td>Experience of the catch</td>
<td>4.33</td>
<td>0.76</td>
</tr>
<tr>
<td>To experience nature</td>
<td>4.21</td>
<td>0.78</td>
</tr>
<tr>
<td>For the challenge/sport</td>
<td>4.17</td>
<td>1.17</td>
</tr>
<tr>
<td>Harvest for personal consumption</td>
<td>4.04</td>
<td>1.12</td>
</tr>
<tr>
<td>Relaxation</td>
<td>3.88</td>
<td>1.12</td>
</tr>
<tr>
<td>To catch many fish</td>
<td>3.83</td>
<td>1.24</td>
</tr>
<tr>
<td>To be with friends</td>
<td>3.63</td>
<td>1.24</td>
</tr>
<tr>
<td>Share knowledge</td>
<td>3.54</td>
<td>1.02</td>
</tr>
<tr>
<td>Family recreation</td>
<td>3.50</td>
<td>1.29</td>
</tr>
<tr>
<td>To catch a trophy</td>
<td>3.50</td>
<td>1.41</td>
</tr>
<tr>
<td>Social consumption</td>
<td>3.46</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Table 2. Number of responses by category to the question, “What are the reasons why you would choose to fish a trotline instead of using a rod and reel?” Thirty-nine individuals (15 lapsed trotline fishers and 24 active trotline fishers) were asked this question. Some individuals supplied multiple reasons.

<table>
<thead>
<tr>
<th>Why use a trotline instead of a rod and reel?</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catch/harvest more fish than rod and reel</td>
<td>30</td>
</tr>
<tr>
<td>For enjoyment/thrill of checking line</td>
<td>12</td>
</tr>
<tr>
<td>To avoid staying up late fishing with rod and reel</td>
<td>9</td>
</tr>
<tr>
<td>Frees up time, minimizes time spent fishing</td>
<td>5</td>
</tr>
</tbody>
</table>
Running trotlines was a family thing—my dad, grandpa, uncles did it. We fished all day every day as a kid. We depended on the food, kept everything.

It was a family affair. The uncles built the wood boats, and the boys all trotlined.

[Trotline fishing is] a family tradition. My dad did it, my grandpa did it, and my great-grandpa did it.

Lack of recruitment and retention appear to be responsible for declines in trotline fishing in the New River. The failure to transmit trotline tradition between generations has two main components. First, trotline fishers of older generations have discontinued participation or feel marginalized and subsequently have failed to teach younger generations to use trotlines. Secondly, younger people in the New River Valley may be less likely to fish than previous generations due to time constraints (e.g., organized sports, television, Internet), and if they do fish, trotline fishers often target Smallmouth Bass, Muskellunge, or Walleye, instead of catfish.

Lapsed trotline fishers primarily cited a “lack of time” as the biggest factor in their decision to quit trotlining (Table 4). But what exactly does lack of time mean? Family and work obligations generally are the primary constraints to fishing (Fedler and Ditton 2001), and lapsed trotline fishers frequently mentioned grandchildre and work obligations as factors in their decisions to stop trotline fishing. Other recreational activities also conflict with trotline use. With long-term declines in fishing and hunting participation (Outdoor Foundation 2010; USDOI et al.) has come increasing participation in nonconsumptive outdoor recreation. For example, despite declining or mostly stagnant participation in fishing and hunting, recreational kayaking grew 32% nationwide (Outdoor Foundation 2012) and has increased markedly over the lifetimes of New River trotline fishers. Many trotline users complained of trotline tampering, both by other fishers and by other New River recreationists.

Changing recreational use of the New River may have led to a sense of marginalization by some trotline fishers. Trotline fisher values, such as the deeply ingrained satisfaction of “living off the land,” may conflict with the values of other New River users, such as fishing guides, who primarily practice catch-and-release fishing. Recreational use of the New River by kayakers and inner-tube floaters was frequently cited by interviewees as barriers to practicing and enjoying trotline fishing. Many trotline fishers grew up on the river when the area was less populated, before the existence of businesses renting kayaks and tubes, or fishing guides, and before the New River Trail system. Two individuals specifically stated that the New River Trail construction in the mid-1980s allowed game wardens to patrol much more of the river and crackdown on illegal fishing. Many of the older trotline users—both lapsed and active—had a sense of ownership over the New River, and many individuals complained that the river “ain’t what it used to be.”

At the beginning of this study, one initial conflict item between trotline users and other river users was the issue of safety. Fishing guides had frequently voiced the opinion that trotlines could hook fishers, swimmers, and boaters (G. Palmer, Virginia Department of Game and Inland Fisheries, personal communication), suggesting that trotline safety was a potential source of conflict between trotline fishers and other river users. However, not one person interviewed from 2010 to 2012, including trotline fishers, fishing guides, rod-and-reel anglers, or sporting goods store owners, could identify a single incident or injury caused by getting hooked or tangled in a trotline. Most trotline users in the New River used trotlines sunk to the bottom, minimizing the exposure to other river users. It appears that the safety issue of trotlines may be a false argument put forth by individuals who already dislike trotline fishing for other reasons. Nevertheless, actions taken by river users to remove trotlines in the name of improved safety may contribute to trotline fishers feeling marginalized.

Various reasons were provided for perceived declines in trotline use, mostly centered on the failed recruitment of younger generations and changing socioeconomic factors and recreational values over time. Comments included the following:

People that trotlined have died out and didn’t pass it down.
Increasing recreational traffic is displacing trotlines too.

Kids don’t get into [fishing with trotlines] nowadays—they got Internet, cable TV. I can’t find kids to help me out with bait because they’re too busy looking at dirty things on the Internet. And the old timers have died out.

It is a generational thing—the younger generation is the fast food and computer generation. Knowledge of trotlines hasn’t been passed down.

People don’t have the know-how, people just as soon, don’t want to mess with don’in’ it themselves.

Kids are distracted with so many activities these days. [Trotline fishing] is a dying art, the same as gardening. Used to be everybody had a garden behind their house, now maybe 1 in 20 has one.

The younger generation lost interest, nobody showed them how to trotline, kids are drinking and doing drugs rather than fishing.

Fishing is hard work—people don’t want to do it anymore. People are too busy, and they haven’t been taught how to trotline, so they just don’t know how.

Trotlines are an old-school way of fishing that people don’t use any more. People around here used to grow, catch, and shoot all their food. Now they don’t.

Trotline fishers strongly believed that younger generations are not interested in outdoor recreation, much less trotline fishing. Many individuals stated that the prevalence of television and the Internet contributes to younger generations’ declining interest in fishing. Their observations are echoed in the literature. Schoolwork and preference for screen media combine to keep children and young adults inside and inhibit participation in outdoor recreation (Outdoor Foundation 2010). Television, the

Table 4. Frequency of reasons cited for ceasing trotline fishing (n = 15 lapsed trotline fishers).

<table>
<thead>
<tr>
<th>Reason for Stopping</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not enough time</td>
<td>8</td>
<td>53.3</td>
</tr>
<tr>
<td>Increased recreational traffic</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>Regulations and enforcement</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Fewer catfish</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Prefer fishing for other fish</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Health advisory on catfish</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>No longer rely on catching fish to eat</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Too hard to catch bait</td>
<td>2</td>
<td>13.3</td>
</tr>
</tbody>
</table>
Internet, and organized sports may now occupy leisure time of children and teenagers that, in the past, would have been available for fishing (Salazar 2002). The ubiquity of videogames, the Internet, smartphones, and cable television are often lamented by those in the natural resource profession. Alarming decreases in youth participation in outdoor recreation and nationwide declines in fishing and hunting during the 1990s and 2000s (Outdoor Foundation 2010; USDOI et al. 2012) frequently are tied to the pervasiveness of technology. Preference for spending free time using screen media was cited by 15% of 6- to 12-year-olds, 27% of 13- to 17-year-olds, and 20% of 18- to 24-year-olds when asked what drove their decision to not participate in outdoor activities (Outdoor Foundation 2010). The concept of technology being part of a number of factors “stealing” time from outdoor recreation and leading to a general disconnect with the outdoors has been referred to as “nature deficit disorder” by author Richard Louv. As children spend more and more time inside playing video games, using the Internet, and watching television, they become further disconnected from nature and less likely to pass down an interest in nature to their offspring, which becomes a self-perpetuating cycle (Louv 2005).

Some of the trotline users we interviewed believed that improvement in socioeconomic fortunes in the New River Valley was responsible for decreasing participation in subsistence activities such as gardening, hunting, and fishing. According to many interviewees, the New River Valley was very socioeconomically disadvantaged decades ago. Three individuals stated that they relied on supplementing their income by selling catfish caught on trotlines during the 1960s and 1970s, and several other interviewees mentioned that this practice was common until the 1970s and 1980s. One individual remarked that his family traded catfish for flour and sugar and sold furs to pay for dental work when he was a child. Several lapsed users said they no longer used trotlines because it was simpler and cheaper to buy fish from the store, and they no longer had a need to supplement their diet with wild-caught fish. Education about consumption advisories may further reduce participation. Two individuals stopped using trotlines because of consumption advisories, suggesting that they are both aware of the potential negative consequences and can afford to remove wild-caught catfish from their diet. Others pointed out the dwindling numbers of households that kept gardens, canned their own food, hunted, and trapped, which may reflect the influence of a growing economy from nearby Virginia Tech University and Blacksburg.

Changes to the economy, demographics, and New River management strategies also appear to be changing the values of the fishing public. New River anglers increasingly desire trophy Smallmouth Bass opportunities, and fewer anglers are harvest-oriented compared to years past (O’Neill 2001; Copeland et al. 2006). New River Smallmouth Bass slot length limits were implemented in 1987 and adjusted in 2003 to improve size structure, creating a widely known fishery that led to an increasing catch-and-release ethic and angler self-regulation (Copeland et al. 2006). Several trotline fishers pointed to the Smallmouth Bass fishery as siphoning off prospective trotline fishers, saying their children fished but preferred to target smallmouth bass. The wide acclaim of New River Smallmouth Bass fishing, combined with the proliferation of fishing media, such as television shows, fishing magazines, and Internet fishing forums and websites, may direct new anglers toward rod-and-reel fishing for bass, rather than toward trotline fishing, particularly in the absence of a family member who fishes with trotlines.

Despite their harvest-oriented nature and lack of expensive fishing equipment, trotline fishers exhibited some characteristics of specialist fishers. The concept of trotline fishing as a way of life suggests that it may be central to the lives of some individuals. These individuals might be considered specialized fishers, or “insiders.” Insiders participate in their sport with long-term commitment, through good times and bad (Ditton et al. 1992). Dedicated New River trotline fishers (fish $> 50\%$ of the time with trotlines) exhibited several of the characteristics of highly specialized anglers described by Bryan (1977): they fish often, with specific techniques often refined through years of experience, and may switch their targeted species or techniques seasonally. However, these individuals did not go on vacations specifically to fish in faraway places and did not possess large amounts of expensive recreational equipment such as high-end fishing rods and/or boats—qualities that Bryan (1977) considered typical of highly specialized fishermen. Many of the older gentlemen we interviewed made and fished out of wooden boats propelled with a wooden pole (Photo 2), and the majority of trotline users made their own trotlines—potential indicators of high specialization, despite the “low-tech” nature of their gear.

Chipman and Helfrich (1988) described a subgroup of Virginia anglers that fished frequently, yet was more harvest-oriented than expected according to the concept of angler specialization. These anglers were more likely to hail from rural areas and were less educated than nonconsumptive angler groups. Such findings suggest that low socioeconomic status may prevent individuals from progressing along the recreation specialization continuum (Bryan 1979; Chipman and Helfrich 1988).

Trotline fishers demonstrated poor awareness of fishing regulations and only slightly better awareness of consumption advisory for catfish. Only one individual had a firm grasp of all trotline regulations for the New River. Although 10 of 24 active trotline fishers said they were dissatisfied with current regulations, most of these individuals expressed dissatisfaction with nonexistent regulations when asked which specific rules they disliked. Support for regulations is directly tied to anglers’ perceptions of how their fishing experience will change as a result of the new regulation (Wilde and Ditton 1999). Because catfish fishing and trotline fishing have never been strictly regulated in Virginia, it should not be surprising that many trotline fishers are opposed to further regulation, even if they do not fully comprehend the regulations already in place. Many trotline fishers expressed some distrust of government in general, which might also contribute to antiregulation attitudes. A slim majority (54%) of active trotline users were satisfied with regulations. Those who wanted regulations changed (41%) overwhelmingly wanted the option to use game fish, such as sunfishes *Lepomis* spp., and Smallmouth Bass, as bait. Four users (17%) wanted more restrictive regulations (reduced bag limits, strict hook limits) on trotlines and/or harvest of catfish; these individuals were younger (mean age = 32.5) compared to the average age of other active trotline users (49.6 years), possibly indicative of changing values between generations. Perhaps these individuals grew up with the dramatically improved New River Smallmouth Bass fishery, populated with self-regulating anglers touting the benefits of catch and release (Copeland et al. 2006), and had higher exposure to conservation-oriented values. Two of these individuals were currently enrolled in college and another possessed a double-major degree from a four-year institution; perhaps higher education levels also play a part in desiring more conservation-oriented regulations. Fewer than half of active trotline fishers were aware of the specific consumption advisory details for
that promotion of the advisory may work as intended. However, two lapsed individuals stated that they stopped using trotlines in part because of the consumption advisory, suggesting that this is part of a larger way of life, both now and in the past. Trotline fishers may rely on harvesting fish for varying degrees of sustenance and feel that trotline fishing is a heritage activity that is part of a larger way of life, both now and in the past. Trotline fishers in the New River Valley generally were secretive in the pursuit of their fish and did not typically boast or publicize their catches. Consequently, most river users are unaware of the occurrence of large catfish in the New River (Photo 3). They may not be aware of consumption advisories and are not very knowledgeable about fishing regulations. Most of them favor even fewer regulations governing trotline fishing, particularly desiring the ability to use game fish as bait. Although trotline fishing appears to have been a family-oriented activity in past years, it may now be a solitary activity with little supporting social network. Although trotline fishing appears to be culturally important to some New River Valley residents, that group is dwindling and not recruiting new users into the tradition. Reasons for the decline of trotline fishing may be changing generational values of New River Valley residents, improving socioeconomic well-being, increasing recreational use of the New River, and reasons that mirror the nation-wide trend of declining participation in consumptive recreation. Decline of trotline fishing fishing likely will continue in the future, which may reduce conflict between trotline fishers, fishing guides, and other New River users.

