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Fisheries (ISSN 0363-2415) is published monthly by the American Fisheries Society; 5410 Grosvenor Lane, Suite 110 • Bethesda, MD 20814-2199 ©copyright 2010. American Fisheries Society • www.Fisheries.org

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COVER: Wild and scenic reach of the North Umpqua River, Oregon.
CREDIT: Rich Grost
During the summer and early fall, I frequently drive over the Snowy Range between my home in Laramie, Wyoming, and the North Platte River valley where I love to fish, float, hike, camp, hunt, and simply hang out. The 75-mile trip from Laramie involves climbing from short-grass prairie into the pine forest, driving along tumbling streams and flowered meadows, watching for elk and moose that occasionally emerge along the road, ascending to a mountain pass on the edge of the alpine zone with crystal clear lakes adjacent to the highway and granite peaks soaring a thousand feet above the road, then descending through similar biomes on the west side of the range. Great views! I have been making those trips for almost three decades and have always enjoyed the drive, but it is not like it was in the past. While change is slow in terms of human awareness, changes are evident to me. Glaciers that I climbed on with my sons in the 1980s are gone. The vast pine forest is dying, the consequence of infestations by pine bark beetles. Pines with rusty-brown needles interspersed with gray trees barren of needles dominate the forest. Many aspen groves are dying off. It's depressing. But, it is especially sad for me to think that my grandchildren will not see the beauty of the Snowy Range as I remember it. Who knows what the consequences will be for trout when there are no longer glaciers to contribute late-summer melt-water to streams, little shade in the forest to slow the melting of snow in the spring and reduce late-summer water temperatures, and fewer sources of large woody debris and leaf litter to contribute structure and productivity to streams. These massive landscape alterations are not unique to the Snowy Range. They are occurring throughout the Rocky Mountains. People can debate the causes, but the weight of scientific evidence supports the global climate change hypothesis and a warmer, drier climate as the probable culprit.

Such changes in ecosystems are not limited to the Rocky Mountains, but are being observed worldwide. Add to that more direct anthropogenic impacts on fish stocks and their habitats, such as the over-harvest of a multitude of fish stocks or the Gulf of Mexico oil spill, and the reality of our global situation becomes more apparent. What do we do?

The American Fisheries Society (AFS) has accepted the mission to advance sound science, promote professional development, and disseminate science-based fisheries information for the global preservation, conservation, and sustainability of fishery resources and aquatic ecosystems. Think about the magnitude of that mission relative to the global changes that are occurring! Nonetheless, we join together because we believe in the mission and a future world with fisheries contributing to the well-being of our grandchildren and their grandchildren. In an effort to provide direction for AFS members in their efforts to carry out the Society’s mission, the Society developed “AFS 2020 Vision,” a strategic plan for 2010–2014. You can take a look at it on the AFS website (www.fisheries.org). The vision is for AFS to be the premier organization of fisheries-related professionals and that we achieve this status by recruiting and training fisheries professionals with a diverse array of technical skills; promoting sound, science-based research, management, and aquaculture practices for fisheries conservation; serving as an intermediary for evaluation, interpretation, and transfer of information by using the best available communication technology; and providing forums for the exchange of information and ideas, promoting diversity, and building partnerships. The strategic plan identifies three primary goals encompassing (1) global fisheries leadership, (2) education, and (3) values of membership in the Society.

With awareness of the wide array of global-scale challenges and the 2010–2014 AFS strategic plan in mind, I have identified the theme for my term as president to be “New Frontiers in Fisheries Management and Ecology: Leading the Way in a Changing World.” Carrying out the mission of the AFS is becoming increasingly complex as the frontiers of fisheries management and ecology expand and change. The spatial and temporal scales at which we work have advanced way beyond individual lakes and streams to large watersheds, whole oceans, and worldwide climate with changes measured not just in years or decades but in centuries and millennia. The array of disciplines contributing to understanding and management of fisheries has advanced far beyond the biological sciences to include sociology, economics, geography, climatology, and a myriad of other fields. Technical advances are taking place at such a rapid rate that they are defining how science is conducted, information is exchanged, and business is carried out. Concomitant with all of these changes, there is increasing diversity in the membership of the Society with people having many different cultural backgrounds, educations, employment histories, and nationalities contributing to our mission. Our challenge is how to carry out the mission of the Society in an ever-changing world.

My work plan proposes that the Society engage in a variety of activities and initiatives, all within the purview of the 2010–2014 strategic plan. The list is far more than I can outline in this.

Continued on page 454
GBIF social site

The Global Biodiversity Information Facility (GBIF) Secretariat has launched a new social site to foster communication and collaboration in the biodiversity informatics community at community.gbif.org. The site is a free online social platform for professional interaction in the scope of GBIF: collaborative projects, discussions, sharing of information and expertise, announcements, and mentoring. The site is open to GBIF delegations, nodes, technicians, biodiversity data publishers and users, and everyone interested in biodiversity informatics. Collaboration tools available on the site include work groups, micro-blogs, community news, online chat, and file and image sharing. The site interface is available in English, Spanish, and French.

Lionfish in the Virgin Islands National Park

Divers identified and killed a 15 cm lionfish in Fish Bay along the southern coast of St. John, making this the fourth such capture and kill of the invasive fish in the Virgin Islands National Park. A team of divers and scientists from NOAA's National Centers for Coastal Ocean Science and the National Park Service were in the area collecting data aimed at evaluating the health of corals, fish, and invertebrates in a 10-year long project funded by NOAA's Coral Reef Conservation Program. NOAA is studying lionfish control strategies and has launched an “Eat Lionfish” campaign, which works with chefs, fishermen, and wholesalers to promote the development of a market for these fish. NOAA scientists have determined that a major fishing effort is required to reduce their numbers and mitigate their impact on reef ecosystems.

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Volume 30 Issue 3  
June 2010

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Errata, 851-852.
Senate hearing on Gulf Coast oil spill damages

On 27 July 2010, the U.S. Senate Committee on Environment and Public Works Subcommittee on Water and Wildlife held a hearing entitled “Assessing Natural Resource Damages Resulting from the BP Deepwater Horizon Disaster.” The hearing featured testimony from various federal, state, and non-governmental organization personnel. These participants included Cynthia Dohner of the U.S. Fish and Wildlife Service, Troy Penn of the National Oceanic and Atmospheric Administration (NOAA), Eva Pell of the Smithsonian Institute, Robert Spies of Applied Marine Sciences, Stanley Senner of the Ocean Conservancy, Erik Rifkin of the National Aquarium Conservation Center, and John Young, Jr. of the Jefferson Parish Council.

During the hearing, the witnesses described many examples of how the BP Deepwater Horizon oil spill has damaged the ecosystem of the Gulf region. Dohner stated the extent of the injuries is not known at this time, but it is believed that, in all likelihood, the dispersants will affect fish, wildlife, and plant resources in the Gulf, and possibly in other areas across the country, for years or more likely decades to come. Penn said that the spilled oil can remain in the sediments along the shoreline, in wetlands, and in other environments for years. He stressed that continued research is also needed to determine the effects of oil and dispersants that are suspended in the water column on pelagic species, as well as research on the effects of oil on deep water corals, chemosynthetic communities (animal communities living in the deep sea on dissolved gases and benthic habitats), and benthic habitats.

Pell testified that scientists who will carry out inventories and surveys of the post-spill environment will want exactly comparable pre-spill surveys using the same methods, designed for the same analytical protocols. There is one ongoing Bureau of Energy Management, Regulation and Enforcement (BOEMRE) and NOAA-funded study of deep corals in the vicinity that is ideally suited to this task. It is possible that such data could be regenerated directly from National Museum of Natural History (NMNH) collections. In conclusion, it is already obvious that NMNH collections have had, and will have, an important role to play in describing the pre-spill ecosystem. Spies said that beyond knowing the full impact of a large spill, a rigorous and robust scientific program pays long-term dividends in advancing our knowledge of ecosystems so that we may more intelligently manage marine activities in the future.

Senner indicated to the subcommittee that the United States has an obligation to chart a different course in the Gulf of Mexico. This includes seeking funds for a restoration program that fully compensates for the harm caused by the oil and seeking funds to restore and enhance the larger Gulf of Mexico ecosystem after decades of degradation. Rifkin said to the subcommittee that the sublethal effects from oil exposure can take the form of reduced growth rates or fertility (alteration of gametes), or increased mortality in larvae and juvenile stages. They can disturb communication between individuals or between them and the environment, causing, for example, an alteration in their migratory behavior.

Young concluded the panel’s testimony by stating that the dispersant Corexit has been banned in the United Kingdom and the Environmental Protection Agency should not have allowed it to be used in the Gulf of Mexico. He echoed the sentiments of other panelists by indicating that the long-term effects of this dispersant are unknown. He questioned whether this may be a case where the “solution” proves to be worse than the problem and stated that issue needs to be further investigated.

Australia limits amount of Victorian snapper

The Department of Primary Industries of Australia is seeking limits on the amount of Victorian snapper that commonwealth-licensed commercial trawl fishers are allowed to harvest. The Australian Fisheries Management Authority (AFMA) is seeking to restrict operators to a maximum of 50 kg of snapper by-product on each trip. This is due to data showing an increase in catches of snapper from waters off the Victorian coast between 2003 and 2009. As a result, the Department of Primary Industries has asked AFMA for immediate action to apply the 50-kg trip limit. These new limits would match the trip limit already in place for non-trawl operators.

Northeast harvest limit increases

U.S. Commerce Secretary Gary Locke has announced that the fishing limits on several fish stocks of the Northeast will be raised. The new limits are based on new scientific analysis that showed this year’s commercial catch limits could be raised and not harm critical stock rebuilding efforts. The pollock limit was raised from 6 to 36 million lbs. Previous recent actions have also raised the spiny dogfish limit from 12 to 15 million lbs. and revised the skate limit upward from 67.5 to 90.5 million lbs. Another pending action proposes to increase the red crab limit from 3.56 to 3.91 million lbs. These increases in catch limits were put in place by NOAA.
ABSTRACT: Until recently, marine fisheries managers have predominately interacted with a single user group—commercial fisheries. However, changes in participation in fisheries and progress toward ecosystem-based approaches have introduced new stakeholders into the management process. Yet, there are few examples of successful approaches of how to engage the spectrum of stakeholders interested in management policy and decisions. Here we describe one such approach that was used in the fisheries for king mackerel (Scomberomorus cavalla) along the U.S. southeast coast. The approach combined consensus building in facilitated workshops and decision analysis in which stakeholders could compare the consequences of alternative management options on trends in the king mackerel population and the fisheries it supports. The process resulted in a workgroup of stakeholders that developed a clear vision for its desired future of king mackerel fisheries and several alternative management options. Decision analysis was used to select the best options that were then recommended to the South Atlantic Fisheries Management Council (SAFMC). These options were more conservative than the council’s own recommendations. Additional benefits of the process included stakeholder education, both in stock assessment methodology and in an understanding other stakeholder positions, and the development of closer cooperation among stakeholders and managers.