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REFERENCES


Bryan, H. 1977. Leisure value systems and recreational specialization: the case of trout fishermen. Journal of Leisure Research catfish, and many who were aware did not heed the advisory. However, two lapsed individuals stated that they stopped using trotlines in part because of the consumption advisory, suggesting that promotion of the advisory may work as intended.

This study provides a foundation for further understanding the human dimensions of trotline fishers. Themes quickly emerged during interviews and reached saturation quickly, at which point responses were very predictable and consistent. However, because we used the snowball method, care must be taken when applying these results to other populations. Individuals who fish with trotlines infrequently probably are lesser known to the “trotline insider” community interviewed; hence, we may not have been referred to occasional trotline fishers as frequently as dedicated individuals. For example, a small number of the individuals interviewed had only used a trotline once or twice in their lifetime, either with friends, on a camping trip, or just because they were curious about the technique. Such occasional trotline fishers may have different fishing habits, preferences, and motivations than dedicated trotline fishers.

Our findings provide a peek into characteristics of trotline fishers that should prove useful for managing or studying this or other hidden fisheries. Trotline fishers place high importance on catch- and harvest-related factors, even though they exhibit many characteristics of highly specialized anglers, who generally are less catch-motivated than other angling groups. Trotline fishers may rely on harvesting fish for varying degrees of sustenance and feel that trotline fishing is a heritage activity that is part of a larger way of life, both now and in the past. Trotline fishers in the New River Valley generally were secretive in the pursuit of their fish and did not typically boast or publicize their catches. Consequently, most river users are unaware of the occurrence of large catfish in the New River (Photo 3). They may not be aware of consumption advisories and are not very knowledgeable about fishing regulations. Most of them favor even fewer regulations governing trotline fishing, particularly desiring the ability to use game fish as bait. Although trotline fishing appears to have been a family-oriented activity in past years, it may now be a solitary activity with little supporting social network. Although trotline fishing appears to be culturally important to some New River Valley residents, that group is dwindling and not recruiting new users into the tradition. Reasons for the decline of trotline fishing may be changing generational values of New River Valley residents, improving socioeconomic well-being, increasing recreational use of the New River, and reasons that mirror the nation-wide trend of declining participation in...


Translating Climate Change Effects into Everyday Language: An Example of More Driving and Less Angling

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Climate change is expected to result in widespread changes in species distributions (e.g., shifting, shrinking, expanding species ranges; e.g., Parmesan and Yohe 2003), especially for freshwater fish species (Heino et al. 2009). Although anglers and other resource users could be greatly affected by changes in species distributions, predicted changes are rarely reported in ways that can be easily understood by the general public. In contrast, climate science that more directly affects human welfare or livelihoods is often more readily communicated to the general public because it is of greater concern or closely related to everyday life. For example, most people can readily interpret how increases in the number of “hot” days above a given temperature threshold might affect their lives, and property owners in coastal areas can use predictive maps to determine how they might be affected by sea level rise (for more examples, see the Third National Assessment of the U.S. Environmental Protection Agency at globalchange.gov). However, the effects of climate change on species are usually reported to the general public using summary metrics or maps designed to communicate concepts that are not normally encountered in everyday life, including changes in habitat suitability, range shifts, or increasing risks from disease or extreme events (e.g., National Audubon Society 2009; Groffman et al. 2014). Though these metrics are necessary, meaningful, and understood by scientists, many people lack the necessary training and background to readily understand them. Further, scientists and nonscientists alike may struggle to convert these metrics into a currency that directly affects day-to-day life.

Climate science is a complex issue, and we argue that when communicating potential responses of vegetation, fish, and wildlife to nonscientists, creative thinking with respect to the currency of communication will facilitate discussions between scientists, policy makers, and the public. We posit that with some additional thought and relatively simple summaries, the responses of fish and other species to climate change can be translated into everyday language that will facilitate climate science communication. Although such translations are rare, one example of this type of creativity is the translation from changes in habitat suitability for tree species to potential reductions in maple syrup production (Westover 2012), which is arguably more interesting and understandable for the general public. Similar translations could be especially important for communicating climate change effects on game fish and other species that are socially and economically important to large groups of people. We demonstrate this translation by communicating the potential effects of climate change on the distribution of a coldwater fish species, the Eastern Brook Trout Salvelinus fontinalis. Rather than communicating the potential forecasted contraction of the Brook Trout’s distribution in terms of habitat loss, we report the predicted increases in the driving distance to streams likely offering Brook Trout angling opportunities under a climate change scenario. Travel costs based on distance have been widely used to value ecosystem services such as angling under climate change scenarios (e.g., Pendleton and Mendelsohn 1998; Mendelsohn and Markowski 1999; Ahn et al. 2000) but, to the best of our knowledge, have not been used for communicating potential changes to the public despite the intrinsic link to everyday life.

BACKGROUND AND APPROACH

The Eastern Brook Trout is a socially and economically important fish that occurs in small coldwater streams and lakes. Wild populations support angling throughout the Appalachian Mountains and the northeastern United States. However, warming air temperatures are expected to reduce available coldwater habitat and result in a smaller Brook Trout distribution and fewer angling opportunities in the future. We used two previously developed models predicting river water temperature (DeWeber and Wagner 2014b) and Brook Trout occurrence probability (DeWeber and Wagner 2014a) to identify streams likely to support Brook Trout under current and future climate scenarios. We identified streams as likely to support Brook Trout if occurrence probability was greater than or equal to 0.46, which corresponded to the highest overall classification accuracy (DeWeber and Wagner 2014a). We did not include lakes in this analysis because occurrence predictions were only available for streams. We used projected air temperature from the downscaled ECHAM5 model described by Hostetler et al. (2011), which predicted region wide average increases of 7.1°F by 2087. We used the Google Maps API (developers.google.com/maps) to calculate the distance required to drive from the centers of 23 cities spread throughout the Eastern Brook Trout range to the 10 nearest stream segments of the NHDP Plus Version 1.0 Dataset (USEPA and USGS) likely to have Brook Trout under current and future conditions. Distance calculations were automated in the gmap package (Kahle and Wickham 2013) in R (R Development Core Team 2014). In cases where stream segments were not directly adjacent to a road and would likely require hiking, we simply report the distance to the nearest point along a road. We present the average distance required to drive from a city to the 10 nearest Brook Trout streams (for angling or viewing opportunities) as a simple and readily understood summary of the potential effects of climate change on Brook Trout occurrence and related resource use.

INCREASES IN DRIVING DISTANCE

Under current conditions, Brook Trout were predicted to occur in streams throughout the region, and average driving distances from cities to the nearest streams predicted to offer angling opportunities ranged from 4 to 87 miles (Figure 1). As a result of projected warming, driving distance to go Brook Trout angling was predicted to increase, on average, by almost 164 miles in the next 70–80 years (Figure 1). For example, the driving route from Philadelphia, Pennsylvania, to the nearest Brook Trout stream was predicted to cover 249 miles in a warmer future, much longer than the current 48 miles (Figure 2).
Figure 1. Plots comparing the average distance to drive from 23 cities to the nearest 10 streams predicted to offer Brook Trout angling opportunities under current conditions and future warmer air temperatures projected under climate change. Cities are ordered based on their geographic location from left (southernmost) to right (northernmost). Warming air temperatures are predicted to result in widespread losses of Brook Trout habitat in the future, resulting in the longer predicted driving distances for anglers.

Figure 2. Driving routes connecting Philadelphia, Pennsylvania (point B), to the nearest stream predicted to offer Brook Trout fishing opportunities under current conditions (point A) and under future warmer air temperatures projected under a climate change scenario (point C).
The lengths of trips from many northern cities, such as Bangor, Maine, were predicted to increase but were still relatively short in the future because nearby streams were still predicted to support Brook Trout under warmer conditions. In contrast, anglers in southern cities (e.g., Cleveland, Tennessee; Figure 1) would experience dramatic increases in the lengths of trips because Brook Trout were predicted to be lost in surrounding areas.

For many anglers in the region, predicted responses of Brook Trout to climate change mean the difference between single-day fishing trips that could be made fairly often and multiday expeditions requiring significant planning and resources. In addition to longer drives, anglers would also likely have to plan on hiking because many of the streams predicted to offer Brook Trout angling opportunities in the future are located in relatively remote, protected lands away from roads. Although anglers tend to be very dedicated, it is unlikely that many would drive great distances to fish very often due to cost, especially if those last remaining streams become popular (Hunt 2005). Although angling opportunities near city centers would likely be available for other species, and streams could still be stocked to provide seasonal Brook Trout angling opportunities; anglers who prefer to catch wild Brook Trout might target alternative species or stocked fish with less enthusiasm and effort. In any case, losses of Brook Trout populations and increased trip lengths would likely result in reduced resource use in many areas.

**SUMMARY**

Longer trip lengths for Brook Trout angling clearly demonstrate how a species response to climate change can be communicated in everyday language for the general public. We chose to focus on the length of angling trips because longer driving distances resulting from losses of Brook Trout populations would greatly affect anglers. Similar translations can be provided for a broad range of climate change effects on species and ecosystems by identifying affected resource users and a relevant, everyday currency. Additional examples of broad interest to diverse groups of people include driving times to observe other wildlife, the likelihood of viewing or harvesting a trophy-sized game animal in a specific location, or the number of bird species that might appear at a backyard feeder. These everyday metrics could be summarized with minimal effort once the difficult part of predicting species responses to climate change is complete and a relevant everyday currency that resource users base decisions upon is identified.

Communicating species responses to climate change in everyday language could greatly increase the ability of resource users and other members of the general public to understand and relate to predicted changes. A clear understanding of potential changes might not lead to greater societal concern about species responses but may enable people to make informed decisions. In any case, people are unlikely to be concerned about effects that they do not understand.

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**REFERENCES**


Finding the Path to a Successful Graduate and Research Career: Advice for Early Career Researchers

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The path to a successful graduate and research career is complex and difficult. Early career researchers (ECRs) have myriad choices and tasks to prioritize and complete as they build their CV but are often confronted with unfamiliar situations in which advice from more senior researchers can be extremely valuable. Here, we summarize a recent workshop held for ECRs by the Canadian Aquatic Resource Section of the American Fisheries Society (AFS) with support from the Education Section. Sessions touched on (1) getting published, (2) science communication and outreach, (3) scoring a job or grad school position, and (4) working within the science–policy interface. The decades of collective experience brought to the table should be shared with the broader readership of AFS, because it may prove useful to ECRs as well as stimulate meaningful conversations on these important and timely issues.

El camino hacia una graduación exitosa y una carrera en la investigación: consejos para los investigadores incipientes

El camino hacia una graduación exitosa y una carrera en la investigación es complejo y difícil. Los investigadores incipientes (II; aquellos que se encuentran en las primeras etapas de su carrera) tienen ante sí una miríada de opciones y retos que deben priorizar y completar a medida que construyen su CV, sin embargo suelen enfrentarse a situaciones poco familiares en las cuales el consejo de investigadores más experimentados puede resultar muy valioso. En este artículo se resume un taller de trabajo llevado a cabo recientemente para los II por parte de la sección de Recursos Acústicos de Canadá, de la Sociedad Americana de Pesquerías (SAP), con la colaboración de la Sección de Educación. Las sesiones trataron de 1) publicación; 2) extensión y comunicación de la ciencia; 3) conseguir un trabajo o una posición en una escuela; y 4) trabajar en la interface ciencia-políticas públicas. Las décadas de experiencia colectiva puestas sobre la mesa de discusión debieran compartirse con un público más amplio de la SAP, dado que pudiera ser útil para los II así como también para estimular conversaciones productivas en estos temas de actualidad.

INTRODUCTION

The path to a successful graduate and research career is, for many people, a complex and difficult experience. Many early career researchers (ECRs; graduate students, postdocs, pretenured academics) must decide how best to prioritize their many tasks, such as writing scientific publications, building social networks, interacting with stakeholders, being relevant to knowledge users, learning new skills, or getting international experience. Few ECRs have a clear picture of how these experiences may help or hinder their future career paths and effectiveness as scientists. Here, we summarize a recent workshop held for ECRs by the Canadian Aquatic Resource Section of the American Fisheries Society (AFS) with support from the Education Section. Bringing together experts from fisheries and aquatic sciences, the workshop consisted of four panel discussions followed by a question-and-answer session. Each session touched on timely and relevant topics to ECRs, including (1) getting published, (2) science communication and outreach, (3) scoring a job or grad school position, and (4) working within the science–policy interface. Given the decades of collective experience brought to the table, we felt it pertinent to share the outcomes of this event with the broader readership of AFS in the hope that this knowledge may prove useful to ECRs as well as to stimulate meaningful conversations on these important issues. In the following sections, we summarize the major motifs.

Publishing is the Best Form of Demonstrating Success, Inside and Outside Academia

“Success” is a loaded word. What is actually meant when we speak of “scientific success”? Particularly in academia, success is defined in terms of one’s publication output; that is, more is better (Fischer et al. 2012). Though this metric may not be the perfect indicator in that it fails to consider the quality of individual contributions, it nevertheless appears to be coarsely correlated with success. Publications can be seen as the “currency of the field,” a concept most would likely agree with. This notion was highlighted in the discussion, emphasizing how publishing research papers shows ability, commitment, and a capacity to follow-through. This is of particular importance for ECRs, who have to prove their worth in their fields in order to secure a job (Schäfer et al. 2011). For example, a recent study by Laurance et al. (2013) highlights the importance of the idea that “early to press is best for success.” They asked the question, “Can one foresee whether young scientists will publish successfully during their careers?” They found that pre-Ph.D. publication success was the strongest correlate of long-term success, suggesting that “early to press” is best for success for young scientists, too. Early career researchers should ensure that their research finds a home in a scientific journal, because “if you don’t publish, it never happened” (John Smol, Queens University). Scientific publication in a peer-reviewed outlet is indeed part of the scientific process.