FishSmart: An Innovative Role for Science in Stakeholder-Centered Approaches to Fisheries Management

Thomas J. Miller, Jeff A. Blair, Thomas F. Ihde, Robert M. Jones, David H. Secor, and Michael J. Wilberg

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Here we explore what led to these precautionary recommendations by the stakeholder group, which included representatives of recreational and commercial anglers, tournament organizers, angling organizations such as the Coastal Conservation Association, tackle shop owners, state biologists, and non-governmental organizations (NGOs) such as The Nature Conservancy and Environmental Defense Fund. We also explore whether this example of stakeholder involvement in developing quantitative recommendations for fisheries management was an anomaly or whether it can apply elsewhere in fisheries management.

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (2006) governs fisheries management in U.S. federal waters. The act requires management that “shall prevent overfishing, while achieving, on a continuing basis, the optimum yield from each fishery.” Traditionally, the primary stakeholders in U.S. federal fisheries management have been commercial interests, albeit composed potentially of multiple sectors. In this situation developing an agreement on what constitutes the “optimum yield” is possible, if not complicated, because all stakeholders often have similar objectives, i.e., make a profit by capturing and selling fish. However, in recent decades several changes have occurred that have brought more stakeholders into the process who often have very different views of what constitutes “optimum yield.” For example, marine recreational fisheries in the United States have expanded substantially. In a recent analysis, Ihde et al. (unpublished data) evaluated U.S. fisheries statistics from 1981–2006 and found that approximately 70% of 55 species examined demonstrated an increase in the proportion of harvest coming from the recreational sector, regardless of whether those species were primarily caught recreationally, commercially, for bait, or as bycatch. For recreational fisheries, neither profit nor the total weight harvested is likely of primary concern (Larkin 1977; Malvestuto and Hudgins 1996; Kirkegaard and Gartside 1998; Ihde et al. in press). Instead, recreational anglers often have a primary goal of the “chance to catch a few fish, and some of them large” (M. Nussman, American Sportfishing Association, pers. comm.). Additional stakeholders such as conservation organizations, recreational divers, and ecotourism operators have all become increasingly engaged in management decisions in the marine environment and each may have a different definition of what constitutes optimum yield (Hilborn 2007).

The diverse array of stakeholder groups that now have a role in management decisions constitutes a new challenge for fisheries managers. Yet, the challenge of involving the multiple criteria in decision making introduced by the presence of multiple stakeholders is not new in the environmental policy arena (Karl et al. 2007; Kiker et al. 2008). This challenge has frequently been met by the use of quantitative decision analysis, in which the outcome of competing policy alternatives are compared (Varis and Kuikka 1999; Harwood 2000). Equally, while environmental policy decisions still require the application of the best available science (Kiker et al. 2008), the full involvement of stakeholders in all phases of decision making has become increasingly common (Gregory and Keeney 1994; Chase et al. 2000; Gregory and Keeney 2002; Karl et al. 2007).

In 2008 we began a project called FishSmart, with the goal of helping recreational anglers explore options for improving the sustainability of marine recreational fisheries. We selected the recreational fisheries for king mackerel (Scomberomorus cavalla) along the U.S. southeast coast as a case study (Box 1).
This species and the fisheries it supports had many desirable features for our application. A stock assessment for the species was underway when we began our project, and thus relevant data had been assembled and appropriately summarized (Southeast Data Assessment and Review 2009). Preliminary results of the new assessment concluded that the king mackerel stock in the Atlantic was not overfished, but was experiencing overfishing, which necessitated reconsideration of management policies. A final consideration for our first application was that the different stakeholders had yet to adopt entrenched positions. As a result, we believed we had an opportunity to achieve an informed consensus among stakeholders within the project's one-year time frame. To ensure broad stakeholder support, we involved stakeholders in all phases of the project, from the development through implementation of recommendations, as opposed to the common practice of only allowing comments prior to adoption and during the final implementation phase.

Stakeholder advisory panels are common within both federal and states fisheries management (Figure 1A). However, many stakeholders feel that this involvement is merely perfunctory: that they are invited, informed, and ignored (Karl et al. 2007). Stakeholders can feel as if they are invited in late, and excluded from the development phase of a project, only to choose the most palatable among a suite of unpalatable options devised by managers. Frequently, they blame assessment science and models as being too opaque or rigid for not incorporating their input, which takes diverse forms such as nontraditional knowledge and unstructured data. Stakeholders often feel that their practical knowledge of the biology of the species and of the distribution and nature of the fishing effort are ignored. Ensuring effective stakeholder involvement is not trivial, and there is a wide diversity of approaches to achieving this goal (Hughey et al. 2000; Mikalsen and Jentoft 2008; Reed 2008; Granek et al. 2008). For example, Kiker et al. (2008) described a linear model in which first stakeholders and policy makers interact to define the objectives (Figure 1B). Subsequently, scientists conduct analyses to recommend the changes needed to meet the objectives. The policy makers and stakeholders then reconvene to recommend regulatory changes. We adopted a different approach for the FishSmart project that places the stakeholders at the center of decision making (Figure 1C). In this stakeholder-centered approach, stakeholders are involved in every phase of the process (Wilberg et al. 2008; Ihde et al. in press). They establish the objectives, develop the options that are to be considered for achieving the objectives, consider important sources of uncertainty, and are intimately involved in developing and evaluating the results of the decision analysis that are used to evaluate the performance of the options. We are not unique in using a stakeholder-centered approach. Cox and Kronlund (2008) successfully used a similar approach for fisheries for sablefish (Anoplopoma fimbria) on the Canadian west coast.

The FishSmart process is a decision-analytical framework involving three entities—the stakeholders, the science team, and the facilitation team—who develop and use a model that simulates the population of the fish stock of interest to evaluate alternative management policies (Figure 1C). The full participation of each entity is essential to the success of the project. The role of each entity is well defined and sometimes different from that typically asked of them.
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As our description suggests, the stakeholder group is at the center of the process. Members of the group are responsible for developing the objectives for the fishery, suggesting policy options that should be considered to meet those objectives and indices that measure how well the policy options have performed in meeting the objectives. This group also plays a central role in evaluating how to respond to the results from the simulation model. The stakeholders decide when and how to modify their objectives, options, and performance measures based on the simulation results. The demand on individual members of the stakeholder group to be familiar with other stakeholder perspectives and previous stakeholder group decisions and results mandates that stakeholders should be consistently involved throughout the process.

The FishSmart process is designed to empower stakeholders through participation, both ensuring they have the power to influence the process outcomes and decisions and the technical capability to engage effectively in building consensus (Tippet et al. 2000; Richards et al. 2004). Therefore, it is essential that the members of the stakeholder workgroup are selected carefully to represent key constituencies in the fisheries. As part of the process for identifying stakeholders, we evaluated the history, perspectives, and relationships among those with a stake in the king mackerel fishery in the Atlantic. Ensuring the right balance of representation is critical to the success of the project. Equally, inviting the right people to represent the different constituencies in the process is also critical. All should be knowledgeable and influential leaders in their community. But, they should also be open to listening to the views of others, even if those views counter their own opinions. We believe that the time we invested at the beginning of the project in identifying key stakeholders and in process design paid benefits later. The size of the workgroup is also an important consideration. From our experience, workgroups larger than about 20 require a different approach to managing the consensus process and require more time and resources. For fishery management questions that cover a wide geographic area, it can be challenging to provide adequate representation.

For our work, we identified candidates for membership based on discussions with management council staff, angler organizations, sports writers, NGOs, and state and federal agencies. The candidates were subsequently interviewed to assess their background and interest in participating. For king mackerel, the final workgroup was composed of 13 members. Stakeholder groups included (number of representatives in parentheses): independent recreational anglers (2), angling organizations (2), charter captains (1), the tournament sector (2), commercial anglers (1), tackle shop owners (1), environmental NGOs (2), and state biologists (1) and managers (1). Workgroup members included the sitting chairperson, the past chairperson, and two other members of the SAFMC Mackerel Advisory Panel, and the managing partner of the Southern Kingfish Association, the largest U.S. tournament circuit for king mackerel. Ihde et al. (in press) provide more details regarding the workgroup.

The second entity in the FishSmart process is the science team. They are responsible for developing the simulation model based on input from the stakeholders, explaining its results, and responding to questions and input from the stakeholders. The initial interactions between the science team and the stakeholders may be very basic, but in our experience a quite sophisticated stakeholder understand-

Figure 2. Schematics used to describe the FishSmart simulation model used in (A) the first meeting and (B) the third meeting to illustrate the evolution of understanding evident in the stakeholder workgroup.
The iterative nature of the process means that the scientists must also be consistently and actively involved throughout the process. In FishSmart, the scientists do not simply present a completed model with its associated results. Rather, scientists work iteratively with the stakeholders to develop a model structure that is accepted and understood by all. For example, stakeholder views on catch-and-release mortality evolved over time as a result of interactions with the science team. Recreational stakeholders gave initial estimates of a catch-and-release mortality of about 5%. However, following discussions, stakeholders came to realize that they must include not only the obvious initial mortality of released fish, but also the deaths of hooked fish attacked by predators while on the line, and the deaths of fish not brought to the boat. After a fuller consideration, stakeholders increased their estimate to 12.5% mortality of fish released alive and added a 15.5% mortality for the discarded recreational catch.

The role of the scientists in the FishSmart process is perhaps the one that differs most from the traditional one. It is important that the scientists are not viewed, and do not view themselves, as having all the answers. The scientists must be willing to take on the role of teachers early on in the process, providing guidance to the stakeholders as to type of questions that are amenable to the decision analytic approach and those that are not. But, a balance has to be struck in that the scientists should not limit approaches and questions considered. The science team must be willing to listen to stakeholder “local knowledge” and be flexible in how information is presented to the stakeholders. For example, in the king mackerel case study, we tried three or four different approaches to summarizing model results before developing, with the stakeholders, the final graphical summary we adopted (Figure 3). The science team must be able to engage in frank discussions about the uncertainties inherent in the data and the model such that the stakeholders can make informed choices. Scientists may also be asked to provide input on what would be required for the stakeholder’s decisions to be credible to the broader management and scientific community in terms of quantitative criteria such as statistical summaries and forecasts.

The final entity involved in the FishSmart process is the facilitation team. The facilitator’s process and group dynamic expertise is as essential as that of the scientists in ensuring a successful outcome of the process. The role of the facilitators is multifold. The first critical role for the facilitators is to help the stakeholders develop meeting and process participation rules to which all agree and respect. These rules are structured to ensure a full, open, and respectful discussion of all aspects of the management challenge and serve to build trust as the process moves forward. Determining the standard by which the group’s decisions will be made is a central aspect of these early discussions. For FishSmart, the facilitators designed and recommended a consensus-based process, with a minimum threshold of 75% or greater for approval, that was unanimously adopted by the stakeholders.

Figure 3. The final approach used to present simulation results adopted by the FishSmart workgroup. The chart shows a box plot of forecast biomasses in the population relative to the biomass reference point for this species from the stock assessment for each option considered. The options were grouped by category. Initial numbers refer to the size of the quota (x10^6 lbs.), the number of fish refers to the bag limit, and size limits (where given) are in inches. Three recreational catch-and-release options included releasing all fish greater than 20 lbs., improving overall catch and release so that half of the catch is released, and introducing gear or techniques to reduce the dead discard rate by half. The “status quo” condition was always shown on the extreme right. Each box shows the 25th percentile, the median, and the 75 percentile of the distribution of model results. The whiskers show the maximum and minimum values.
A simple majority may allow a single interest group to dominate proceedings. Alternatively, requiring unanimity may permit a single interest group to block progress.

Another critical role for the facilitators is to assure the stakeholders that there would be no final votes until the end of the last meeting. This ensures that stakeholders are not locked into their initial positions and are free to re-evaluate their rankings based on the discussions and new information. Within our process, options and recommendations were evaluated using a four-point ranking scale, with 4's and 3's in favor and 2's and 1's opposed, and could be re-ranked as many times as members wished prior to the final vote. Another role for the facilitation team is run all aspects of the meetings, as neutrals, thereby ensuring all stakeholders are allowed to fully express their views and soliciting the appropriate involvement and interaction of the science team with the stakeholders. To be effective, facilitators should ensure that stakeholders identify and agree on what the key issues are before evaluating the full range of options relevant to each of the key issues. The facilitator's expertise is also important in providing advice on how quickly new material can be presented to the workgroup. However, the facilitators' role is to focus on process, and they should be perceived and function as totally neutral throughout the meetings. A final role of the facilitators is to keep accurate records of the discussions. It is helpful if these notes are projected live on screen during the meeting as this allows people to track discussions and to see that their input is recorded accurately and valued. In our experience, the facilitator's expertise is vital in helping pace the meetings so that objectives are achieved, while ensuring that concerns are fully aired so that stakeholders are ready to make decisions. The facilitation team also serves as a conduit for post-meeting summaries, transcripts, and information for the stakeholders between workgroup meetings. This contact between meetings helps to keep the attention of individual stakeholders on the project.

The FishSmart process involves a series of structured workgroup meetings to come to a final set of recommendations. Wilberg et al. (2008) and Ilde et al. (in press) provide details of the FishSmart meetings conducted to develop the recommendations for the king mackerel fishery that were presented to the SAFMC. Wilberg et al. (2009) provides details of the numerical population simulation model that was used for the decision analysis. Four meetings were held between April–November 2008. The first meeting focused on crafting an objective statement and developing a vision for the future fishery shared among all stakeholders. Another objective of this meeting was to provide guidance to the scientists regarding the likely biological and population dynamic issues that would have to be represented in the model. For example, the workgroup was as interested in the size of fish caught as in the number and thus the model had to be able to predict the size structure in the king mackerel stock. Similarly, workgroup members were less interested in spatial processes at the local level. As a result, the model only had to represent the spatial structure of the stock at a very coarse, regional level. The second meeting introduced a prototype version of the simulation model that included components suggested by the stakeholders. Revised simulation results were presented at the third meeting. The last meeting involved evaluating the final model configuration and results and crafting recommendations.

Progress toward consensus at each meeting was made by ranking resolutions proposed by workgroup members during the meeting as described above. This consensus building approach was central to the FishSmart process. As an example of its use, Box 2 charts the development of specific recommendations on quota, size, and bag limits that were made to the SAFMC. The initial resolution was proposed on 17 October 2008. Members of the stakeholder workgroup were asked by show of hands whether the found the resolution acceptable, whether it was acceptable with minor reservations, whether they had major reservations, or whether it was not acceptable. Votes were then recorded (Box 2). Extended discussion followed and the key themes were captured live on the screen. Based on concerns expressed by the workgroup, the science team was charged with running additional simulations that were reviewed at the next meeting (6–7 November 2008). A second resolution was proposed on November 6th after further discussion regarding the overall level of quota. This resolution met the consensus standard adopted (75% of votes for levels 3 or 4), but reservations remained. A revised resolution led to higher acceptance. Some resolutions received such little support that they were withdrawn after the first vote. Other resolutions, such as the vision for the king mackerel fishery, were viewed as so central to the process that they were reconsidered at each meeting (Box 3).

The FishSmart process is based on the fundamental belief that when stakeholders are truly engaged in the process, they take ownership of the results, which lends credibility to the results and to subsequent implementation (Karl et al. 2007). This was certainly the case for the king mackerel fishery. Workgroup members requested that they present their recommendations to the SAFMC. Council members were open to the recommendations and voted to include them in the options taken to public scoping meetings because they were presented by a broad coalition of stakeholders in the fishery. Indeed, council members were surprised by the specificity of the recommendations and questioned workgroup members why such recommendations had not arisen from the council’s own stakeholder process. We would argue that such recommendations were not forthcoming previously because stakeholders were not at the center of the process. Previously, stakeholders were asked to select among options presented to them, but were not vested in developing either the objectives for the fishery, the options themselves, or the method for evaluating the options. In the FishSmart process, stakeholders understood and trusted the way in which the alternative options were evaluated. As a result, the stakeholders felt empowered to select among the alternatives that they themselves had suggested. A fully participatory approach, such as exemplified by FishSmart, is more likely to ensure that stakeholders become passionate advocates for the future of the fishery and willing participants in instituting necessary changes (Granek et al. 2008). FishSmart was a success not because it involved stakeholders, nor because it used decision analysis modeling, or because it was designed as a facilitated consensus-building process, but because it combined all of these features.

There is a widespread desire for increased stakeholder involvement in fisheries management decisions (Hughes et
Box 2. Evolution of a management recommendation. We show each resolution put forward and the votes received. Below each resolution are the abbreviated comments displayed on the screen for the stakeholder workgroup to see.

**RESOLUTION 1. Minimum size limit of 28 inches from 24 inches for recreation only.**

<table>
<thead>
<tr>
<th>Initial Ranking 17 October 2008</th>
<th>4 = acceptable</th>
<th>3 = minor reservations</th>
<th>2 = major reservations</th>
<th>1 = not acceptable</th>
</tr>
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<tbody>
<tr>
<td>Ranking 6 November 2008</td>
<td></td>
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Members Comments (17 October 2008)
- Too early to do this? Need to look at combinations.
- Fought for this to get to 24. Mercury issue is significant for KM. Concern re: safety. Size range has less mercury. But for mercury issue, would support this.
- Don’t make this 28 for commercial, but for recreational only.
- Is mercury at 28 inches greater than 24? Evidence shows at 33 inches? Fish grow quickly.
- This would be about 3 years old and sexually mature (sweet 16).
- 32 inches—around 6–8 year old twice the time to gain mercury.
- 28 inch is about 6 lbs. Still in the range—target for commercial take. In this size range mercury not as great a concern.

**Resolution failed as no vote called.**

**RESOLUTION 2. 8M TAC, 32 inch min. size, recreational only**

<table>
<thead>
<tr>
<th>Initial Ranking 7 November 2008 First</th>
<th>4 = acceptable</th>
<th>3 = minor reservations</th>
<th>2 = major reservations</th>
<th>1 = not acceptable</th>
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<tbody>
<tr>
<td>Ranking 7 November 2008 Second</td>
<td></td>
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Members Comments and Reservations (November 2008)
- Too big of a jump. 24 to 32. Down the road another jump.
- More "noise" in these models—uncertainty re catch-and-release mortality.
- 2nd best—overfishing/overfished mortality.
- Allows most fish to mature or reach maturity.
- 32 inches is still a baby kingfish.
- Public will need to absorb this in a stepwise fashion.
- Over next 5 years—bring in from 28 to 32 over a period of time? Avoid the shock that this may bring by going directly there.
- Precedents in fishery management for going this way.

**Resolution passed, and led to:**

**RESOLUTION 3. 8M TAC, 2 fish bag limit, 28 inch min. size, recreational**

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<tr>
<th>Initial Ranking 7 November 2008 First</th>
<th>4 = acceptable</th>
<th>3 = minor reservations</th>
<th>2 = major reservations</th>
<th>1 = not acceptable</th>
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</table>

Presentation Summary of How the Option Performs Relative to Others
- Performs 2nd best for spawning stock biomass.
- Performs 3rd best in terms of overfishing and overfished-mortality.
- Meets other criteria.

Round of Comments
- Do we need to get a 3rd option to present to the council?
- Presented—for recreational perspective. Commercial will have to respond to the 20% reduction in addition to this. Let them hash that out separately.
- Taking out of NC hide
- Expected outcome is no season closure.
- What does the model tell us? In terms of 24 and 28 how much more biomass value do we get?
al. 2000; Granek et al. 2008; Mikalsen and Jentoft 2008) and the broader natural resource management arena (Chase et al. 2000; Gregory and Keeney 1994, 2002). However, until stakeholders are actively involved in crafting the policy options themselves, we believe the success of these efforts will be limited. Involving stakeholders will require procedures to balance potential conflicting ideas on how the resources should be managed. In the current fisheries management arena, even when stakeholders are consulted, a mechanism for balancing these conflicting recommendations is lacking. Decision analysis has been used in fisheries before, but often its use has been viewed as tool for scientists and managers alone (Peterson and Evans 2003; Cox and Kronlund 2008; Irwin et al. 2008; Reinert and Peterson 2008). However, these tools are most powerful when incorporated into a consensus building process that enables stakeholders to select among policy options (Cox and Kronlund 2008). Finally, this FishSmart consensus building process demonstrates that a trade-off between meaningful stakeholder participation and scientific rigor is by no means inevitable. Instead, there is a broad recognition that involving stakeholders actively in natural resource management decisions is the best approach to ensuring the sustainability of the resources we seek to conserve and the human activities such as fishing that rely on them (Kates et al. 2001; Karl et al. 2007; Carpenter et al. 2009).