“Publishing is hard ... don’t give up ... write often ... become familiar with your inner writing voice.”—Donna Parrish, President of the American Fisheries Society

Everyone gets writer’s block. Dante’s description of his own writer’s block illustrates well what all writers have felt at one time or another: “It seemed to me that I had undertaken too lofty a theme for my powers, so much so that I was afraid to enter upon it; and so I remained for several days desiring to write and afraid to begin” (Flaherty 2005:8). Two simple methods to combat such troubles were highlighted in the workshop. The first being that one should take the time to write every day. This can include keeping a personal journal or a work journal or even writing letters to friends and family. However, we would take that piece of advice one step further and advise directed writing on a daily basis. This necessarily requires you to add focus and depth to your writing. For instance, pick an event or topic that piques your interest—something that interests you when reading the paper or watching the news—and then jot down a paragraph or two about the subject. As Donna Parish explains, this allows you to become more familiar with your “inner writing voice” and fosters confidence in your own writing skills. The second piece of advice is to write something—anything—down when faced with a blank page. As Mike Donaldson noted, “No matter how bad the experiences I’ve had, the most stressful experience I have is sitting down in front of a blank Word document. ...” Just write something down, and before your know it, words will begin flowing. Start with a clear outline and objectives, then keep an eye on the target (e.g., watch for mission creep), and add structure. Make sure to add comments to keep an understanding of where you left off once you have stepped away from writing for a day, a week, or longer.
Don’t Forget, Editors and Reviewers are People, Too!

Editing and peer review is an integral process that gives sustainability and strength to the scientific method. It is a long process that almost feels like a never-ending dance that you, your editor, and the selected peer reviewers take together. The vast majority of editors-in-chief, editorial board members, and reviewers donate their own time to the peer-review process. Therefore, it’s important to keep in mind that editors and reviewers are people, too. They have deadlines to meet, meetings to attend, classes to teach, their own students to mentor, etc.

In addition, there are myriad challenges to the implementation of the peer-review process, of note being the “tragedy of the reviewer common” (Hochberg et al. 2009)—that is, the increasing difficulty journals have in trying to find reviewers due to the drastic increases in paper submissions combined with static journal acceptance rates. Facilitating the work done on the editorial side of the table will benefit you and offer a greater chance of publication. Four pieces of advice sum up the extent of the discussion around this topic. First, choose the right journal for your research. Aligning the topic of your paper with the scope of the journal is key to a successful peer-review process. A simple tip for those struggling to decide on a journal: take a look at your reference list—what journals do you most often cite in a particular manuscript? Think twice about submitting a paper to a journal that you do not reference once; there is likely a better fit for your work elsewhere. Second, don’t skimp on the cover letter. Editors often must decide very quickly about whether a manuscript should go to review. Spending a few extra minutes to present a convincing case in the cover letter will help ensure that your paper gets full consideration. Third, understand the importance of following the author’s guidelines. This cannot be overstated. Referencing formatting may seem irrelevant, but for reviewers, it demonstrates your commitment and attention to detail in writing your paper (and by extension, the research itself). Finally, know that editors will be sympathetic to conflicts of interest. If you do not feel that a specific person should review your paper, convey this honestly in your cover letter. Editors will most often heed this request.

“As scientists we are trained to argue our point. When communicating with Aboriginal and Indigenous peoples, it’s more important to listen.”—Louise Chavarie, Michigan State University

It is critical to develop a “presence” in the community in which you are working. Louise Chavarie (Postdoc, Michigan State University) has spent the past eight years working with First Nations in Northern Canada. She stresses the importance of “listening” to the communities. By listening—quite literally, closing your mouth and stopping yourself from speaking—you demonstrate that you care about their wants, needs, and way of life. Without the development of this trust, successful scientific endeavors in indigenous communities can become challenging. Also, when developing a communication plan, take into account the time involved. Schedule monthly or annual meetings where you report on your progress and ask for input on a project’s directions. If you can’t be present to talk with the community, think about starting a Facebook page where community members can go to ask questions. Collectively, this advice can be extended to other stakeholder groups (e.g., anglers, commercial fishers, etc.) and will facilitate effective communication and involvement by all parties.

Cultivate a Web Presence—Own Your Online Self

The importance of having a web presence must be stressed. This goes for all levels of scientific organization, from individual websites (self-promotion), to project websites (community involvement), to lab groups, and organizational websites. Also, there is a shifting demographic on how individuals utilize social media. Twitter and Facebook have become an important form of electronic word of mouth (Jansen et al. 2009; Parsons et al. 2014), representing a unique opportunity to reach new viewers and gain citations. These social media outlets provide a useful conduit to share your research and promote both an open dialogue with the public and transparency in scientific research. We find that a common objection to creating an online presence is that too much work is involved. We would suggest that while working with your particular university’s or institution’s website may be onerous, there is a plethora of easy-to-use alternatives available, most of which are free of charge. A good place to start is by creating a Google Scholar profile. In addition, there are many other sites, including LinkedIn, Academia.edu, and Research Gate, that allow you to build a free webpage. Also consider the possibility of building a personal webpage—an easy task with the use of free page building websites (e.g., Weebly, WordPress). Having a personal website can help you share your work with family, friends, and the greater public domain. Another often overlooked tool in the academic’s tool box includes utilizing your university’s outreach and communications department. Though you may not know how to draft a press release, they do. The communication department is there for the exact reason of bolstering the university’s own web presence with research done under their umbrella. If you’ve done researchers and managers in scientific disciplines unrelated to yours. For example, imagine that you have two researchers looking at the same river (say, a hydrologist and a fish biologist). Not only will they both see that system differently, but they will also interpret the workings of that system differently. Both languages are needed to fully understand the system in its entirety. Learning the language of others can facilitate meaningful discussions and fruitful collaborations with researches, managers, and the public.

“To Truly Reach People, You Must Learn Their Language

The communication of science to laypeople can be a challenging but very rewarding experience. To achieve success it is vital to understand the importance of the language of the people with whom you are trying to work. This goes not only for having productive interactions with the public but also for working with
research, they want the information. Consider drafting up 200 words for them, including some high-definition photos. All of these sources can greatly help in communicating your research, and you should attempt to use some of them, because at the end of the day, your research and publications only exists to those who read them.

Is It Who You Know or What You Know? Both, Really ...

The idea that “it’s not what you know, it’s who you know” was shown to be rather context dependent. Daniel Health (professor, University of Windsor) and Don Jackson (professor, University of Toronto) discussed how the concept of scientific pedigree (e.g., your scientific background) has recently lost its importance. The chief reason is because academics are much more interested in your publication record (i.e., what you have done). Similarly, screening approaches at most government institutions make it highly unlikely that someone you know will be handling your application, at least in the first round. In many cases, applications are screened using automated keyword searches. Because of this, who you know can have some impact in academia. A strong reference letter from a well-known scientist may help human resources when they are trying to make a decision between two equal candidates. Accordingly, the importance of having all of the basic qualifications (e.g., a degree) and setting yourself apart with unique skill sets and experiences cannot be overstated. Conversely, who you know can be an incredibly beneficial asset if trying to land a job in the private sector where employers have much more latitude in who they hire. Environmental consultant companies will often seek candidates who are either known in the field or who have had past work-related experience with them. Generally, building a social network is indeed important, but you must still focus on gaining useful skills that will benefit you in your chosen field of study.

You Have More Skills Than You Think as a Graduate Student

Early career researchers actually have many more skills than they typically think. Rarely do ECRs stress the importance of their graduate research as a skill beyond the degree they’ve achieved. Yet, unlike medical school, the path for students in aquatic sciences is diverse. In many settings, graduate research offers important skills that employers desire. Tailor your skill set to the job application and include skills like project management (a very important asset no matter what the job), logistical expertise (e.g., the ability to plan fieldwork in difficult environments, development of safety plans); supervisory experience; and budget experience, when appropriate. And, of course, your publication record demonstrates to employers your ability to complete a project. Remember, publications show people your ability, commitment, and capacity to follow-through.

Keywords are Not Just for Publications

For many jobs, just getting screened is a difficult process. Often human resources personnel are inundated with applications and screening is done through an automated process of looking for keywords or by a clerk who may not have the same background and is similarly looking for keywords. Look at the job advertisement and use the same keywords as in the employment ad in both your cover letter and résumé or CV. Make sure your keywords are succinct; for example, if the ad says “biomonitoring,” don’t write biological assessments.

Should I Take a Job Abroad or Stay Where I Am to Build My Social Network?

Mobility helps for many reasons. There are rich experiences to be had all over the world. Get experience in your field, wherever that experience can be found. Moving to Europe to get a job in fisheries (if you’re a fish scientist) is more beneficial for your career than staying and working in a job outside your line of work. The key to being a great job candidate is having a balance of experiences and an ability to demonstrate a wide breadth of skills. Aim for a middle ground between your current expertise and your next project with the goal of expanding your skill set, and seek out opportunities to collaborate on multidisciplinary teams.

Interview Your Potential Graduate Advisors and Their Students

When choosing a prospective graduate (or postdoc/job) advisor, make sure that you will be able to work and communicate well with him or her (O’Connor 2012). This can be a relatively easy task to accomplish and can be done at the same time you are being interviewed. Have a list of questions to ask your potential adviser following the questioning period. After the interview, e-mail his or her current students, and ask questions about both the advisor and the other students in the lab. These questions shouldn’t be personal in nature but more general. For example, “How do you like working for Dr. John Doe? Does he/she provide a guideline from which research will be done, or does he/she provide autonomy for you to steer your project in the direction you see fit?” These questions can end up saving you immeasurable headaches in the future. A supervisor whom you cannot work or communicate with will often lead to failed opportunities and a lower likelihood of finishing your degree. Indeed, in an ideal scenario your graduate advisor will become one of your lifelong mentors, helping to guide you with your professional and personal development (Cooke and O’Connor 2014), emphasizing the importance of getting it right!

“Building successful policies requires credibility, legitimacy, and relevance; we rarely consider all three.”—Jake Rice, Chief Scientist, Department of Fisheries and Oceans

Developing policies at the science–policy interface often requires a transdisciplinary consensus between scientists, social scientists, political scientists, and economists. At the heart of achieving success is the understanding that science–policy requires credibility, legitimacy, and relevance. Any idea, proposal, or policy must be put forth by credible authorities, have a legitimate chance of working, and be relevant to the people it will affect. Effective policy making must therefore take into account that the policy is needed and how the public will be impacted by the policy. To be successful, ECRs need to understand the ways in which decisions are made and identify ways in which they, the ECR’s, can contribute to the process (see Rice 2011).

CONCLUSION

The path to a successful career in research—whether in academia, government agencies, nonprofits, or the private sector—is rife with challenges, difficulty, and uncertainty. Early career researchers are indeed the most vulnerable group in the science system (Laudel and Gläser 2008) and are thus most in need of guidance in dealing with both large, important topics (e.g., working with journal editors, deciding whether to move abroad for work, etc.) as well as the often seemingly inconse-
quential, though necessary, minutiae of the research process (e.g., following journal guidelines, communicating with the general public, etc.). Obtaining guidance from senior researchers can often be a difficult task given the sheer number of responsibilities and commitments they have on a daily basis. We hope that this compilation of advice from some of the most prominent researchers in the aquatic sciences—whose collective experience totals many decades of work—ameliorates some of the challenges. Early career researchers have in the path to success. Finally, though this perspective is targeted toward ECRs, we hope that more seasoned researchers will also find this information useful and encourage them to provide guidance to those endeavoring to pursue a career guided by the scientific process.

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We are thankful to the Canadian Aquatic Resources Section (CARS) and the Education Section of the American Fisheries Society (AFS) for sponsoring this workshop. We graciously thank the panel members who led the discussions of the workshop. Panelists included (1) Getting Published: Donna Parrish (president AFS, University of Vermont USGS CO-OP Unit), John Smol (professor, Queens University), Rolf Vinebrooke (professor, University of Alberta), Mike Donaldson (Canada Science Publishing); (2) Science Communication and Outreach: Jack Imhof (director of Conservation, Trout Unlimited Canada); Louise Chavarie (postdoctoral fellow, Michigan State/GLFC), Mike Rennie (research scientist, University of Manitoba, IISD-ELA); (3) Scoring a Job or Grad School Position: Dan Heath (professor, University of Windsor, GLIER), Don Jackson (professor, University Toronto), Jenny Winter (scientist, Ontario Ministry of Environment and Climate Change), Pete Cott (biologist, Government of Northwest Territories); (4) Working at the Science–Policy Interface: Jake Rice (chief scientist, Fisheries and Oceans Canada); Nick Lapointe (senior scientist, Conservation Science and Planning, Nature Conservancy Canada), Martha Guy (Environment Canada), and Vivian Nguyen (Ph.D. student, Carleton University).

REFERENCES


O’Connor, C. M. 2012. How to find a good graduate advisor and make the most of graduate school. Fisheries 37(3):126-128.


AFS NEWS

Membership Testimonials

My favorite thing about a career in fisheries is the constant opportunity to learn something new. More often than not, that learning turns into something bigger. As a member of AFS, these opportunities can be as easy as walking through a door. As a member, you can attend any Section meeting or go to talks on subjects you know little about. For me, exploring new areas ignites ideas on how to look at a research question from a different angle. These sparks often turn into other questions, then ideas, then discussions, and suddenly you have a collaboration going. Thinking back on the mentors and colleagues in my career, most (if not all) somehow link back to AFS. That is a pretty amazing source of fisheries brainpower.