Beyond specific recommendations, the consensus process resulted in the development of highly knowledgeable stakeholders and the integration of both scientific and stakeholder knowledge. This in turn contributed to a more comprehensive consideration of the complex and dynamic fishery system and more robust solutions. Members of the king mackerel workgroup left the process with a deeper understanding of the dynamics of the fisheries, the assessment of the stock, and the king mackerel stock itself. They gained a firsthand understanding of the uncertainty associated with our knowledge of these components. As a result, they became champions of new data collection programs, both volunteering data they already had, but that had not been used in assessments to that point, and in developing new data collection programs. They also saw actions that they could take as individuals to help ensure the sustainability of the stock. For example, the Southern Kingfish Association, the principal tournament organizer in the southeast United States is considering increasing the minimum size of fish caught in the tournament independent of any action by the council and restricting the number of fish checked in at the dock. By the end of the process, all participants had gained an improved understanding of other stakeholder groups and of their concerns. The approach also led to new partnerships between anglers and NGO organizations that share a common interest in the sustainability of the coastal environment.

Box 3. Evolution of the objectives for the king mackerel fishery adopted by the workgroup.

C. Create a sustainable management regime that will enable a fair allocation among all user stakeholders and maximum access to the AKM fishery.

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<tr>
<th>4 = acceptable</th>
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<th>2 = major reservations</th>
<th>1 = not acceptable</th>
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<tbody>
<tr>
<td>Initial Ranking 11 April 2008</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
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</table>

Comments after Ranking of the Goal
- Would like more time to get the words clear and correct.

17 October 2008
GOAL FOR THE ATLANTIC KING MACKEREL FISHERY
A sustainable AKM fishery managed to maintain an optimum yield and genetic diversity of fish to provide acceptable levels of access and allocation for all sectors while conserving biological and ecological functions.

6 November 2008
GOAL FOR THE ATLANTIC KING MACKEREL FISHERY (Revised and Ranked 11-6)

A sustainable AKM fishery should be managed to prevent overfishing from occurring, prevent the species from being overfished, to ensure optimum yield is not exceeded, while maintaining the maintain an optimum yield and genetic diversity of fish to providing acceptable levels of access and allocation for all sectors while conserving biological and ecological functions.

<table>
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<th>4 = acceptable</th>
<th>3 = minor reservations</th>
<th>2 = major reservations</th>
<th>1 = not acceptable</th>
</tr>
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<tr>
<td>Initial Ranking 11 April 2008</td>
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</tr>
<tr>
<td>As Revised 6 November 2008</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Member’s Comments and Reservations (October 2008):
- The following statements should be incorporated into the AKM Fishery Goal Statement:
  - Prevent the species from ever being overfished.
  - Prevent overfishing from occurring.

Member’s Comments and Reservations (November 2008):
- Optimum yield ties old concepts with new
However, adopting the FishSmart approach is not without its challenges. First and foremost it requires a substantial investment in time and resources. We used four face-to-face meetings and extensive inter-sessional modeling work to achieve the project's objectives. In fisheries that have more challenging conservation issues, a substantially longer period will likely be needed to reach consensus. In our application, there were not substantial conflicts between commercial and recreational interests—such conflicts are present in other fisheries and in such cases, we expect a considerably longer time will be needed to understand opposing views and reach consensus. Indeed, the literature confirms that participatory processes require “long time frames to sensitize, build awareness, strengthen relevant institutions, and work through existing stakeholder dynamics and cultural barriers” (Kessler 2004: 15). The approach is likely not suitable for acute problems, but could serve as a practical approach to address, solve, and more constructively manage chronic challenges in specific fisheries. The time commitment required for success should not be underestimated. Extensive work needs to be invested before the first meeting in identifying the stakeholders and the workgroup members. Once the process is underway a substantial amount of communication with workgroup members is needed to ensure that they understand the steps in the process and remain committed and involved. As we have already noted, the process places a lot of demand on the workgroup members’ time—and the longer the process, the more difficult it might be for some individuals and even some constituency groups to commit that time. For example, the commercial anglers and charter boat captains on our workgroup were foregoing working to attend meetings and they were not compensated for their time.

The approach also requires a substantial commitment from the scientists. In many cases, stock assessment biologists are already hugely over-committed and finding additional time to provide the support for a stakeholder-centered process may be difficult. The challenges that the scientific team face in such a project also should not be underestimated. Members of the stakeholder workgroup enter the process with extremely different backgrounds and considerable effort and patience is needed to ensure the process moves to active participation in recommending options. Considerable effort must be expended by the scientific team to ensure that stakeholders feel that the product of the workgroup (i.e., the simulation model) is theirs (though the science team provides the knowledge and skills to build the model), and that the stakeholders take ownership of the results. Of course, the time commitment required by all parties comes with a high associated cost, which may itself challenge the budgets of many agencies.

Despite the challenges noted above, we were able to achieve noteworthy progress in developing specific management recommendations for the king mackerel fisheries that included substantial reductions in quota and bag limits and substantial increases in minimum sizes. We believe this success was a direct result of the process we used, where stakeholders reached consensus in a participatory decision-making process. Central to the success of FishSmart was the ability of the stakeholders to frame not only the options, but also the objectives for the fishery. They were not constrained to consider only biomass and harvest levels. In setting an objective that explicitly focused on minimizing seasonal closures, stakeholders saw that concern for this objective was carried through all of the options considered for management. The stakeholder-centered approach we adopted in FishSmart empowered stakeholders in the fisheries to recognize and jointly come to terms with the challenges faced by the fisheries. We also believe that by placing the responsibility on the stakeholders, we allowed them to take “ownership” of the future of their fisheries. Indeed, a common refrain in the stakeholder discussions was the plea to ensure that king mackerel fisheries will be open and available for the workgroup member’s children to enjoy in the years to come.

Acknowledgements

The authors wish to thank the members of the FishSmart king mackerel workgroup for their enthusiasm, dedication, and insight. We also wish to thank members of the project’s steering committee for helpful guidance and advice. In particular, we recognize the contributions of Michael Nussman, president and CEO of the American Sportfishing Association, for encouraging us to pursue this research. The project was funded by grant from the Marine Conservation Initiative, a program of the Gordon and Betty Moore Foundation. This is contribution number 4428 of the University of Maryland Center for Environmental Science.
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Southeast Data Assessment and Review. 2009. South Atlantic and Gulf of Mexico King Mackerel, 16. Southeast Data Assessment and Review, North Charleston, South Carolina.


ABSTRACT: Environmental flow studies normally involve sampling. Except for hydrologically based methods, the studies usually are conducted only on part of the reach of stream to which the study results will be applied. This assumes that the study sites, or the samples, are representative of the stream as a whole. There is no way to be sure of this without studying the whole stream, but it is possible to estimate how close the study results and the “true” results are likely to be, if the study uses a probability (random) sampling design that allows for estimating confidence intervals. Sampling designs that allow for interval estimates of statistics are normal in science, but, strangely, not in environmental flow studies. I then describe and critique the sampling in some recent studies using the Physical Habitat Simulation System (PHABSIM), the method most commonly used in the United States, which I describe briefly for readers not familiar with it. Finally, I explain why deliberate selection of samples gives biased results, and describe the experience that persuaded statisticians of this fact early in the twentieth century.

Muestreo para valoración de caudales ambientales

RESUMEN: la evaluación de caudales ambientales comúnmente implica actividades de muestreo. Con excepción de los métodos hidrológicos, los estudios normalmente se realizan sólo en una parte de la extensión total de un río, sobre la cual los resultados serán aplicables. Esto supone que los sitios de estudio, o las muestras obtenidas, son representativas del cauce entero. No hay forma de tener seguridad acerca de la veracidad de esta práctica más que estudiando un río en su totalidad, pero es posible estimar la certidumbre de dichos resultados si el estudio se basa en un diseño de muestreo (aleatorio) probabilístico que permita estimar intervalos de confianza. Los diseños de muestreo que permiten estimar la confiabilidad estadística son comunes en la ciencia, pero curiosamente no lo son en estudios de caudales ambientales. En la presente contribución se describen y discuten algunos diseños de muestreo de este tipo, y consideraciones relacionadas, en el contexto de estudios de caudales ambientales. Después se describe y critica el muestreo realizado en estudios recientes que utilizan el sistema de simulación de Hábitat Físico (PHABSIM), considerado como el método más comúnmente utilizado en los Estados Unidos de Norteamérica, el cual se explica brevemente para los lectores no familiarizados. Finalmente se menciona por qué la selección deliberada de muestras produce sesgo en los resultados y se comenta la experiencia que persuadió de este hecho a los estadísticos a principios del siglo veintiuno.

Introduction

In 2008, the American Fisheries Society adopted a strong resolution calling for funding of instream flow protection programs, and making good recommendations regarding attributes of instream flow recommendations or the studies that produce them (AFS 2008). The resolution is silent, however, about one aspect of instream or environmental flow studies that often falls short of normal scientific practice: sampling.

Environmental (or instream) flow assessments, studies to inform decisions about how much water to leave in a river or stream to maintain environmental resources, generally involve sampling. Except for hydrologically based methods such as the Tenant or the range of
variation methods (Tenant 1976; Richter et al. 1997), the environmental flow methods (EFMs) normally are applied only to part of the reach of stream that will be affected by the decision, and the results are extrapolated to the rest of it. This procedure assumes that the sample is representative of the whole.

Sampling is ordinary in science and is a well-developed part of statistics, but has received surprisingly little attention in environmental flow assessments (Williams 2010). For example, Annear et al. (2004), in an otherwise comprehensive review, do not discuss sampling at all. Unfortunately, most applications of EFM use deliberate or purposive methods rather than random (probability) methods to select samples, so the assumption that the sample represents the stream lacks a solid foundation, and it is not possible to assess quantitatively how good the representation is likely to be. There are good reasons, rooted in practical experience as well as in theory, why random or probability sampling is standard practice in science and in other fields such as opinion polling that rely on survey sampling: “Without a census, a statistical survey with the incorporation of probability sampling is the only way to assure the selection of a representative sample from which can be drawn unbiased conclusions about the population as a whole” (Stevens et al. 2007).