Julie Claussen
Research Biologist at University of Illinois
Urbana-Champaign, Illinois Area

Through the AFS magazine and meetings, we get updated information on policies, endangered/invasive species, management methodologies, and on the recent advances in fisheries science among others. Also information on new devices and equipment is particularly of importance. We are dedicated to the study of the taxonomy and ecology of planktonic stages of fish larvae and cephalopods from marine environments respectively. We found information useful or potentially applicable to the marine environment. We are also able to talk with colleagues about how similar problems in freshwater systems in North American rivers or ponds could be focused to get solutions in our country. Being member of the AFS represents a bonus in our career.

Roxana De Silva-Dávila
Profesor-Investigador, CICIMAR-IPN

Every graduate student position and job on my resume is a direct result of being a member of AFS. I met Mike Allen from the University of Florida through the AFS job page, Tom Kwak from North Carolina State University at an AFS meeting in Oklahoma City, my colleagues at The Fisheries Blog through the AFS student writing contest, and Smith-Root at AFS Trade Shows. Those opportunities would not have happened if I were not a member of AFS.

Patrick Cooney
Certified Fisheries Scientist & Author and Co-founder of The Fisheries Blog

AFS membership has been integral to my personal and professional development as a fisheries biologist. When I attended my first AFS Annual Meeting, I was terrified to talk to people, let alone present my undergraduate research! But, by the day of my talk, I had already met several professors and agency professionals, as well as students from other universities, and every single one that had said they would be at my talk was there. Rows of familiar faces, each with an encouraging smile. That’s what AFS is: support.

Rebecca Krogmann
Reservoir Research Biologist
Iowa Department of Natural Resources

There are so many reasons to attend AFS meetings at any level—Chapter, Division, or international. You have amazing opportunities to hear the best and latest in fisheries and aquatic science, connect with old and new friends, and visit places you’ve never seen! But, for me, nothing reinvigorates my commitment to the profession like the parent Society Annual Meeting. In the afterglow of the meeting, I am brimming with new ideas for my teaching, research, and service!

Melissa Wuellner
Assistant Professor
South Dakota State University
AFS is and always has been comprised of hardworking devoted curious knowledge seekers, wisdom recipients, and mentors. Those wonderful people with the live hearts and the live minds that unselfishly give their talents to something bigger than themselves. Being an AFS member means I am part of this long line of passionate people that devoted their lives to protecting, enhancing, and conserving our world’s fisheries resources…it’s about having made a conscious decision to spend your brief flicker of time on this earth trying to make things a little better, and to me that is surely something to be proud of.

Tom Lang
AFS Socioeconomics Section President
Texas Parks and Wildlife Department, Inland Fisheries Division

The best thing I did for myself as a student was to get involved in AFS. I met other students, fisheries professionals, and AFS leaders who provided advice, friendship, and mentorship. When I was ready to apply for jobs, those contacts were invaluable. I’ve managed to have more than a little fun through AFS, too!

Tracy Wendt
Graduate Student
University of Montana
College of Forestry and Conservation

I’m proud to say that I am an AFS member as it is an integral component to my professional career. AFS has paid dividends for me as I have undertaken this journey as a fisheries biologist. My early involvement as a graduate student allowed me to network with fellow graduate students and fisheries professionals. Attending meetings and participating in the Continuing Education Workshops provided insight into novel approaches that propelled my research to a new level. Meeting folks from around the country allowed me to begin collaborative work on larger-scale projects. After working in the profession for a few years, I began to participate at both the Section and Chapter levels. Contributing within committees assigned to specific tasks has provided a whole new level of professional development and has led me to assume leadership roles at various levels. To me, AFS is more than meetings and journal access. It is a tool for me to stay relevant in the fisheries field, and I believe that all fisheries students and professionals would benefit from becoming a member.

Marty Hamel
Large River Ecology Specialist
University of Nebraska-Lincoln
School of Natural Resources

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 perspective 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.

Justin Davis
Fisheries Biologist, CT DEEP Eastern District Headquarters

I have been a member of AFS since 2004 and have met a great deal of people, especially as the communication officer for the Canadian Aquatic Resources Section. However, my best AFS networking experience occurred at the AFS Physiology Section meeting in Barcelona, Spain, where I met my partner, Jen….who lived only a few minutes away from me in Ottawa, Canada.

Caleb Hasler
Post-doctoral Research Associate
University of Illinois at Urbana-Champaign
Meet the AFS Staff

It’s that time year again – Annual Meeting time! A lot of time is spent each year preparing for this event, and a lot of people work hard to make sure it goes off without a hitch. Meet the staff behind the scenes of the Annual Meeting and at *Fisheries* magazine.

In this job, I help to orchestrate opportunities to protect fisheries and aquatic resources. In fact, the first objective in the AFS Constitution is to “promote the conservation, development, and wise use of fisheries.” So one of my main functions is to create an environment that will help to ensure that we make the mission and vision of the Society come to life. This includes a wide variety of roles such as finances, effective and creative meetings, excellence in publications and communications, advocating for development and use of sound science, and much more.

*My Fun Fish Fact:*

Douglas Austen
Executive Director

After previously working for 11 years as the managing editor of *Fisheries*, I now have a different role at AFS coordinating social media and other forms of digital communication. We are always seeking new ways to bring our members useful information and today that often involves platforms such as Facebook, Twitter, and LinkedIn. I am also the primary news media contact for the Society and maintain our overall communications calendar. I assist staff in all departments with writing, editing, updating websites, photography, and designing simple publications and signage.

*My Fun Fish Fact: Eels migrate the opposite way from salmon (ocean to river and back to the ocean, rather than from river to ocean and back to the river). They are also delicious.*

Beth Beard
Digital Content and Engagement Strategist

My duties include close work with AFS Chapters and Sections and comparable work with private and public sector partners with interests in fish or their habitat. Prior to joining AFS in early 2014, I worked for the federal government for 37 years, most recently as chief of the Habitat Protection Division in NOAA Fisheries Service headquarters in Silver Spring, Maryland. My NOAA career included work in regional and headquarters offices on marine, coastal, and riverine programs. I have also have leadership roles with AFS (two terms as chair of Resource Policy Committee, president-elect of Fish Habitat Section, past member of Governing Board, monthly columnist for *Fisheries* magazine, and received three AFS Distinguished Service Awards).

*My Fun Fish Fact: I learned that AFS is even more dynamic than I imagined as an undergrad in 1973. There’s someone for every fish and other critters, for every stream and lake. The opportunities to make a difference are immense, all while having fun. Who could ask for more?*

Thomas Bigford
Policy Director

I come to AFS with nearly 30 years of experience in association management. I have held roles of COO and SVP of finance and administration for associations in the scientific, medical, and business communities, most recently with an engineering society and before that a medical education association. At AFS, I oversee all operations functions such as meetings, communications, finance, technology, and human resources. I reside in Fairfax, Virginia, with my 15-year-old son and two Chihuahuas.

*My Fun Fish Fact: A lot of people, scientists, managers, etc. are really interested in fish ... with beer coming in at #2.*

Daniel Cassidy
Deputy Executive Director
I've worked at AFS for almost 11 years as member support for individual membership. That entails every type of question, from what kind of organization is AFS to where are you located, as well as a lot of listening. I try to answer all questions as completely as possible. I also do initial mentoring of students and new members and try to make our members feel as welcome as possible. And, that if they have any questions or concerns they will automatically know that membership will be there to assist them. During the Annual Meeting, I will be working on registration.

My Fun Fish Fact*: Catfish have over 27,000 taste buds all over the surface of their entire body, with the gills containing the highest concentration, followed by the barbels and the mouth. They are like swimming tongues!

Juanita Flick
Membership Assistant

I oversee the content packaging, art direction, management, and production of the magazine, working closely with the executive director, science editors, and writers in content conception and development.

My Fun AFS Fact: That AFS member Dana Schmidt's son (Brian) won the Nobel Prize in Physics for his work in astrophysics (using supernovae measurements and Doppler-shift technology), which helped confirm what Einstein could not ... that our universe is actually expanding.

Sarah Gilbert Fox
Managing Editor, Fisheries & AFS Content Director

I help our content director create and edit content to engage and inform members, deliver timely and appropriate information to the larger community of interest in order to advance the mission of AFS, and to reach out to new communities (prospective members, lost members, potential partners) to engage them in AFS activities.

My Fun Fish Fact: Whale Sharks, the world's largest fish, lay the world's largest eggs. An egg over seven inches long has been found.

Sarah Harrison
Editor, Fisheries & Content Coordinator

My Fun Fish Fact*: The world's tiniest fish is the Stout Infant Schindleria brevipinguis and is only one-fourth of an inch when fully grown.

Laura Hendee
Journals Production Coordinator
Text to come

My Fun Fish Fact:

Shawn Johnston
Administrative Coordinator

A books production coordinator at AFS since 2000, I've had the pleasure of helping to produce several of our books. I enjoy the variety in my work, whether copy editing manuscripts, laying out chapters, working with graphics, composing covers, or preparing books for the printer, I've worked with some pretty terrific authors and editors as well. Not only have they been incredibly gracious, but the excitement they have for their work, when they share it with me, is contagious. Here, in the office, my editorial coworkers and I have our own lively conversations and debates about AFS style and Pantone colors. Yes, we truly do enjoy our work.

My Fun AFS Fact: In addition to conversation, the best gift I have received recently was an electronic picture of one of the authors proudly holding a copy of his book. (Love it.)

Debby Lehman
Books Coordinator

My Fun Fish Fact*: Goldfish have pharyngeal teeth--teeth in the pharyngeal arch of the throat --to help them crush their food.

Aaron Lerner
Publications Director

I came onboard AFS in April 2015 working with the Hutton Junior Fisheries Biology Program. I work closely with Beverly Pike and the Hutton Committee to deliver the program’s mission: stimulating career interest among young people from underrepresented groups. I help with the selection process of highly qualified students, matching selected students, Hutton Scholars, with mentors, communications with all parties (AFS staff, mentors, and students), and recording activities of student progress. At the Annual Meeting, I will be manning the Hutton booth.

My Fun Fish Fact*: Eels and morays have the most acute demonstrated sense of smell, with some species capable of detecting substances at less than one part per trillion.

Cynthia Oboh
Educational Program Coordinator

I joined AFS in 2014 as director of student and professional development. As director, I oversee professional development programs and the Hutton Junior Fisheries Biology Program. I have 14 years of experience in distance learning that includes both professional development and higher education. I began my adult learning career in 2001 as a communications instructor. In my previous position as associate director of educational initiatives at a healthcare multimedia company, I was responsible for high-profile online nursing and allied health continuing education courses. My instructional design experience also includes digital textbook development and as well as engineering and human resource CE. I hold an MA in communications from the University of South Alabama and currently reside in northern Virginia.

My Fun Fish Fact: Did you know Tom Bigford has 12 fish ties?

Beverly Pike
Director of Student & Professional Development
I grew up in Warsaw, Poland and graduated from Warsaw University with a degree in applied linguistics. I moved to Maryland 22 years ago with my husband and children and started working for AFS in 1999, as a part time membership assistant. When I am not helping our members, I like to go on hiking trips with my husband and our dog, knit, and figure skate.

My Fun Fish Fact*: There are over 700 known soniferous (sound producing) species of fish. Some fish can grunt, growl, moan, boat whistle, honk, hiss, croak, wail, and shriek. However, fish do not have vocal chords and make sounds using other parts of their bodies, including pulsating their swim bladder, body and tendon vibration, and air release.

Eva Przygodzki
Membership Coordinator

As the units coordinator, I work as the liaison to Units, Chapters, Sections, Divisions, and committees for the Society. It's a surreal experience to see everything come together for the Annual Meeting because you get to meet all of the Society members you had been coordinating with all year long. It's a great environment to work in.

My Fun Fish Fact*: Sailfishes are the fastest fish in the ocean, while seahorses are the slowest.

Jasmine Sewell
Unit Services Coordinator

I help make things run smoothly, ensuring everybody is doing what they’re supposed to and that they’re responsive to the needs and questions of membership. If there are any issues, I’m the person that people come to and we figure out what to do. I am in charge of human resources and overseeing accounting and IT; I also manage meeting planning with Administrative Coordinator Shawn Johnston, handle issues involving office facilities, and engage with the Hutton Junior Fisheries Biology Program and other continuing education programs. I also ensure that our office is working smoothly. During Annual Meetings, I always circulate from one event to the next, making sure that everything is running as planned.

My Fun Fish Fact*: Mudskippers (family Gobiidae) are amphibious fish that can “walk on land” and they use water held in their mouths to capture via “suction feeding” — gulping in water to draw prey into their mouths.

Denise Spencer
Office Administration Manager

As one of the book production coordinators on staff, I have my hand in just about every aspect of the publication process, from copy editing submitted manuscripts all the way to preparing every file for the printing press. A big part of my job involves working with manuscript authors and volume editors, sending out queries and incorporating edits and changes to the text, and ensuring that each book project meets AFS standards in style and quality while also realizing the editors' vision for the book. In addition to maintaining timetables and deadlines, I also perform the typesetting, layout, and design of the book contents and cover, creating the look of the final product.

My Fun AFS Fact: The color of the Sixth Edition of the "Names of Fishes" book was supposed to be blue, but a color-coding error caused it to print as purple instead. Despite the error, the lavender color helped make the book easily distinguishable. Many members have affectionately referred to it as "The Purple Bible."

Kurt West
Books Coordinator

I am currently going into my sophomore year of college at the University of Maryland, College Park. Go Terps! I looked into AFS for a summer job last year, and it was suppose to be just for that summer. Well… it’s been about a year and I’m still here, and I’ll be forever grateful for the opportunities that they have given me.

My Fun AFS Fact: I never knew AFS existed, let alone how big and impactful they really were until I started working here.

Mohammad Hossain
Archive Editor
AFS Seeks Journal Editor

The American Fisheries Society (AFS) seeks a scientist to serve as an editor of North American Journal of Aquaculture (NAJA). Editor must be committed to fast-paced deadlines, and would be appointed for a five-year renewable term. Duties include:

1. Deciding on the suitability of contributed papers, and advising authors on what would be required to make contributions publishable, using advice of associate editors and reviewers. Reviewing papers for scientific accuracy as well as for clarity, readability, and interest to scientists and culturists concerned with the culture of fish and other aquatic organisms;
2. Soliciting manuscripts to ensure broad coverage;
3. Setting editorial standards for NAJA in accordance with AFS policies;
4. Making recommendations to enhance the vitality and prestige of the Journal.

To be considered, send a current curriculum vitae along with a letter of interest explaining why you want to be a Journal editor by e-mail to alerner@fisheries.org. To nominate a highly qualified colleague, send a letter of recommendation to the same e-mail address.

Note: Editors receive an honorarium, and support to attend the AFS Annual Meeting. Position begins January 2016.
MISSION

The AFS mission is to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science and promoting the development of fisheries professionals.

TESTIMONIAL

"An organization like AFS provides that nexus for everyone in the fisheries world, linking to all professional folks in fisheries, government agencies, NGOs [nongovernmental organizations], and academia. Their journals, the presentations at the Annual Meeting, and symposia are all valuable [aspects of the organization]. Right now the NMFS [National Marine Fisheries Service] is in the middle of reauthorizing the Magnuson-Stevens Act. It’s hard to get everyone involved in fisheries at one single time. A group like AFS can provide that forum for professionals in fisheries to discuss and come together and establish goals of what they could change and refurbish within the act."

Steve Meyers
NMFS, Domestic Fisheries Division
This year we are breaking with the recent tradition of the last 25 years or so in that we do not have a theme for 2014-2015 or for the 2015 Annual Meeting. As all of the possible combinations of looking back to look forward, from land to sea, bridging research and management, etc. had all been taken, being “themeless” seemed like a great way to assure that all fish-related topics were welcome for this year’s Annual Meeting. Major efforts this presidential year focused on communications, education, member diversity, collaboration with international societies, and society governance. Below are some examples of AFS leadership accomplishments and participation this year.

- Represented AFS and gave technical presentations at the annual meetings of the Korean Society of Fisheries and Aquatic Sciences, the China Society of Fisheries, and the Japanese Society of Fisheries Science.
- Working with AFS staff on a MOU with the Australian Society of Fisheries.
- Held Society Mid-Year Governing Board Meeting co-located with the Southern Division Annual Meeting in Savannah, Georgia.
- Organized the Annual Meeting in Portland, Oregon; one of the Society’s largest in attendance.
- Participated in planning meetings for the 7th World Fisheries Congress to be held in Busan, South Korea, from May 23-27, 2016. Accepted the position of program chair in an effort to recruit a diverse group of presenters.
- Met with Chinese delegation of Hainan Academy of Ocean and Fisheries Sciences in Bethesda.
- Participated in a meeting sponsored by the National Association of University Fisheries and Wildlife Programs to discuss the role of AFS in the future of fisheries education.
- Held the 2nd October meeting of AFS officers in Bethesda, successfully hosted the 2nd Fisheries Leadership Dialogue at the Hall of States Building, and met with Theodore Roosevelt Conservation Partnership leaders to build a new conservation science partnership.
- Communications Strategic Plan Committee, chaired by Gwen White, worked with Potomac Communications Group on addressing AFS communication issues and developing strategies for the future communications within and outside of AFS.

AFS has been expanding its reach within the membership and to outside partners during this past year. We have made it our goal to enhance these connections through the use of a variety of communications tools, our Annual Meetings, and by increased engagement.

Providing improved membership services and value is an area that we’ve focused a great deal of attention. In the science society world, the buzz phrase “value proposition” is all the rage. This boils down to an individual deciding on AFS membership based upon the value in relation to the cost. What do they get for their dollars spent? Simple personal finance economics in one regard, but complicated professional commitment on the other. Of course, many of the veteran members can philosophize for hours on how it was expected of them, as part of becoming a fisheries professional, to be an active AFS member. But that math doesn’t seem to resonate as well today as it did in the past. Our goal in focusing on the value proposition is to make that equation quite clear and compelling.

This was the year we put particular emphasis in continuing education (CE) and the Hutton Scholars program. Through numerous surveys, conversations, and years of experience, the role of AFS as a provider of opportunities for members to keep current with developments in science, management, policy, and technology is quite clear. Our members want it, fisheries professionals who are not members want it, and AFS is perfectly positioned to be a provider. Beverly Pike has been re-engineering both CE and the Hutton Program and, with the help of Cynthia Oboh—our new educational program coordinator—we will soon be experiencing the benefits of their efforts. Continuing education classes at the Portland meeting will be more expansive and cutting edge than we’ve ever seen. The 2015 class of Hutton Scholars is among the most qualified and diverse as we’ve likely ever seen, and it will only get better. A new partnership with the Bureau of Land Management (BLM) is expanding the program in a visionary effort by BLM to match Hutton Scholars with BLM fisheries staff. We anticipate other new support for the Hutton Program, given its proactive role in engaging youth with science that matches so well with national efforts.

Linking science and policy has been another area where AFS has made tremendous progress. AFS Policy Director Tom Bigford has established a new policy fellowship program that links professionals interested in policy with experienced members in order to address key issues. The first program resulted in a full review of three AFS policies on the Endangered Species Act and will continue to combine, update, and clarify our position on this important topic. With us this summer are two policy interns, one from Virginia Tech and the other from Stockton University (New Jersey), who will be assisting Bigford with policy work and gaining valuable professional experience. This builds nicely on our participation in the policy council of the Theodore Roosevelt Conservation Partnership, where we work with a number of federal agencies to provide congressional briefings on science-policy issues. Look for more of this in the years to come.
Advocacy on Specific Issues
AFS joined with dozens of conservation and sportsmen’s groups to sign letters on three issues affecting fish and related interests:
- Climate change
- Clean Water Act and wetlands
- Bristol Bay mining
- Nomination procedures and potential sites for National Marine Sanctoraries

AFS was pleased that the final decision on each issue reflected our concerns for fish, fish habitat, and fishing.

Special Coastal and Marine Partnerships
In the policy arena, AFS partnered with two publications to advance our fish interests:
- With ECO magazine’s annual fish issue, AFS arranged an interview with Doug Austen about his role and our Society and a guest column by Tom Bigford on how our fish interests resonate with ECO magazine’s coverage of coastal and offshore issues related to regulations, assessment, mitigation, and restoration.
- More recently, AFS joined the U.S. Forest Service and Association of Fish and Wildlife Agencies (AFWA) to write an article for ECO on recent applications of environmental DNA (eDNA) analyses and mapping in natural resource management. AFS is proud to host an eDNA website to help experts across the disciplines connect with one another.
- With the Taylor and Francis journal Coastal Management, Tom Bigford joined The Coastal Society (TCS) to serve as guest editor of a special issue on coastal and marine fish habitat conservation. The issue, now in production, will feature six manuscripts on the scientific, policy, legal, and management challenges of protecting and restoring habitats.

Other New Partnerships
One promising approach to increasing our influence is to partner with others who share our interests in aquatic systems generally or fish specifically. One such effort has unfolded nicely in the past year:
- At the May 2014 Joint Aquatic Science Societies meeting in Portland, Oregon, then-AFS President Bob Hughes and Doug Austen met with counterparts in other professional societies to explore stronger partnerships among the aquatic societies. At the meeting, AFS officially joined CASS (Consortium of Aquatic Science Societies) and agreed to pursue joint efforts on shared interests. CASS may also pursue working relationships with aquatic-focused organizations in Europe and elsewhere.
- As one example of the CASS partnership, AFS joined with the Society of Wetland Scientists (another CASS member), the Environmental Law Institute, and TCS to host a wetland science and policy event during National Wetlands Month (May 2015). A panel of inland, riverine, and estuarine wetland experts shared perspectives with direct application to the Clean Water Act debate and the regulations that were scheduled for release days after the event.

AFS in the Lead
AFS continues to strengthen its connections to fish circles both in the DC area, nationally, and internationally.
- After the successful “Fish Leaders Luncheon and Roundtable Discussion” in October 2013, Doug Austen decided to convene a similar group last fall. The 2014 event was hosted by AFWA at the Hall of States, included a mix of public and private partners, and focused on partnership opportunities. Initial plans are underway for a fall 2015 gathering.
- As required in its cooperative agreement with National Oceanic and Atmospheric Administration (NOAA)/National Marine Fisheries Service (NMFS), AFS organized and hosted three briefings on marine fishery management for congressional staff. The events in spring 2015 were attended by about 125 people, including about 30% Hill staff.

Other Partnerships
Other select efforts:
- AFS continued to forge a close working relationship with the Theodore Roosevelt Conservation Partnership (TRCP) on water and natural resource issues. During the past year, AFS participated in the TRCP Policy Retreat in June 2014, attended two TRCP Board of Directors meetings, attended two TRCP Policy Committee meetings, served on its Water Resources Committee, and attended regular meetings with EPA’s Office of Water on shared issues.
- AFS also advanced its long partnership with TCS by serving a strong role in the Restore America’s Estuaries (RAE) and TCS joint meeting in Washington, DC, in November 2014. Rise to the Future. A similar RAE/TCS partnership is being organized for December 2016 in New Orleans, with a focus on fish habitat issues in the Gulf of Mexico.
- With another long-term AFS ally, we organized a special technical session on “Fish as Integrators of Coastal Watershed Health” at Coastal and Estuarine Research Federation biennial meeting to be convened in November 2015 in Portland, Oregon. Speakers will address fish issues from all coasts and will include several AFS members.
- Cooperated with NOAA/Sea Grant Program Office and its state programs on several issues of joint interest – reviewed a proposal for funding on coastal resilience (for Woods Hole Sea Grant Program) and a joint effort on the State of the Coast (with the North Carolina Sea Grant Program).
- Established joint effort with NOAA’s Office of Education to share data and insights on how often students majoring in a fisheries field or participating in an intern/fellowship program recruit to fish-related employment or return to the agency or program that funded parts of their education and/or internship opportunity. This effort connects to general data from the National Science Foundation on postgraduate career paths and to a parallel effort by the National Association of University Fish and Wildlife Programs (NAUFWP).
- As just noted, AFS is an active participant in NAUFWP. This past summer, two AFS policy interns reviewed the fish and wildlife programs of every NAUFWP member (about 42) to develop a detailed spreadsheet on the size, scope, focus, etc. of each
program. The resulting data can be searched by NAUFWP, member institutions, prospective students, or others.

- AFS continues to be involved in the FishNet group of fisheries-related organizations that work on policy and legislative issues. That effort, formerly hosted by and coordinated by the American Sportfishing Association, may be re-focused depending on the on-going review by member parties.
- AFS leadership met with Eric Schwab at the National Aquarium in Baltimore to explore potential partnerships with the aquarium. Schwab, chief conservation officer and senior vice president, was working on a number of projects of interest to AFS but just moved to the National Fish and Wildlife Foundation in June 2015. A National Aquarium-sponsored symposium will be contributed to the Portland meeting. Future work could continue with the aquarium or extend to the foundation.

**Coordination with Units**

AFS joined with several of its Units to advance our mission and reach:

- Meeting with Potomac Chapter leaders regarding joint activities, including the fall 2014 Fish Leaders event mentioned above, the series of congressional briefings convened in spring 2015, and joint efforts with other societies and organizations in the D.C. area.
- Attended the Southern Division meeting in Savannah in March 2015 to represent AFS interests and develop relationships with our “home” division (Maryland is in the Southern Division). AFS also convened its spring Governing Board meeting at the Southern Division meeting.
- Attended the joint spring (May 2015) meeting of East Carolina University’s AFS Student Subunit and their university chapter of TCS. That event was a great opportunity to share the benefits of joining AFS.

**Actions Related to AFS Policies**

AFS has recently elevated its work related to existing and new policies. Our by-laws require reviews of each policy every five years, followed by action to extend, revise, or rescind each of our 38 policies. In the past year we:

- Organized our general records and web offerings to centralize our policies and related actions (letters to agencies based on issues covered by an approved policy statement, resolutions on similar issues, etc.). Our web offerings are now current and more informative.
- AFS has three policies on threatened and endangered species, which is now being rewritten by our AFS Policy Fellow to become one, more concise, policy suitable for AFS review by later this year.
- AFS has a Surface Mining Policy that has been under review for several years. The lengthy process has now yielded a new version that is nearly ready for Unit and public review.
- Our outdated policy on marine wilderness is under review with hopes it will be available to influence work on potential National Marine Sanctuaries over the next few years. One of our AFS policy interns (summer 2015) has played a major role in this effort.
- The AFS policy on freshwater flow is being considered for review by our next AFS policy fellow (fall 2015 into mid 2016).

**Actions Included under Cooperative Agreements**

- NMFS
  - Based on a specific task in our existing five-year agreement with NOAA/NMFS, AFS organized three briefings for congressional staff in the spring of 2015. The briefings covered issues related to marine fisheries management, identified by NMFS and congressional staff as their top priority. About 125 people attended the three briefings, including about 40 Hill staff (a primary audience). The results were summarized in *Fisheries* magazine and back to NMFS.
  - Proposed with USFWS
    - AFS staff (Austen, Pike, and Bigford) met with USFWS staff (David Hoskins, Jeff Underwood, Sue Wells, Jarrad Kosa, Dave Miko, and Richard Christian) to discuss a new cooperative agreement, including a national freshwater fisheries summit. Multiple drafts were shared, with some progress by April 2015. By that time, effort shifted away from an over-arching agreement and toward the freshwater summit that could be in the fall of 2016. AFS participated in a June meeting with prospective sponsors and attendees to develop the agenda and invitation list, among other details.
  - Proposed with USGS
    - AFS staff (Bigford, Pike, and Austen) met with USGS key staff (Ann Kinsinger, Bill Lellis, Andrea Ostroff, and Matt Anderson) in January 2015 to initiate development of a possible cooperative agreement to work on mutually beneficial projects. AFS sent draft ideas in early February, USGS responded in late May, and AFS responded in early June with ideas to split between a new cooperative agreement and a new memorandum of understanding (or similar vehicle).