Sampling for EFMs is essentially similar to sampling for other kinds of studies, so textbooks such as Cochran (1977), Jesson (1978), or Thompson (2002) provide comprehensive treatments that are applicable to EFMs. However, the lack of attention to proper sampling approaches in environmental flow assessments indicates a need for a brief review focused on EFMs. Here, I provide such a review, using examples from applications of the Physical Habitat Simulation System (PHABSIM), probably the best known and widely used EFM in the United States, which calculates an index of habitat called weighted usable area (WUA) as a function of discharge (See Box 1 for a brief description of PHABSIM). I refer primarily to PHABSIM because many readers will be familiar with it, but the discussion also applies to other methods that rely on samples, such as the numerical habitat models described by Guay et al. (2000) or Railsback and Harvey (2001), or the demonstration flow assessment (DFA) method described by Railsback and Kadvany (2008).

Environmental flow methods generally estimate an index of habitat value at a given discharge from samples of transects or short reaches of stream, which begs the question, how good are the estimates? We would like to know how close the estimated value of the index is to the unknown “true” value of the index for the river reach of interest at that discharge, the value that could be calculated by someone with perfect knowledge of the river. Without knowing the “true” value, this question cannot be answered. However, if an appropriate sampling design is used, it is possible to estimate how similar the estimate and the “true” value are likely to be. That is, one can calculate an interval estimate, an interval within which the unknown “true” value will fall with a given probability, i.e., a confidence interval. Statisticians regard this approach to estimation as basic, and it is conventional in science. Castleberry et al. (1996) urged that it be used in applications of PHABSIM. However, PHABSIM and other EFMs generally do not use this approach. Instead, sample sites or transect locations usually are selected deliberately, and the results of EFM studies are presented as point estimates at a given discharge, rather than as interval estimates.

Developing interval estimates requires an appropriate sampling design, and my main objective is to provide guidance regarding such designs for EFMs. Following a general exposition, I present four case studies to illustrate the main points. I also touch on aspects of study planning that are related to sampling designs, and the empirical evidence that convinced statisticians of the need for probability sampling.

Aspects of study design

Study objectives

A good sampling design is only part of a good study design (Box 2). Specifying the problem to be addressed is always a critical step in any study, since it is otherwise impossible to tell whether the study will actually address the problem. As noted by Cochran (1977), “A lucid statement of the objectives is most helpful. Without this, it is easy in a complex survey to forget the objectives when engrossed in the details of planning, and to make decisions that are at variance with the objectives.” Typically, the objective in environmental flow studies will be to define a relationship between discharge and habitat value for a given reach of stream. Usually, this will not be done for its own sake, but rather to serve some management purpose that provides context for the study.

One factor that should be considered in environmental flow studies, but typically is not, is how accurate the estimates of habitat value resulting from the study need to be to meet the purpose of the study. This could be visualized in terms of an accuracy/utility function (Figure 1). (By accuracy, I mean both precision and lack of bias.) If the study is intended to inform a decision about instream flow standards, it may be useful to consider the flow increments that the decision-maker is likely to consider. If such increments are about 10%, say from 10 to 11 m³/s, there may not be much point to developing an estimate that is precise enough to support a decision between 10.0 and 10.5 m³/s. On the other hand, a study that cannot usefully distinguish the habitat values at 10 and 12 m³/s would be less accurate than would be desirable. Accuracy must be balanced against effort and expense, and very likely a study that is as accurate as is desirable will not be practicable, but if the results are expected to be too inaccurate, then the utility of the study should be questioned.

Sampling universe

A clear definition of what is to be sampled is important. Defining this “sampling universe” may be easy for some environmental flow assessments, since flow decisions generally apply to a well defined reach of stream, but it may be a major challenge in some cases. Even when the reach of interest is well defined, access to parts of it may not be available for practical or legal reasons. Then, the actual sampling universe is the accessible parts of the reach, to which any conclusions from the study should be restricted. If possible, the actual
**Box 1. Summary description of PHABSIM.**

PHABSIM is a collection of hydraulic and biological models used to assess the value of habitat in a stream as a function of discharge for a particular species or life stage. PHABSIM operationally defines and estimates a suitability $S$ for a species or life stage, and uses $S$ ($0 \leq S \leq 1$) to weight the area of the stream, yielding a statistic called weighted usable area (WUA). Conceptually, $S$ varies continuously over the surface of a stream, and is defined operationally in terms of “microhabitat” variables; usually these are water depth, velocity, and substrate size or cover, but sometimes other variables such as distance to cover or velocity gradient. Substrate and cover are estimated by field surveys, usually as categorical variables, but water depth and velocity are estimated over a range of discharge with a hydraulic model. The biological models normally used to calculate $S$ for depth and velocity are curves called habitat suitability criteria (HSC), that vary between 0 and 1 as a function of one of the microhabitat variable at points or small areas in the stream. For categorical variables such as substrate, a suitability value is assigned to each category (Figure B1). The sampling and modeling issues involved with developing habitat selection models are well covered in Manly et al. (2002), and the discussion applies to HSC as well.

The hydraulic models used in PHABSIM are usually one-dimensional (1-D), with which depth and velocity are estimated at points along transects perpendicular to the flow. Increasingly, however, two-dimensional (2-D) models are being used, with which areas of the stream are divided into many small cells or tiles, and depth and velocity are estimated for each. At a given discharge, the values of the suitability curves for each point or cell are combined, often by simple multiplication, to calculate WUA.

Details are complicated by the large number of options available in PHABSIM, but in the general case, with the 1-D models, the river reach of interest is represented by a set of transects, and each transect is assumed (e.g., through “weighting factors”) to represent some fraction of the total reach. One of several hydraulic models is used to estimate water depth and velocity at usually 20 or more points along each transect. The values at the points are assigned to “cells” with nominal areas calculated from the weighting factors and the distance between the points on the transect. WUA for the transect at a given discharge is estimated by:

$$WUA_t = \sum_{i=1}^{n} a_i S_i$$

where the summation is over the $n$ cells on the transect, $a_i$ is the nominal area of the $i$th cell on the transect, and, for the default option,

$$\hat{S}_i = \hat{s}_v,i \hat{s}_d,i \hat{s}_s,i$$

and $s_v,i$, $s_d,i$, and $s_s,i$ are the values of the HSC for the species or life stage in question for velocity, depth, and substrate/cover for the $i$th cell, again at the given discharge; the “hats” indicate that the terms are estimated from samples. Repeating this process at each transect over a range of discharge and interpolating results in curves of WUA over discharge, and summing over these gives a composite curve of WUA over discharge for the reach (e.g., Figure B2). Usually, the sum is normalized by stream length, so the final results are reported as WUA per length, which has a dimension of length. The process is similar with 2-D models, except in this case the $a_i$ are real areas that are determined by the grid of the hydraulic model.

The composite curves are the basic product of PHABSIM, although they can be used to assess flow regimes rather than specific levels of flow by combining the curves with a hydrograph to produce times series of WUA. As stated by Annear et al. (2004:149), “…the primary value of PHABSIM is its ability to identify trade-offs between streamflow and hydraulic habitat …” Bovee et al. (1998) and Waddle (2001) describe PHABSIM in detail. Recently, some investigators (e.g., Guay at al. 2000) have estimated the $\hat{S}_i$ using logistic regression with microhabitat values as independent variables, rather than using the usual HSI, but the basic process is similar.

**Figure B2.** WUA for juvenile Chinook salmon at the Seiad study site, Klamath River, California. Redrawn from Hardy et al. (2006).
sampling universe should be determined during the planning phase of the project; if it is too small a fraction of the reach of stream that will be affected by the flow decision, then the utility of the study should be reconsidered.

In other cases, the sampling universe may be restricted to certain types of habitat; for example, Gallagher and Gard (1999) applied PHABSIM to "optimal [Chinook salmon] spawning areas based on substrate size and past redd distributions," for an assessment of how well WUA predicts spawning site selection. Similarly, if the concern is for a riffle-dwelling or a pool-dwelling fish, then restricting the sampling to the relevant habitat probably is appropriate. Or, suppose that the habitat index to be used will return a habitat value of zero for sand or mud substrates, and that these can be identified reliably on aerial photographs of the stream. Effort sampling such areas would be wasted, unless the objective is to test the index. When the sampling universe is restricted to part of the stream, however, some operational definition will be needed for the areas to be included or excluded.

**Sampling units**

The sampling units, the things that make up the sample and determine the sample size, must also be defined. This is easy for transect-based methods, such as 1-D PHABSIM, where the transects make natural units. For area-based methods, such as DFA or 2-D PHABSIM, the study sites are the sampling units, and decisions must be made about how big the sites should be and how their boundaries will be determined. For methods incorporating 2-D hydraulic models, the sites should provide for sensible boundary conditions for the hydraulic models, so the hydraulic modeler should be involved in defining the units.

In EFMs such as PHABSIM, sampling also occurs when data on microhabitat variables are collected. When depth and velocity data are collected at transects for calibrating the 1-D models, for example, the depth is usually measured at particular points, and these values are applied to some interval across the transect. Similarly, the vertically averaged water velocity at the same points is estimated by measurements measured at one or two depths, and applied to the same interval across the transect. Finally, WUA is calculated interval by interval across the stream at a given discharge, and summed to produce an estimate for the transect. It might seem that the intervals are the basic sampling unit, so that the sample size would be the total number of intervals on the all the transects.

To see why the intervals are not the basic sampling unit from a statistical point of view, and why the total number of intervals on all transects is not the sample size, consider the consequences of making the size of the intervals across a single transect smaller and smaller. In the limit, if there were infinitely many intervals, the sample size would be infinite, but there would still be information only about that single transect. Similarly, with 2-D PHABSIM, no matter how fine the computational grid in the 2-D model, there would still be information only about the site. In terms of sampling theory, the basic point is that whenever any of the cells or tiles in a site is selected, all of them are selected, and similarly, whenever any interval on the transect is selected, all of them are selected (Thompson 2002). The reasoning is the same for systematic samples.

For 1-D methods, the number of potential sampling units is effectively infinite, but for 2-D methods, there can be only a limited number of non-overlapping units. Accordingly, as described in the textbooks cited above, a finite population correction factor should be included in the variance estimates, unless the fraction of the sampling universe contained in the samples is small.