**Policy Fellows/Interns**

This past year AFS revitalized intern programs that flourished in the 1995-2010 era but then languished. Pilot efforts in 2014 and 2015 confirmed the benefits of these opportunities for students and young professionals and the benefits to AFS from their toils.

- Based on support from the AFS Governing Board and Doug Austen, AFS hired its first AFS policy fellow in the fall of 2014. Patrick Shirey is now wrapping up work on threatened and endangered species issues.
- After a trial in early 2015, AFS hired two AFS policy interns for this past summer. The undergraduate students proved very capable of helping on multiple policy fronts, supporting key initiatives of the Resource Policy Committee, Policy Director, and Executive Director. Examples include work with Eric Hallerman (Virginia Tech and president of NAUFWP), Ken Williams (executive director of The Wildlife Society) and NAUFWP counsel about cooperative opportunities among the groups as well as with forestry partners (Society of American Foresters, the forestry counterpart to NAUFWP). The interns provided essential support to NAUFWP that reflected well on AFS.
- Plans are now underway for a second AFS policy fellow to work on freshwater flow issues during 2015-2016.
NOTEWORTHY PUBLICATIONS
The AFS Book Department published three titles in 2014:
• Future of Fisheries: Perspectives for Emerging Professionals
• Guidelines for the Use of Fishes in Research
• Foundations of Fisheries Science

AFS WEBSITE: FISHERIES.ORG
Visit fisheries.org for the latest on fisheries science and the profession.

AFS MAGAZINE: FISHERIES
The AFS membership journal, Fisheries, offers up-to-date information on fisheries science, management, and research, as well as AFS and professional activities. Featuring peer-reviewed scientific articles, analysis of national and international policy, chapter news, job listings, interviews with prominent professionals (as well as new members), archived content dating back to the beginning of AFS, and more. Fisheries gives AFS members the professional edge in their careers as researchers, regulators, and managers of local, national, and world fisheries.

Fisheries is available to members online at fisheries.org.
Publishes monthly, Volume 39
36 peer-reviewed articles published in 2014 (624 pages)
Impact Factor: 2.51

AFS JOURNALS
• TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY
  bimonthly, Volume 143
  135 articles published in 2014 (1,611 pages)
  Impact Factor: 1.31
• NORTH AMERICAN JOURNAL OF AQUACULTURE
  quarterly, Volume 76
  59 articles published in 2014 (436 pages)
  Impact Factor:.70
• NORTH AMERICAN JOURNAL OF FISHERIES MANAGEMENT
  bimonthly, Volume 34
  118 articles published in 2014 (1,282 pages)
  Impact Factor: 1.11
• JOURNAL OF AQUATIC ANIMAL HEALTH
  quarterly, Volume 26
  36 articles published in 2014 (294 pages)
  Impact Factor:.96
• MARINE AND COASTAL FISHERIES: DYNAMICS, MANAGEMENT, AND ECOSYSTEM SCIENCE
  annually, Volume 6. Online-only, open access
  24 articles published in 2014 (296 pages)
  Impact Factor: 1.81

The Fisheries InfoBase now includes all AFS journals back to 1872, including the complete contents of all issues of Fisheries.

(Journals are also available to subscribing members online at fisheries.org/books-journals/journal-access)

AFS BOOKS:
Our online bookstore at fisheries.org/shop offers digital downloads of many books or just their individual chapters.

Recent book titles:
• Future of Fisheries: Perspectives for Emerging Professionals
• Guidelines for the Use of Fishes in Research
• Foundations of Fisheries Science
• Biology and Management of Inland Striped Bass and Hybrid Striped Bass
• Common and Scientific Names of Fishes from the United States, Canada, and Mexico, Seventh Edition
• Native Fishes of Idaho
• Fisheries Techniques, Third Edition
• Small Impoundment Management in North America
FINANCIAL RESULTS

The Society’s financial position continues to improve and assets have increased 12% since 2012. AFS is highly liquid with nearly 80% of assets held as cash and investments. Sixty-five percent of net assets are unrestricted (meaning not part of an endowment or other restricted funds). Reserves stand at over 200% of expenses (a ratio for assessing the financial health) and four times the typical nonprofit association level of 50%.

AFS continues to generate positive net revenues every year! Revenues have been relatively stable the past few years with investment gains masking a continuing decline in membership and mixed results from programs. Expenses have been slowly increasing reflecting higher program costs and additional staff resources.

As a percentage of revenue, dues stand at 18%, down from 21% two years earlier, while investment income is 20%, up from 12% over the same period. Subscriptions continue to generate the most revenue followed by dues. Grants revenue has fallen nearly 40% over the past three years.

The proportion of expenses as a percentage of revenue has been stable between 2012-2014, though they are up 10% on a nominal basis during this period. Expenses as a function of net assets is strong at 44%.
**FISHERIES MAGAZINE**

- In 2014, AFS launched its redesign of *Fisheries* magazine using the publisher Taylor & Francis (saving approximately $40,000) along with new and exciting content: the Policy Column, Journal Reviews, the Landscape Column, and the Back Page.
- The "Criteria For Becoming a Science Editor or Reviewer" for publications was drafted up by AFS/POC and implemented.
- A Q&A on the new fish health management tool—Halamid® Aqua (100% chloramine-T), approved by the FDA in 2014 based, in part, on work conducted by AFS members—was featured in the August 2014 issue of *Fisheries*.
- *Fisheries* aquaculture-themed issue in November was the first time every single Section of AFS contributed to an issue. It received high praise, making headlines: "NOAA’s Contributions to Progress in Aquaculture Highlighted in *Fisheries* Magazine" and "Idaho’s sockeye salmon escape the ‘extinction vortex.’"
- The planning process has begun for the first-ever climate change themed issue of *Fisheries*, with the anticipated publication date of March 2016.
- Journal Reviews featured in *Fisheries* routinely increased article views in all five AFS peer-reviewed journals, with two articles featured now being the top most-read articles.
- Olaf Jenson (Rutgers University) accepted the position of co-chief science editor for *Fisheries*, joining Jeff Schaeffer and bringing a marine perspective to his position.
- As well as being the co-chief science editor, Jeff Schaeffer took on the role of being an advisory to non peer-reviewed articles (e.g., magazine articles) as well as a contributing writer to *Fisheries*.
- Sarah Harrison joined AFS in August 2014 as a content editor to assist the content director with editing, writing, and creating content for *Fisheries*, fisheries.org, news.fisheries.org, and the bi-weekly newsletter.
- Natalie Sopinka joined *Fisheries* as a contributing writer, bringing a fresh young perspective to the magazine and writing articles for the Back Page to engage students and young professionals on subjects such as social media, new science research, and interesting species.

**NEWSLETTER**

- In 2014, AFS launched its first-ever bi-weekly newsletter, a now popular member benefit that features the latest news and announcements, policy updates, science and research, and member spotlights, giving members more information, more access, and more ways to stay engaged in AFS and other professional activities.

AFS Newsletter System
- Moved it to a plugin that costs a fraction of the cost as Mailchimp ($2,500 vs. $99 a year!).
- The new system allows us to host our own data on our own server.
- This has brought almost as much traffic—in one month—as Twitter and Facebook have brought to fisheries.org in over two years!
- AFS highlights members' research through the Society's blog and podcasts.

**SOCIAL MEDIA**

**More Visibility**

In 2014, AFS established a more regular presence on social media by starting the first official AFS Facebook page, posting more often to Twitter, reviving an existing LinkedIn company page and creating a new LinkedIn group, and experimenting with new accounts on Pinterest and YouTube. Posts are mix of science news, events, jobs, and announcements, reaching several hundred members and non-members each week. Member participation is welcome on any AFS social media site—you can find all of our social media platforms on our website.

Official Facebook page: facebook.com/AmericanFisheriesSociety
Facebook group: facebook.com/groups/39804224812
Twitter: @AmFisheriesSoc
LinkedIn company page: linkedin.com/company/american-fisheries-society
LinkedIn group: linkedin.com/groups/American-Fisheries-Society-7438153/about

Number of likes/members/followers on major social media platforms.
WEBSITE
• Updated our Policy Resolutions so that they now have introductions with added information about which are being updated, have been updated, etc.
• New Member Welcome Site
• Recruitment Tool Kit (in works)
• Retention Tool Kit (in works)
• Donation Tool Kit (in works)
• Updating Unit Survival Guide
• New Career Help page – adding new content

Working with the guidance of ESAB’s analysis of past website surveys and evaluations, AFS revamped the entire navigational design of the website. Implementation of the new site navigation is in progress, with an upcoming member-focused test phase to ensure intuitive movement through the site by users. Extensive editing is also in progress, with redundant information being removed and related information being consolidated, enhancing the usefulness and readability of information on the AFS website.

Unit Sites - built by the Society and hosted on the Society server:
We have saved our Units considerable money, and set the stage for the new multi-site, where we can eventually hook them up to the Society site in order to brand us together and grow our membership.

• AFS now provides a Survey Monkey account for Units to hold voting

Working with guidance from ESAB, AFS hired Wood Street, Inc., a web design firm in Frederick, Maryland, to build a new multisite for Fisheries.org and Unit sites. A WordPress platform was chosen because of its ability to handle multisites, thereby providing more Unit support, and its user-friendly content management interface. The objectives of migrating Unit sites to the multisite were fourfold:

(1) To provide web space to AFS Units at no cost to the Units.
(2) To provide easy-to-use website management tools to Units, enabling non-technical webmasters to manage content with minimal training.
(3) To enhance communication between AFS and its Units, with greater information sharing across sites.
(4) To strengthen branding and consistency in presenting AFS as a professional society.

In addition to these objectives, the multisite enables AFS to provide technical assistance and content help to Units instantly, improves troubleshooting of Unit website issues, and allows WordPress tools available to AFS to be made available to Units.

Redesign of Fisheries.org with Wood Street:
We have worked closely with ESAB and FITS to come up with a design that is tailored for fisheries professionals. The process has taken longer than expected, but has debuted this month.

• The website now integrated with the IMIS membership database

Our Annual Meeting Website:
We will have a standardized format that the Society runs.

• Built the World Council of Fisheries Societies site
  • Partnered with USFS and AFWA to build the eDNA database website
  • In the process of constructing a “Names of Fishes” Database

Member Added Value:
Our plans for the future include growing our website so we can create member-only content. A good example of this is the Education/Career book, being developed by headquarters, Steve McMullin, Ron Essig, and AFS Sections, including CARS (Caleb Hasler and Michael Donaldson) and the International Fisheries Section (Felipe Amezcua).

More Member Added Value and Ways to Connect Students/Young Professionals with the Society
• With the help of Craig Paukert and Andrew Carlson, we are working to get together a team of up-and-coming younger fisheries members to record video interviews with past presidents.
Congratulations to the 2014 AFS Award Recipients. Awards were announced during the Annual Meeting in Québec City, Québec, August 17–21. They were honored for their contributions to the American Fisheries Society, to their profession, and to resource conservation.

AWARD OF EXCELLENCE—Presented to an AFS member for original and outstanding contributions to fisheries science and aquatic biology.

Kenneth A. Rose, Louisiana State University

PRESIDENT’S FISHERY CONSERVATION AWARD—Presented in two categories: (1) an AFS individual or Unit or (2) a non-AFS individual or entity, for singular accomplishments or long-term contributions that advance aquatic resource conservation at a regional or local level.

Co-Recipient: David Fielder, Alpena Fisheries Research Station
Co-Recipient: Michael Thomas, Lake St. Clair Fisheries Station

WILLIAM E. RICKER RESOURCE CONSERVATION AWARD—Presented to an individual or organization for singular accomplishments or long-term contributions that advance aquatic resource conservation at a national or international level.

Ronald Taylor, Fish and Wildlife Research Institute

CARL R. SULLIVAN FISHERY CONSERVATION AWARD—Presented to an individual or organization for outstanding contributions to the conservation of fishery resources.

Gary Grossman, University of Georgia

MERITORIOUS SERVICE AWARD—Presented to an individual for loyalty, dedication, and meritorious service to the Society throughout the years and for exceptional commitment to AFS’s programs, objectives, and goals.

Dale Burkett, Great Lakes Fishery Commission

THE EMMELINE MOORE PRIZE—Named after the first female AFS president, Emmeline Moore (1927–1928), this award recognizes career achievement in the promotion of demographic diversity in the Society.

Gwen White, U.S. Fish and Wildlife Service

DISTINGUISHED SERVICE AWARD—Recognizes outstanding contributions of time and energy for special projects or activities by AFS members.

Stanley Moberly, Northwest Marine Technology, Inc.

OUTSTANDING CHAPTER AWARD—Recognizes outstanding professionalism, active resource protection and enhancement programs, and commitment to the mission of the Society.

Missouri Chapter

OUTSTANDING STUDENT SUBUNIT AWARD—Recognizes outstanding professionalism, active resource protection and enhancement programs, and commitment to the mission of the Society.

Florida Chapter Student Subunit

EXCELLENCE IN PUBLIC OUTREACH AWARD—Presented to an AFS member who goes the “extra mile” in sharing the value of fisheries science/research with the general public through the popular media and other communication channels.

Ellen Pikitch, Stony Brook University

GOLDEN MEMBERSHIP AWARDS: THE CLASS OF 1965—Recognizes individuals who have been AFS members for 50 years.

Emory Anderson
Alexander Argue
John Blake
Peter Bourque
Charles Cross
William Eustance
James Fessler
Delano Graff
James Haas
Terry Haines
William Hauser
Walter Hoagman
Donald Johnson
Jerome Kerby
Larry Kallemeyn
William Leggett
William McClay
John Meldrim
Robert Miles
Peter Moyle
Joseph Rachlin
Kenneth Roberson
Monte Seehorn
Douglas Sheppard
Richard Slama
Stephen Swedberg
John Thomas
William Thorn
Robert Wilbur
EXCELLENCE IN FISHERIES EDUCATION—Recognizes excellence in organized teaching and advising in a field of fisheries.
Steve Miranda, Mississippi State University

EMERGING LEADERSHIP MENTORSHIP—The Emerging Leaders Mentorship Award was established 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 AFS Governing Board.
Recipients:
Steve Midway, Pennsylvania State University
Cari-Ann Hayer, USGS Columbia Environmental Research Center
Patrick Cooney, Smith Root
Justin Davis, CT DEEP Inland Fisheries Division

SKINNER AWARD—The John E. Skinner Memorial Fund was established to provide monetary travel awards for deserving graduate students or exceptional undergraduate students to attend the AFS Annual Meeting.
Recipients:
Jeremiah Osborne-Gowey, Oregon State University
Jan-Michael Hessenauer, University of Connecticut
Augustin Engman, North Carolina State University
Kyle Wilson, University of Calgary
Noelie Yochum, Oregon State University
Karen Dunmall, University of Manitoba
Natalie Scheibel, South Dakota State University
Stacy Vega, University of Alaska Fairbanks
Nicholas Sievert, University of Missouri
Laura Heironimus, South Dakota State University

Honorable Mentions:
David Kazyak, University of Maryland, College Park
David Deslauriers, South Dakota State University
Konstantine Rountos, Stony Brook University
Kyle Bales, Southeast Missouri State University
Henry (Jared) Flowers, North Carolina State University

J. FRANCES ALLEN SCHOLARSHIP—Awarded to a female AFS Member and doctoral candidate who is conducting aquatic research.
Winner: Karen Dunmall, University of Manitoba
Runner-up: Cassandra May, Ohio State University

STEVEN BERKELEY MARINE CONSERVATION FELLOWSHIP
Recipient: Cassandra Benkwitt, Oregon State University
Honorable Mentions: Nathan Furey, University of British Columbia and Marissa McMahan, Northeastern University

STUDENT WRITING CONTEST
Best Paper: Elizabeth Ng, University of Idaho
“Learning from the Past”
Runner-up: Sarah Harrison, Mississippi State University
“Subsistence Fishing—Sustenance for the Soul”

2014 BEST PAPER AWARDS
MERCER PATRIARCHE AWARD FOR THE BEST PAPER IN THE NORTH AMERICAN JOURNAL OF FISHERIES MANAGEMENT
Paul J. Askey, Eric A. Parkinson, and John R. Post

ROBERT L. KENDALL BEST PAPER IN TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY
A. Drauch Schreier, B. Mahardja, and B. May

BEST PAPER IN THE JOURNAL OF AQUATIC ANIMAL HEALTH

BEST PAPER IN THE NORTH AMERICAN JOURNAL OF AQUACULTURE
Louis R. D’Abramo, Terrill R. Hanson, Susan K. Kingsbury, James A. Steeby, and Craig S. Tucker

BEST PAPER IN MARINE AND COASTAL FISHERIES
Sean P. Powers, F. Joel Fodrie, Steven B. Scyphers, J. Marcus Drymon, Robert L. Shipp, and Gregory W. Stunz
**SECTION AWARDS**

**BIOENGINEERING SECTION**
Career Achievement Award: 
Ned Taft Scholarship:

**CANADIAN AQUATIC RESOURCES SECTION**
Peter A. Larkin Award
Ph.D. level: Vivian Nguyen, Carleton University
Runner up: Natalie Sopinka, University of British Columbia
M.Sc. level: Sean Godwin, Simon Fraser University, and Maxime Veilleux, Carleton University
Runner up: Jacqueline Michelle Lavery, University of New Brunswick

**EDUCATION SECTION**
Young Professional Achievement Award: Mark Fincel, South Dakota Game, Fish and Parks
AFS Best Student Poster Award (at the 2014 Annual Meeting in Québec City, Québec)
Winner: Nick Sievert, University of Missouri
AFS/Sea Grant Best Student Paper at the 2014 Annual Meeting in Québec City, Québec
Winner: Zach Penney, University of Idaho
Honorable Mentions: Antranik Kajajian, Old Dominion University, and Sara M. Turner, SUNY College of Environmental Science and Forestry

**ESTUARIES SECTION**
Student Travel Award: Geoffrey Smith, University of Florida

**FISHERIES AND INFORMATION TECHNOLOGY SECTION**
Best Student Poster Award: Nick Sievert, University of Missouri

**FISH CULTURE SECTION**
Student Travel Awards: Paula Caldentey, Mote Marine Laboratory, and Meghan Manor, West Virginia University
Best Paper in NAJA: Louis R. D’Abramo, Terrill R. Hanson, Susan K. Kingsbury, James A. Steeby, and Craig S. Tucker

**FISH HEALTH SECTION**
Snieszko Student Travel Awards: Thomas Rosser, Diem Thu Nguyen, Carissa Gervasi, Megan Kepler, Bikramjit Ghosh, and Kevin Erickson

**FISHERIES ADMINISTRATION SECTION**
2014 Outstanding Sport Fish Restoration Program Projects
- Research and Surveys Category: Wisconsin Department of Natural Resources—Development and Evaluation of Watershed Models for Predicting Stream Fishery Potential

**FISHERIES MANAGEMENT SECTION**
Award of Excellence: Jake Rice, Department of Fisheries and Oceans
Conservation Achievement Award: Bonefish and Tarpon Trust
Hall of Excellence: Gordon C. Robertson, American Sportfishing Association, and Harold L. Schramm, Jr., Mississippi State University

**GENETICS SECTION**
James E. Wright Graduate Award: Ryan Waples, University of Washington

**MARINE FISHERIES SECTION**
Steven Berkeley Marine Conservation Fellowship
Winner: Cassandra Benkwitt, Oregon State University
Honorable Mentions: Nathan Furey, University of British Columbia, and Marissa McMahans, Northeastern University
Oscar E. Sette Award: Mary C. Fabrizio, Virginia Institute of Marine Science
Student Travel Awards: Laura Koehn, University of Washington, Owen Nichols, University of Massachusetts at Dartmouth, and James Robinson, University of Victoria

**SOCIOECONOMICS SECTION**
A. Stephen Weithman Best Student Paper Award
Winner: Ingrid Biedron, Cornell University
Honorable Mention: Scott Knoche, University of Maryland

**WATER QUALITY SECTION**
Best Student Poster Award: Steven Mattocks, University of Massachusetts-Amherst
Program Growth & Advancement

The Hutton Program underwent a dynamic transformation over the last year. The director of Student and Professional Development worked with the Hutton Committee to innovate and streamline processes, update materials, enhance involvement, expand outreach efforts, grow support, and increase the number of minority student applicants.

- Created online applications—students and mentors were able to complete the application process online for the first time in the program’s 14-year history.
- Renamed the Hutton Oversight Committee to the Hutton Committee.
- Created online applicant review and evaluation process; the Hutton Committee can now review student applications and complete applicant scoring online.
- Added open-ended questions to the student application.
- Created online progress reports; mentors can now complete the student evaluation form online.
- Created online student reports; students can now complete reports online.
- Created new Hutton educational and promotional materials, such as a YouTube video, slide presentation, website, logo, flyers, and brochures, to increase awareness of fisheries science and the Hutton Program among high school students and educators.
- Engaged Hutton alumni in fisheries; the Hutton website is also a resource for Hutton alumni to learn about college scholarships and internships in fisheries science.
- Expanded mentor recruitment efforts; social media, email blasts, and the AFS newsletter were used to recruit mentor applicants from across the United States.
- Updated levels of support and sponsorship packages.
- Delivered presentations about the Hutton Program to existing and potential partners.
- Increased program funding by $30,000 from the previous year.
- Cynthia Oboh joined AFS in April as the educational program coordinator.

The 2015 Hutton Program

The summer 2015 program kicked off in early June by awarding 33 scholarships to outstanding high school students, the highest number of scholarships awarded since 2009. This year’s enhanced recruitment efforts resulted in 114 student applications, more than over twice as many as last year. AFS awarded scholarships to the highest number of minority recipients since 2009.

The Hutton Program Class of 2015 Demographics:

<table>
<thead>
<tr>
<th>Minorities: 18 (55%)</th>
<th>Non-minorities: 15 (45%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females: 24 (73%)</td>
<td>Males: 9 (27%)</td>
</tr>
<tr>
<td>Minority males: 7 (21%)</td>
<td>Minority females: 11 (33%)</td>
</tr>
<tr>
<td>Non-minority females: 13 (40%)</td>
<td>Non-minority males: 2 (6%)</td>
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</tbody>
</table>

* The Hutton Program has awarded a total of 565 scholarships since 2001, with 310 minority recipients and 255 non-minority recipients.

Congratulations Hutton Junior Fisheries Biology Program Class of 2015!

<table>
<thead>
<tr>
<th>Student</th>
<th>Mentor(s)</th>
<th>Organization</th>
<th>City, State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya Bhadkamkar</td>
<td>John Rothlisberger, Ewing Joseph</td>
<td>USFS and Discovery World</td>
<td>Milwaukee, WI</td>
</tr>
<tr>
<td>Samantha Delaney</td>
<td>Earl Meredith</td>
<td>NOAA</td>
<td>Gloucester, MA</td>
</tr>
<tr>
<td>Hayley Ehrlich</td>
<td>Matthew Poach</td>
<td>NOAA</td>
<td>Highlands, NJ</td>
</tr>
<tr>
<td>Benjamin Ferreri</td>
<td>Quinton Phelps</td>
<td>Missouri Department of Conservation</td>
<td>Cape Girardeau, MO</td>
</tr>
<tr>
<td>Nora Hargett</td>
<td>Craig Paukert</td>
<td>USGS Missouri Cooperative Research Fish &amp; Wildlife Research Unit</td>
<td>Columbia, MO</td>
</tr>
<tr>
<td>Thomas Janetos</td>
<td>John Baldwin</td>
<td>Florida Atlantic University</td>
<td>Boca Raton, FL</td>
</tr>
<tr>
<td>Jason Jaworski</td>
<td>Daragh Deegan</td>
<td>City of Elkhart Office of Public Works</td>
<td>Elkhart, IN</td>
</tr>
<tr>
<td>Jordyn Matherly</td>
<td>Brent Nichols, Elliot Kittel, Alix Blake</td>
<td>Spokane Tribe of Indians</td>
<td>Wellpinit, WA</td>
</tr>
<tr>
<td>Wyatt Thurman</td>
<td>Helen Krueger</td>
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<tr>
<td>Harini Pasupuleti</td>
<td>Daryl Ellison</td>
<td>Minnesota Department of Natural Resources</td>
<td>Shakopee, MN</td>
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<tr>
<td>Riley Rettig</td>
<td>Maura Santora</td>
<td>USFS</td>
<td>South Lake Tahoe, CA</td>
</tr>
<tr>
<td>Dionna Walker</td>
<td>Jennifer Pritchett, Jeff Powell, Anthony Ford</td>
<td>USFWS</td>
<td>Daphne, AL</td>
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<tr>
<td>Shreeya Desai</td>
<td>Michael Parsons</td>
<td>Coastal Watershed Institute</td>
<td>Fort Myers, FL</td>
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<tr>
<td>Daniel Lagmay</td>
<td>Heidi McRoberts</td>
<td>Nez Perce Tribe</td>
<td>Lapwai, ID</td>
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<tr>
<td>Mariah Penney</td>
<td>Loren Miller, Mark Hove</td>
<td>University of Minnesota</td>
<td>St. Paul, MN</td>
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<tr>
<td>Asia Weaskus</td>
<td>Dominique Lazarre</td>
<td>University of Miami</td>
<td>Miami, FL</td>
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<tr>
<td>Liana Wheeler</td>
<td>Robert Anderson</td>
<td>Wisconsin Lutheran College</td>
<td>Milwaukee, IW</td>
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<tr>
<td>Darby Finnegan</td>
<td>Gary Diridoni</td>
<td>BLM</td>
<td>Redding, CA</td>
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<tr>
<td>Leilani Gasner</td>
<td>Lorene Miller</td>
<td>University of Minnesota</td>
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<td>Danielle Barnes</td>
<td>Mark Hove</td>
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<td>Bridger Banco</td>
<td>Robert Anderson</td>
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<tr>
<td>Richard Cain</td>
<td>Gary Diridoni</td>
<td>BLM</td>
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<td>Myles Fowler</td>
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<tr>
<td>Alberta Clough</td>
<td>Stephanie Messerie</td>
<td>BLM</td>
<td>Coos Bay, OR</td>
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<tr>
<td>Abbey Knight</td>
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CONTINUING EDUCATION

The director of student and professional development position was created in 2014 to oversee management of the Hutton Junior Fisheries Biology Program as well as improve upon and expand the Society’s continuing education offerings. Since coming to AFS last August, the Director of Student and Professional Development has examined and improved upon existing program management practices to better meet members’ professional development needs, increase educational effectiveness, and ensure wise use of the Society’s resources.

- The director of student and professional development worked with the Continuing Education Committee (CEC) chair to assess the CE needs and interests of AFS members by creating a CE survey. Nearly 950 respondents completed the survey after it was launched in the fall of 2014.
- The Portland CE Committee, the CEC chair and the director of student and professional development worked closely to develop a menu of CE classes for the 2015 Annual Meeting. Survey results were used to identify general topics for Annual Meeting as well as for three webinar series. Experts on each topic were identified and invited to be instructors. While different from what has been done in the past, this approach enables AFS to meet members’ CE needs while ensuring the Society’s resources are wisely invested.
- The Continuing Education Committee continues to ensure the quality of all AFS-sponsored CE by reviewing course proposals. All AFS-sponsored CE classes must be approved by the CEC. AFS members can now learn about the course proposal and approval process on the AFS website.
- Assisted CEC Chair in writing revisions to CE course approval requirements & procedures.
- “Planning & Executing Successful Rotenone & Antimycin Projects” was offered twice in 2015.
- The director of student and professional development worked closely with Nancy Leonard and Jim Bowker to conduct a video podcast pilot of symposia presented at the 2015 Annual Meeting.
- The Fish Culture Section created a video tutorial on designing professional slide presentations. The tutorial is available on the AFS website.