**Sampling frame**

The method by which the sample will be selected—some method by which random numbers will be associated with sampling units on the stream—must also be defined. In survey sampling, this is normally a list, such as a list of telephone numbers used to select a sample for a political opinion poll. For an area-based EFM, the stream of interest might be divided into potential study sites, with the sample selected from a list of the sites. For EFMs, however, the sampling frame probably will be some representation of the stream such as US. Geological Survey (USGS) topographic maps or aerial photographs. Then, for example, a line could be drawn down the center of the channel, and distances could be measured along this line. For transect-based methods, samples can be selected by placing transects at distances along the line corresponding to the random numbers. For area-based methods, the upstream boundary of the study sites might be specified by lines across the channel at the points corresponding the selected random numbers, or, for numerical habitat models, by the first locations upstream from the points that provide reasonable boundary conditions for the hydraulic model. Division of the stream into potential study sites could also be done before the sampling, with sites being selected if the

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**Box 2. Steps in developing the sampling plan for an EFM.**

1. Clearly define the purpose of the flow assessment.
2. Determine how accurate the estimates resulting from the study must be, in order to satisfy the purpose of the study.
3. Determine the actual sampling universe for the EFM.
4. Develop the conceptual plan for the sampling, including the sample sizes and strata to be used.
5. Estimate the accuracy/utility function for the EFM.
6. Tentatively assess whether the proposed method can satisfy the purpose of the study.
7. Develop the details of the sampling plan, and conduct the study.
8. Test whether the results meet the accuracy criterion identified in Step 2, and if not, collect more samples.
Sampling designs for PHABSIM and other environmental flow assessment methods

The basic requirement for probability (random) samples is that all elements in the sampling universe—for example all possible transect locations on the study stream in 1-D PHABSIM studies—have knowable, non-zero probability of being selected for the sample, so that the probability of the actual sample can be calculated. Much effort has gone into developing sampling designs that meet this requirement but also provide for economy of effort and spatial balance. Designs may also provide for variation in the probability that potential elements of the sample will be included in the selected sample, i.e., variation in the sampling intensity, so that more effort can go into areas thought to be important. Probability sampling does not require that knowledge or information about the study stream be ignored, but rather that it be incorporated into the study and sampling design, or into the estimator of the index of habitat used by the EFM, and not into choosing the actual sample.

The objective of the sampling design for a PHABSIM study should be to produce an estimate of the unknown “true” WUA curve for stream in question that is as accurate as possible, given the resources at hand and practical complications such as lack of access to parts of the stream, and to allow the accuracy of the estimate to be assessed. Probability sampling avoids sampling bias, but sampling bias cannot be eliminated if parts of the stream are unavailable for sampling, as is often the case. Precision is determined partly by the variation in the thing being sampled, which the investigator cannot control, but also by the sample size and the sampling design.

Economy of effort

Stratified and multi-stage sampling are common approaches to reducing the effort and cost of the sampling required to achieve a given level of accuracy. The basic idea of stratified sampling is that the sampling will be more efficient if information about the stream can be used to divide it into strata, such that sites within the strata generally are more like other sites within the same strata than sites within other strata. Using habitat types as strata is an obvious possibility, although this is not always effective (Williams et al. 2004); whether to use habitat types for strata, or the particular set of habitat types to be used, should depend on the morphology of the stream under study.

Stratification also allows for more intensive sampling in areas thought to be important. When investigators want the sample to include particular habitats, such as the shallow riffles that might cause passage problems, such habitats could be made a separate stratum. It may be preferable, however, to make the assessment of passage a separate part of the overall study. Transects at hydraulic controls that are required by step-backwater hydraulic models could similarly be put in a separate stratum, so that they are not given too much weight in the habitat modeling, or simply be left out of the habitat modeling.

With 1-D modeling, it will often be possible to model more transects on a given budget if the transects are clustered in space, so that the time spent getting people and equipment to the transects is reduced. For example, transects can be clustered within habitat types, which can be clustered within sites. This is multi-stage sampling. However, when estimating the variance of the resulting habitat-index estimates, the variance among the study sites and among the habitat types must be added to the variance among the transects within the habitat types. Thus, developing an interval estimate of the habitat index requires that there be replicate study sites containing replicate habitat types with replicate transects.

Some sort of multi-stage, stratified sampling design is common in PHABSIM studies, even if probability sampling is not. Examples are described below. Particularly if the stream is long, it is often divided into segments based mainly on discharge, especially junctions with major tributaries, and possibly also on slope, geology, etc. (Bovee et al. 1998). Study sites are then distributed among the segments (e.g., Hardy et al. 2006). This is a form of spatial stratification. Typically, sampling for 1-D PHABSIM is stratified by “mesohabitat types” such as pools, riffles, runs, etc. Bovee et al. (1998) also suggest that “representative reaches” can be selected within the segments. Transects are then placed within the represent-
tative reaches or the habitat types. Provided that they are implemented within a probabilistic sampling design, these approaches may be appropriate and effective.

Spatial balance

A common concern with simple random sampling, especially for natural resources, is that the sample may be clustered, so that parts of the area to be sampled are represented more heavily than other parts. Natural resources typically exhibit spatial patterns, and if these differ from the patterns in the sampling, the sampling will be inefficient at best and perhaps misleading. Increasing the sample size will tend to remedy this, but using a spatially balanced sampling design is more effective, and some investigators in various fields have favored using a systematic sample with a randomly selected starting point for this reason (e.g., Mier and Picquelle 2008). In a systematic sample with 1-D PHABSIM, transects would be located at a fixed intervals from a randomly chosen point. One practical drawback with systematic samples for environmental flow studies results from periodic variation in the sampling universe. For example, pool-riffle sequences in alluvial streams may have a period of about 7 bankfull channel widths, in which case transects located every 7 channel widths would likely give misleading results, as would transects located every 3.5 or 14 channel widths, etc. Also, estimating confidence intervals from systematic samples raises complications. Statisticians treat systematic samples as single samples (Thompson 2002), so for 100 transects divided into 10 systematic samples each with a random start, n = 10. Although standard methods for calculating confidence intervals are often used with single systematic samples (Manly 2002), this will tend to overestimate the width of the intervals if adjacent transects tend to be similar (Thompson 2002).

Spatial stratification avoids the problems associated with picking samples at a fixed interval. The stream could be divided into intervals, and one or more samples could be drawn randomly from each. But suppose, however, that after the sampling was completed and confidence intervals were calculated around the resulting WUA curves, the confidence intervals were wider than what was thought necessary to meet the objectives of the study. Increasing the sample size to increase the precision of the WUA estimates would be awkward. The same problem can occur with systematic samples.

An alternative for achieving spatial balance that avoids such problems is available. Called GRTS, for the "generalized random tessellation stratified" design, this is a flexible probabilistic sampling approach that gives good spatial balance (Stevens and Olsen 2004) and is increasingly used in monitoring programs (Stevens et al. 2007). The details of GRTS are complex, but essentially it can be regarded as an extension of spatial stratification which retains efficiency in the face of the practical complications, such as access problems, that field work on streams often entails. A Windows-based program for selecting GRTS samples, S-Draw, is available at www.west-inc.com, and a GRTS library for the R statistical program is available from the EPA at www.epa.gov/nheerl/arm/analysispages/software.htm.

With multi-stage sampling, spatial balance may be an issue at each stage. For example, if primary sites are stratified by habitat types such as pools and riffles, it would seem desirable that the primary sites be well distributed across the sampling universe, and that the pool transects have a roughly even distribution over the length of the pools.

There is obvious tension between achieving spatial balance and increasing efficiency of effort by clustering samples. There is no general resolution for this problem, but information about the likely spatial pattern of habitat value in the stream could be used to develop a sampling design that strikes a reasonable balance between the two. A related question with 2-D studies concerns the trade-off between more study sites and larger sites. The best balance may depend on the EFM used. With a demonstration flow assessment method, there would probably be less cost associated with having more but smaller study sites than would be the case with numerical habitat models involving hydraulic models. Practical experience is probably needed for useful guidance on the trade-offs involved, but simulations may also be useful.

Case studies

Four recent case studies illustrate the main points made above. Two were conducted in the context of major controversies, one of which has been the subject of two National Research Council (NRC) reports, and two are more "run-of-the-mill" studies conducted by scientists from the U.S. Geological Survey. These studies involved more than just applications of PHABSIM, but my review deals only with the sampling aspect of that component of the study.

Salmon River Basin: U.S. Geological Survey scientists used 1-D PHABSIM "to identify streamflow needs from July to September to provide fish passage and support various life stages of bull trout, Chinook salmon and steelhead trout" (Salvelinus confluentus, Oncorhynchus tsawwyscha, O. mykiss) in selected streams in the upper Salmon River Basin in Idaho, with 51 transects in 8 study sites on 6 streams (Maret et al. 2006). That is, the study aimed to elucidate the relationships between flow and both habitat and passage. The study sites were selected deliberately, based partly on access, and "one to two transects were selected to represent each major mesohabitat in the reach," apparently with care to place one or more transects in shallow riffles that might cause passage problems at low flow.

Rather than support instream flow recommendations for particular streams, the study results are presented more as preliminary information that might guide further work, as suggested by language at p. 12: "Once an adequate number of sites have been characterized using PHABSIM, it may be feasible to develop habitat/discharge relations for streams with similar basin characteristics in specific geographic locations." Results were presented site by site, with no attempt in this report to apply the results beyond the sites. Accordingly, the only sampling issues immediately raised in
this study involve how well the transects represent the sites, discussed below. However, the larger project suggested by
the language cited above would require a proper sampling
design and probability sampling for the “adequate number of
sites” in order to allow for interval estimates.

Maret et al. (2006) stratified their sites by mesohabitat
types, but did not describe the types used or how they were
defined. The variance in estimates of WUA for the sites
then depends on the variance within and among the meso-
habitat types. With only two transects per type, however,
the variance within the mesohabitat types can be estimated
only poorly, and with one transect it cannot be estimated
at all, so the stratification would not be effective even if
the transects had not been deliberately selected. More
useful results probably could have been obtained with the same
number of transects by using a spatially balanced probabil-
ity sampling design without stratification, or by collecting
data for and modeling more transects within the mesohabi-
tat types, again with a probability design. If collecting the
data and modeling the transects is a small part of the overall
work, as seems likely, then the latter alternative will likely be
preferable. Similarly, probably little extra effort would have
been involved in collecting data for hydraulic modeling on
a few deliberately selected transects that could address pas-
sage separately from habitat. Trying to address both flow and
habitat within the same sampling design will tend to bias
one or both assessments.

North Fork Shenandoah River: U.S. Geological Survey
scientists applied RHABSIM, a variant of PHABSIM, to
tree segments of the North Fork Shenandoah River dur-
ing the low flow season (Kristolic et al. 2006). The stated
objectives of the study were “to enhance understanding of
summer low-flow conditions in the North Fork Shenandoah
River, relate water availability to physical habitat needs of
fish, and develop a relation for the availability of suitable
fish habitat and instream flows.” The segments (the sam-
ping universes) were defined in terms of physical charac-
teristics of the basin and stream gage location, so that there
was a stream gage near the lower end of each site. Kristolic
et al. (2006) mapped the river into 9 habitat types, and deliber-
ately placed 35 transects in 6 study sites 45 to 610 m in
length. The 80.6 km lower segment included 21 transects in
4 sites, the 28.3 km middle segment included 5 transects in 1
site, and the 63.2 km upper segment included 9 transects in
1 site. Kristolic et al. (2006) placed transects in “sections of
the river where the mesohabitat was homogenous across the
channel.” They chose accessible sites that included relevant
habitat types, and developed WUA curves for each segment
from the transect curves for each habitat type and the pro-
portion of the segment occupied by the habitat type.

Like most applications of PHABMSIM, the Kristolic et
al. (2006) study set out to characterize flow/habitat rela-
tions for lengthy reaches of a river, not just sites along it. As
such, the objective of the study was more demanding than
the objective of Maret et al. (2006), and required a more
careful sampling design. Unfortunately, the sampling design
fell short. The location of the study sites was spatially unbal-
anced, apparently because the study was expanded mid-
course: “The original scope of the project focused on the
Seven Bends area..., therefore, five of the six reaches are
in the northern end of the basin, in the middle and lower
sections of the river. As the study progressed, the Plains
Mill reach... was added to incorporate the upper section...”
The actual sampling universe was limited to accessible parts
of the river where the mesohabitat homogenous across the
channel, and so was biased in the statistical sense. All but
one of the sites included habitat types represented by only
one transect, so the variance of the transect data within the
actual sampling universe could not have been estimated,
even if the transects had been placed randomly.

developed flow recommendations for the “usual and accus-
tomed” fishing places of the Nez Perce Tribe in Idaho, for
a large number of streams in a ~65,000 km² project area.
The recommendations were used in stream adjudication,
a legal process to quantify water rights in the Snake River
Basin. Sampling was necessary not just to develop relations
between flow and habitat in particular streams, but also to
select streams for study, since it was impractical to study all
the streams that would be affected by the adjudication.

For developing the sampling frame for streams, the
project area was divided into 1,145 subbasins stratified by
the Strahler order of the associated stream segment, using
1:100,000 scale maps. These subbasins were the sampling
universe. Groups of similar subbasins were defined based on
14 physical characteristics, using a cluster analysis follow-
ing a principal components analysis. Thirty-four groups of
subbasins were defined, following some ad-hoc adjustments
of the cluster analysis results to deal with outliers and small
clusters. At least three stream segments in each group were
randomly selected for PHABSIM analysis, and PHABSIM
analyses were also conducted on four other streams identi-
fied as important by the Nez Perce Tribe.

On each stream segment, study sites were selected ran-
domly, based on distance along the stream from the down-
stream boundary of the subbasin (the site sampling frame),
although in some cases parts of the stream were excluded
from sampling because access was too difficult. The 208
sites were approximately 25 channel widths long. Sites were
stratified by six habitat types: pool, run, riffle, cascade, sim-
ple island, and complex island. Three transects were then
placed randomly in one habitat unit of each habitat type
that made up more than 10% of the site, although in some
cases transects were also placed randomly in habitats that
were judged to be important, even if they made up less than
10% of the site. In addition, for pool habitats, a transect was
placed at the hydraulic control, as required by the hydraulic
model used.

Flow recommendations were developed separately for
each of the 34 groups of subbasins, so the study sampled
stream segments within the groups, study sites within the
stream segments, habitat types within the stream segments,
and transects within the habitat types. With some minor
exceptions, the sampling was random, so bias in the recom-
mendations is minor. However, the recommendations are
point estimates, and because only one site was selected per
stream segment, interval estimates cannot be calculated—
there is no way to estimate the within-segment variance.
Interval estimates for the relation between flow and habitat could have been developed for the sites, but they were not. However, the general approach used here would also be suitable for the Maret et al. (2006) study discussed above.

Klamath River: “Water is for fighting over,” and nowhere more so than the Klamath River basin in Oregon and California, the site of well publicized conflict between agricultural, hydropower, and fisheries interests. In a study for the Department of the Interior, Hardy et al. (2006) used several methods, including 2-D PHABSIM, to develop recommendations for “instream flows on a monthly basis for specific reaches of the main stem Klamath River below Iron Gate Dam by different water year types,” to “provide for the long-term protection, enhancement, and recovery of the aquatic resources” of the river, especially anadromous fishes. Chapter 5 of NRC (2008) reviews the complex approach taken to combine PHABSIM results for several species and life stages with each other and with other considerations, but I focus on the sampling for the PHABSIM modeling.

Hardy et al. (2006) divided the 310 km of Klamath River between Iron Gate Dam and the estuary into five segments of unequal length, based on tributary junctions. Eight study sites were deliberately selected, with one site in the most upstream and downstream segments, and two sites in the remaining segments. The hydraulic model was applied to each site, but results were unsatisfactory in the most downstream site. Results from modeling the seven remaining sites, which totaled 8.4 km in length, were extended to the segments using a mapping of the entire river into five habitat types: pool, run, low slope, moderate slope, and steep slope; thus, if a given habitat type occupied 25% of the study site but only 20% of the segment, the model results for that habitat type would be weighted by a factor of 0.8.

For reasons already discussed, interval estimates could not have been developed for two of the segments with this study design, even if the study sites had been randomly chosen, and the estimates would have been poor for the other three. Only about 3% of the sampling universe was sampled in this study, so a finite population correction would have little effect on the estimates of variance.

Of the recent PHABSIM studies described above, only the R2 Resources Consultants study used random sampling to select study sites or transect locations. Even this study fell short of what would be needed to calculate confidence intervals for the WUA curves that were developed. The other studies selected sampling sites deliberately, apparently based on the judgment of the investigators and on access. Besides the bias inherent in the deliberate selection of samples, the sample sizes in the studies reviewed seem small, given the evident variability of rivers and simulation studies of the relationship between transect numbers and the width of confidence intervals (Williams 1996, 2010), although the sample sizes are ordinary or large for PHABSIM studies (Payne et al. 2004). Given the likely magnitude of the sampling error in PHABSIM studies and other sample based EFMs, careful attention to estimating the error is needed to meet ordinary norms for scientific practice.

Although I have criticized particular studies, my criticisms are aimed not at the authors, but at the standard of statistical practice in environmental flow assessment, which the studies reflect. Hardy et al. (2006) did not select their study sites by themselves, but rather, in consultation with an inter-agency group. I chose USGS studies for this article partly because the USGS has an internal review process, which presumably approved them, and both the Salmon River Basin and Shenandoah River studies involved inter-agency collaborations.

Why deliberate selection doesn’t work

To understand the problems with deliberate selection of transect locations or study sites, consider how one might try to select a “representative” sample of transects that would generate something close to the “true” WUA curve for the reach of interest. Somehow, the investigator would have to inspect the entire reach, make judgments about how the conditions in the river that determine WUA would change with discharge along the entire reach, and then select sites
that would, in the aggregate, reasonably represent the way the conditions that determine WUA change with discharge. This is a tall order, and, if the investigator could fill it, what would be the need for the PHABSIM study?

I should note that a recent National Research Council study reviewed Hardy et al. (2006), and with minor caveats approved the deliberate selection of study sites in that study. However, the committee that wrote the report included no statisticians (although it did include one of the developers of PHABSIM), and cited no statistical authorities to support its approval of deliberately selected sampling sites. The report (NRC 2008:193) noted that “...the representativeness of the study sites was determined by inter-agency group agreement and was not statistically assessed,” but the report also implied that “basic channel properties” might be used to assess whether the Klamath River samples sites used in Hardy et al. (2006) were reasonably representative of the river. How might this work? Stream channel width and slope are basic channel properties. Suppose that aerial photographs taken over a range of discharge were available, so that the width (W), change in width with discharge (ΔW/ΔQ), and slope (S) could be determined photogrammetrically for the 310 km whole reach. Then, following the suggestion in NRC (2008), one might determine whether the means of W, ΔW/ΔQ, and S were approximately the same for sites and for the river. If so, one might argue that the sites were reasonably representative.

The idea that information about the whole could be used for purposive selection of a representative sample was advocated by some statisticians early in the twentieth century, but was abandoned following a critical review in a seminal paper by Neyman (1934) that laid the basis for modern survey sampling. This study addressed the very practical problem of getting results quickly from census data, at a time when compiling and reducing the data took years. Some statisticians supposed that information known for all the census districts might be used to select representative districts, for which the complete census data could be compiled and reduced to give preliminary results, upon which public policy could be based until the full results were in. Others advocated selecting random samples for the same purpose, and this was a situation in which, over time, the two approaches could be tested. Neyman (1934) showed that stratified random samples gave reasonably accurate estimates, whereas the deliberately selected samples did not. More fundamentally, Neyman (1934) rigorously considered what it means for a sample to be representative, and concluded that the most that can be done is to define a “representative method of sampling and a consistent method of estimation.” Essentially, these are methods that allow for calculating interval estimates. Much subsequent experience has confirmed Neyman’s argument (Converse 1987). There are three reasons for random sampling: to allow estimates of variance, so that the quality of the estimate can be assessed; to get more accurate estimates (unless the sample is very small); and to avoid bias, either deliberate or unconscious (Jesson 1978). Information about the stream should not be ignored, but it should be used in developing the sampling plan, not in choosing the sample itself.

Conclusions

To be scientifically credible, EFMs based on samples should incorporate probability sampling, and report interval estimates for whatever index of habitat the method produces. The sampling design should provide for a balance between sampling efficiency and spatial balance. The GRTS design, which is increasingly used in water quality monitoring, seems well suited for EFMs as well. All streams are unique, so knowledge of the stream and of the assessment method to be used are critical for developing a good sampling design, and results will be most satisfactory if a statistician familiar with sampling is involved in planning the study.

Acknowledgments

This work was completed with funding by the Public Interest Energy Research of the California Energy Commission through the Instream Flow Assessment Program of the Center for Aquatic Biology and Aquaculture of the University of California, Davis. Suggestions by Peter Moyle, Joe Kiernan, several reviewers, and especially Ken Newman, improved the text.