CERTIFIED FISHERIES PROFESSIONALS

The American Fisheries Society’s professional certification program provides a way for fisheries professionals who achieve specific standards of professional competence to be recognized. Congratulations to the following individuals who were approved as certified professionals during 2014.

EMERITUS-EM

In order to be recognized as a fisheries professional with Emeriti status, a member must have the FP-C designation for at least 20 years and be employed less than full time or retired. In 2014, the following AFS members reached this milestone:
- Gary L. Armstrong, Dempsey H. Barwick, James C. Borawa, Paul R. Bowser and Norman R. Dube

CERTIFIED FISHERIES PROFESSIONALS- FPC

The following members became newly certified or renewed their status as a certified fisheries professional:

<table>
<thead>
<tr>
<th>Student</th>
<th>Mentor(s)</th>
<th>Organization</th>
<th>City, State</th>
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<tbody>
<tr>
<td>Kadie Heinle</td>
<td>Christina Stuart</td>
<td>BLM</td>
<td>Miles City, MT</td>
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<tr>
<td>Yvette Garcia</td>
<td>Paula Belcher</td>
<td>BLM</td>
<td>Kremmling, CO</td>
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<td>Charlee Manguso</td>
<td>Brett Blundon</td>
<td>BLM</td>
<td>Springfield, OR</td>
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<tbody>
<tr>
<td>Garrett Woodcock</td>
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<td>Chelsea Pohrman</td>
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<td>Emily Russell</td>
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<td>Asyn Lysiak</td>
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<tr>
<td></td>
<td>John Fraley</td>
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<td></td>
<td>Barbara Franova</td>
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<td>Stephen T. Grabacki</td>
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<td>James W. Gracie</td>
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**Certification Coordinator:**
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- **Chelsea Pohrman**
- **Charlee Manguso**
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### August 16–20, 2015
145th Annual Meeting of the American Fisheries Society | Portland, Oregon | 2015.fisheries.org

### October 21–23, 2015
6th International Oyster Symposium | Falmouth, Massachusetts | oystersymposium.org

### October 25–30, 2015
The Second Mississippi-Yangtze River Basins Symposium | Wuhan, China | news.fisheries.org/the-second-mississippi-yangtze-river-basins-symposium

### October 27–29, 2015
The 4th International Conference on Members of the Genus *Flavobacterium* | Auburn, Alabama | flavobacterium.com

### January 24–27, 2016
76th Midwest Fish & Wildlife Conference | Grand Rapids, Michigan | midwestfw.org

### February 17–21, 2016
Southern Division Spring Meeting | Wheeling, West Virginia | sdafs.org

### May 21, 2016
2nd World Fish Migration Day | www.worldfishigrationday.com

### May 23–27, 2016
7th World Fisheries Congress | Busan, South Korea | wfc2016.or.kr

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- Kyle Beard
- Emily Berger
- Eva Bergman
- Thais Bernos
- Nolan Bett
- Jack Bloomer
- Barry Bolton
- Megan Brady
- Doug Braun
- Lindsey Bruckerhoff
- Eric Brunsdon
- Quinn Buckley
- Christopher Butler
- David Byrnes
- Lucius Caldwell
- Louise Chavarie
- Matthew Cieri
- Pedro Colón
- Kristin Connelly
- Brice Crayne
- Chante Davis
- Angel Dieppa
- Juliana Diniz
- Jessi Doeringhaus
- Aaron Donnell
- Christine Dudley
- Jennifer Dupuis
- Heather Dziedzic
- Jordan Embry
- Asa Enakfal
- Andrew Esbaugh
- Peter Esselman
- John Faustini
- Hamilton Fennie
- Robert Fernandez
- John Froeschke
- Masami Fujimura
- Rasmus Gabrielson
- Bill Galbraith
- Julio Garcia
- Ryan Gatchell
- Anna Geffre
- H. Giddings
- Taylor Goelz
- Stephanie Good
- Jorge Ruben Sanchez
- Gonzalez
- Kimberly Gordon
- Rachel Graham
- Paul Greger
- Beau Gunter
- Anna Hagelin
- Dana Haggarty
- Ty Hardymon
- Crystal Herron
- Rachael Heuer
- Lyndie Hice Dunton
- Gregory Hill
- Aimee Hoover
- Jessica Howell
- Greg Huchko
- Coley Hughes
- Heidi Hugunin
- Parker Hurst
- Betsy Irish
- Tom Iwaniwick
- Joseph Jackson
- Chad Jackson
- Alexander Jensen
- Alex Kain
- Neisha Kashef
- Adam Kautza
- Alicia Kee
- Jennifer King
- Timothy Kniffen
- Benjamin Lakish
- Robin La Rochelle
- Shawn Larson
- Crystal Lee Pow
- Benjamin Leonard
- Morten Limborg
- Vanessa Lo
- Joseph Love
- Jennifer Malavasi
- Nathan Malmborg
- Kevin Malone
- Andrew Martin
- Ian Mayer
- Carlin McAuley
- Katie McBain
- Louise McGlarry
- Garrett McKinney
- Scott Melville
- Caroline Melville
- Cristina Miller
- Cody Minor
- Jessica Missaghihan
- Lars Mobrand
- Mitchell Morton
- Aryan Mosthri
- Michael Murphy
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- Emily Nelson
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- Rafaella Schmiegger
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- Jason Scott
- Megan Shavalier
- Karen Shearer
- Alison Simon
- Jon Egil Skjærbaesen
- Adrienne Smits
- Liming Song
- Jarrod Stackhouse
- David Stafford
- Paul Struthers
- Kathryn Sutton
- Sierra Love Stowell
- Tyler Swarr
- Cacy Sylvester
- Amber Szoboszlai
- Spencer Talmage
- Shwana Theisen
- Wilawan Thongda
- Cameron Turner
- Kendall Ulmer
- Shannon Vincent
- Aaron Von Eschen
- Ninh Yu
- Stacy Wais
- Christopher Wheaton
- Karen Whitman
- Ryan Whitmore
- James Whitney
- Leslie Wikus
- Natasha Wingert
- Rennie Winkelman
- Joel Wixson
- Gilian Wright
- Marcelo Morales Yokobori
- Hao Yu
Beneficial Effects of Rhodotorula sp. C11 on Growth and Disease Resistance of Juvenile Japanese Spiky Sea Cucumber Apostichopus japonicas. ZhiPing Yang, JianMing Sun, and Zhe Xu 27:71-76.


Chitosan Influences the Expression of P-gp and Metabolism of Norfloxacin in Grass Carp. Kun Hu, Xinyan Xie, Yi-Ni Zhao, Yi Li, Jiming Ruan, Hao-Ran Li, Tianyi Jin, and Xian-Le Yang 27:104-111.

Growth Inhibition of Bacterial Fish Pathogens and Quorum-Sensing Blocking by Bacteria Recovered from Chilean Salmonid Farms. Mery de la Fuente, Claudio D. Miranda, Paz Jopia, Gerardo González-Rocha, Nicolás Guiliani, Katherine Sossa, and Homero Urrutia 27:112-122.

Characterization of Isolates of Streptococcus agalactiae from Diseased Farmed and Wild Marine Fish from the U.S. Gulf Coast, Latin America, and Thailand. Esteban Soto, Rui Wang, Judy Wiles, Wes Baumgartner, Christopher Green, John Plumb, and John Hawke 27:123-134

Oral Vaccination of Channel Catfish against Enteric Septicemia of Catfish Using a Live Attenuated Edwardsiella ictaluri Isolate. David J. Wise, Terrence E. Greenway, Todd S. Byars, Matt J. Griffin, and Lester H. Khoo 27:135-
Try This! “Tweeting the Meeting”

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With more than 3,500 fish and fisheries professionals converging at the Oregon Convention Center, live-tweeting is a way to connect with fellow attendees as well as those who couldn’t make it to Portland. Whether an established or novice Twitter user, try capturing your 2015 Annual Meeting experience with Twitter. Not on Twitter? Download the AFS Conference Scheduler mobile app, and share your conference highlights with others using this communication and networking platform.

RECOMMENDATIONS FOR LIVE-TWEETING

1. Think in threes: A conference presentation tweet can be divided into three parts. First is the content of the talk you are tweeting. If you are directly quoting the speaker, use quotation marks. You may also wish to include links to the speaker/organization’s website or relevant publications. Second is the speaker’s name. To save character space, put only the speaker’s last name. If you know the speaker’s Twitter username/handle (e.g., @AFS2015), reference it instead of their last name. Third, be sure to include #AFS145 at the end of your tweets so your tweets don’t get lost in the Twitverse! By searching for #AFS145 on Twitter, you can see what others are tweeting.

2. Reply to yourself: If you are tweeting multiple times during a talk, reply to your first tweet when writing subsequent tweets to create a chain of tweets. Your audience will be able to see all the tweets pertaining to a particular talk. Start a new chain for each talk you tweet.

3. Think about your audience: If you are tweeting to engage with Twitter users following #AFS145, keep the content broad and avoid jagging that those outside the study area may not know. Target your tweets to cover the natural history of the study species or the take-away message of the talk (i.e., content from the introduction and discussion; Shiffman 2012a). If you are tweeting to catalogue information you want to remember after the conference, you may tweet content that is more detailed.

4. Incorporate images: Tweets with images are more appealing visually but will reduce your 140-character limit. Photograph your early morning Spawning Run, field trip to the Klickitat River, and reunion with former colleagues. When using images that are not your own, always give credit to the artist of the image (Lewis 2014). If a speaker with a Twitter account has tagged a tweet as protected, you can tag them in the photo you choose to accompany your tweet without reducing the 140-character limit. If the artist does not use Twitter, mention their name in your main text. Taking a photograph of the speaker and/or their presentation slides can be distracting for both the speaker and the audience. Try to seek permission to photograph/tweet a presentation from the speaker prior to the talk. If this is not possible, you can write down your tweets and tweet them after introducing yourself to the speaker (Shiffman 2012b).

5. Take breaks: Tweeting is audio-visual-digital multi-tasking and can be time and energy consuming. You are listening to a speaker, condensing information into a dozen or so words, and trying not to forget the conference hashtag. Take breaks! Tweet a few talks per day. Tweet one day but not the next. Consider setting a tweet limit. It’s up to you! You can choose to tweet once per talk and summarize the study conclusions. You can tweet twice per talk and include background information in addition to conclusions. A tweet limit is flexible of course. If the speaker says something incredibly compelling that you want to share with Twitter followers, don’t feel constrained by your pre-determined tweet limit.

6. Correct mistakes: As David Shiffman, shark biologist and avid Twitter user states, “All science communicators and educators should strive to accurately relay information.” (Shiffman 2012). Still, conference talks are fast-paced, and rapidly texting thumbs or typing fingers may slip. Spelling errors are to be expected and generally are not condemned by Twitter users. If you have misheard the speaker and/or tweet content that is inaccurate, identify the erred content, and tweet a correction. Having a tweet limit in place and taking breaks (#5) reduces the sense of urgency in tweeting everything the speaker says, and thus, can reduce errors.

7. Continue the conversation: If fellow conference tweeters from other sessions are responding to your tweets, tweet back when you can and suggest meeting for coffee to chat without character limits. Conference tweeters can also arrange “tweetups” throughout the conference to connect in-person. If tweeters not attending the conference engage in your tweets, again, tweet back when you can. If Twitter users ask pertinent questions, engage the speaker into the conversation either during the question period or during a scheduled break.

8. Compile your conference notes: Similar to sketching your conference notes (Fisheries 40(7):338-339), tweeting is another alternative to traditional note-taking. At the end of the conference, #AFS145 tweets can be transformed into an online notebook using the program Storify (storify.com). You can include tweets from presentations you missed and the selfie you took with AFS President Donna Parrish. Easily share conference “notes” with colleagues by sending them the link to your “notebook.”

9. Twitter etiquette: Tweeting conference talks is an ever-evolving platform for information dissemination. Just as conferences are a professional forum to share advancements in knowledge and methodologies, and stimulate conversation among colleagues to build new collaborations, so Twitter should be too (Cordell 2013). If you have questions for the speaker, ask the speaker first, not the Twitverse. Similarly, discuss your thoughts or comments on talk content with the speaker face-to-face so that they can respond and participate in the discussion. If speakers indicate that they do not wish to have their talks tweeted, respect their request. Also, be aware that staring down at your phone or typing on a laptop during a presentation may be interpreted as rude.

REFERENCES


ECOLOGICAL OBSERVATORIES: WHOLE-LAKE TELEMETRY SYSTEMS

Q: How can I continuously monitor the effects of climate on fish behavior and interactions for multiple seasons and over many years?

A: Lotek 2D and 3D whole lake positioning systems are field proven – 6 year mission.

Fish transmitters from 0.28g for monitoring the smallest fish.

Autonomous receivers permit monitoring 24/7.

UMAP positioning software allows one to control data qualification and processing for unlimited number of hydrophones.

Lotek: www.lotek.com
Biotrack: www.biotrack.co.uk
Sirtrack: www.sirtrack.com
BioSonics Telemetry: www.biosonicstelemetry.com

Innovative solutions for a sustainable future.
Q: Where have fish & other aquatic life been monitored using HTI Acoustic Tags & Hydroacoustic Echo Sounders?

A: On almost every continent, major land mass, and ocean around the world.

* Greenland, we’re looking at you.