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The AFS Young Professional Mentoring Program: Our Experience as the First Cohort of Mentees

The American Fisheries Society is interested in the training and retention of young leaders for the Society. One strategy for leadership training is to encourage young professionals to observe the governance processes of the Society, particularly the work of the Governing Board at Annual Meetings and the year-long activities of the Society’s Management Committee. To formulate this strategy, the Governing Board established a mentoring program for young professionals beginning in 2009. The mentoring program involves the selection of motivated young professionals based on nominations from AFS Units, particularly Divisions and Sections. Travel expenses to the Annual Meeting are subsidized by entities within AFS to enable nominees to attend the annual retreat and meeting of the Governing Board at Annual Meetings and the incoming Governing Board meeting. Mentees are paired with members of the Governing Board whom they “shadow” during the Annual Meeting. Mentors introduce mentees to Governing Board members and AFS staff, explain AFS procedures, and help them feel welcomed. Additionally, mentees are encouraged to participate in monthly calls of the AFS Management Committee for the year following the Annual Meeting. It is hoped that this overall experience will motivate young professionals to become involved as AFS leaders at all levels of the Society, but particularly the activities of the parent Society.

In 2009, four mentees were identified as the initial cohort: Felipe Amezcua, a faculty member at the Institute of Marine Sciences and Limnology at the Universidad Nacional Autónoma de México; Tom Lang, a fisheries program specialist with the Kansas Department of Wildlife and Parks; Quinton Phelps, a Ph.D. student and graduate research assistant at Southern Illinois University, Carbondale; and Jeremy Tiemann, a field biologist with the Illinois Natural History Survey. As the first cohort involved in the mentoring program, we have reflected on our experiences and share some thoughts.

Being involved in this program has been very valuable to us. It has removed the mystery surrounding the activities of the Governing Board. We witnessed the formal business procedures and became aware of protocols used by the Governing Board. For instance, we learned about the occurrence of an “in camera” session, at which only Governing Board members are present to discuss AFS staff performance, and the importance of a strong constitutional consultant to assure that Robert’s Rules of Order are maintained and the AFS Constitution is observed. Sitting in on the meetings and monthly calls allowed us to gain deeper understanding of many societal issues. The institutional knowledge we acquired should prove valuable as AFS leaders retire or move on to other endeavors and we are called upon to serve AFS. Having been there, we now feel more comfortable and confident in pursuing more parent Society leadership roles. Furthermore, we believe this experience will enable us to be more effective in future leadership roles in AFS. The Unit reports at the Governing Board meeting and the monthly Management Committee calls further reiterated how amazing

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Tom Lang, Jeremy Tiemann, Felipe Amezcua, and Quinton Phelps

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SPECIAL ESSAY SERIES:
FISHERIES EDUCATION IN THE 21ST CENTURY

EDITOR’S NOTE: This series is based upon presentations made at the “Fisheries Education in the Twenty-first Century” symposium held at the AFS Annual Meeting in Nashville in 2009. Essays appearing in the series have been reviewed internally by members of the AFS Education Section.

Needs and Proficiencies of Fisheries Hires by State Agencies

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ABSTRACT: The Fisheries Administration Section of the American Fisheries Society surveyed state inland fisheries administrators to assess the current and future importance of 54 competencies (college courses) for entry-level fisheries biologists and to determine how proficient recent hires have been in applying knowledge of these competencies. Thirty-five responses were received, with competency importance levels differing greatly for management/research biologists compared to hatchery biologists. Many of those competencies considered not very important for entry-level hires may eventually be very important to employees who advance up the administrative ladder.

Necesidades y competencia de científicos pesqueros contratados por agencias estatales

RESUMEN: la Sección de Administración de Pesquerías de la Sociedad Americana de Pesquerías realizó un sondeo dirigido a los administradores de pesquerías de aguas continentales con el fin de evaluar la importancia actual y futura de 54 competencias (cursos de nivel superior) para biólogos pesqueros recién egresados y para determinar cuan competentes han sido las últimas contrataciones en cuanto a la aplicación del conocimiento adquirido en dichos cursos. Se recibieron 35 respuestas, en las cuales los niveles de importancia acerca del grado de competencia difirieron significativamente entre los biólogos enfocados a manejo e investigación y los biólogos dedicados al cultivo. En muchas de estas competencias, consideradas de poca importancia para las contrataciones de recién egresados, pueden eventualmente resultar muy importantes para los empleados que aspiran a ascender en la escalera administrativa.

In preparation for the Education Section's symposium, “Fisheries Education in the 21st Century: Accommodating Change,” held at the 2009 American Fisheries Society meeting in Nashville, the Fisheries Administration Section developed a survey to determine the educational needs of entry-level fisheries hires by state fish and wildlife agencies. A survey previously conducted for The Wildlife Society by Steve McMullin served as a template and was modified to assess fisheries needs.

Methods

According to Gabelhouse (2005), fisheries biologists in 41 state fish and wildlife agencies performed about two dozen different functions in 2001. However, sport fisheries management, fish production and distribution, and research accounted for an average of nearly 75% of all employees working in those agencies. Considering this and the fact that many other functions performed by fisheries biologists are not entry-level responsibilities, the survey was limited to assessing the educational needs of only inland fisheries management, hatchery, and research biologists. The survey was administered by Fairfield Research, Inc. of Lincoln, Nebraska, and sent electronically to state inland fisheries administrators. It asked administrators the following 3 questions about 54 competencies (college courses):

1. For entry-level fisheries management, hatchery, and research biologist hires in your agency, how important to success in the position is knowledge of each of the following?
   1 = Not at all important;
   2 = Slightly important;
   3 = Moderately important;
2. How proficient are recent entry-level fisheries management, hatchery, and research biologist hires in your agency at applying knowledge of each of the following?

1 = Not at all proficient; 2 = Slightly proficient; 3 = Moderately proficient; 4 = Very proficient; and 5 = Extremely proficient

3. Ten years from now, do you think the following will be less (score of 1), the same (score of 2), or more important (score of 3) than they currently are to the success of entry-level fisheries management, hatchery, and research biologist hires in your agency?

In addition, administrators were asked to provide other areas of competency not listed in the survey that they considered to be important to the success of entry-level fisheries management, hatchery, and research biologist hires in their agency.

Survey results

After the initial request and two reminders, 35 responses were received. Of those, 21 (60%) respondents indicated their agencies employed management biologists, 18 (51%) said they had research biologists, 5 (14%) had management-research combination biologists, 26 (74%) had hatchery biologists, and 9 (26%) had biologists who performed all three functions. Three states reported they did no in-house research.

Results for biologists who performed management or research functions (management, management-research, research, or management-research-hatchery biologists) were similar, but differed substantially from results provided for hatchery biologists. Average importance scores for 54 competencies, as well as competencies of recent hires that were deemed not very proficient (average scores of < 1.5) and competencies predicted to be more important in 10 years than they are now (average scores of > 2.5), are reported in Table 1. Competencies are arranged in descending order of importance scores for entry-level biologists with management or research responsibilities, and are compared to scores provided for hatchery biologists. The top 21 competencies for management/research biologists were all

<table>
<thead>
<tr>
<th>Competency</th>
<th>Average scores for fisheries management/research biologists</th>
<th>Average scores for fish hatchery biologists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisheries management</td>
<td>4.86</td>
<td>4.04</td>
</tr>
<tr>
<td>Fisheries field techniques</td>
<td>4.72</td>
<td>3.38</td>
</tr>
<tr>
<td>Technical writing</td>
<td>4.64</td>
<td>3.79</td>
</tr>
<tr>
<td>Oral communication/speech</td>
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</tr>
<tr>
<td>Ichthyology</td>
<td>4.42</td>
<td>4.21</td>
</tr>
<tr>
<td>Basic statistics</td>
<td>4.42</td>
<td>3.33</td>
</tr>
<tr>
<td>Population and community ecology</td>
<td>4.41</td>
<td>2.83</td>
</tr>
<tr>
<td>Population dynamics</td>
<td>4.33</td>
<td>2.67</td>
</tr>
<tr>
<td>Research methods</td>
<td>4.30</td>
<td>3.00</td>
</tr>
<tr>
<td>Experimental/survey design</td>
<td>4.29</td>
<td>2.88</td>
</tr>
<tr>
<td>Basic ecology</td>
<td>4.19</td>
<td>3.21</td>
</tr>
<tr>
<td>Limnology</td>
<td>4.18</td>
<td>3.88</td>
</tr>
<tr>
<td>Adaptive management</td>
<td>3.84</td>
<td>3.08</td>
</tr>
<tr>
<td>Geographic information systems</td>
<td>3.82</td>
<td>2.26</td>
</tr>
<tr>
<td>Mathematics/calculus</td>
<td>3.78</td>
<td>3.25</td>
</tr>
<tr>
<td>Multivariate statistics</td>
<td>3.77</td>
<td>2.58</td>
</tr>
<tr>
<td>Natural resource policy</td>
<td>3.73</td>
<td>3.04</td>
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<tr>
<td>Integrated resource management</td>
<td>3.73</td>
<td>2.92</td>
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<tr>
<td>Conservation biology</td>
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<td>2.75</td>
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<td>Human dimensions</td>
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<td>2.88</td>
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<tr>
<td>Popular writing</td>
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<td>2.96</td>
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<tr>
<td>Fish health</td>
<td>3.44</td>
<td>4.71</td>
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<tr>
<td>Invertebrate zoology</td>
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<td>3.21</td>
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<tr>
<td>Basic chemistry</td>
<td>3.37</td>
<td>3.50</td>
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<tr>
<td>Aquatic plants</td>
<td>3.34</td>
<td>3.08</td>
</tr>
<tr>
<td>Water quality (civil engineering)</td>
<td>3.34</td>
<td>3.78</td>
</tr>
<tr>
<td>Vertebrate zoology</td>
<td>3.33</td>
<td>3.21</td>
</tr>
<tr>
<td>Genetics</td>
<td>3.28</td>
<td>3.57</td>
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<tr>
<td>Landscape ecology</td>
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<tr>
<td>Entomology</td>
<td>3.20</td>
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<tr>
<td>Fish culture</td>
<td>3.15</td>
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<td>Organic chemistry</td>
<td>3.03</td>
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<tr>
<td>Biochemistry</td>
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<tr>
<td>Animal physiology</td>
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<td>2.92</td>
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<tr>
<td>Computer programming</td>
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<td>2.52</td>
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<tr>
<td>Inorganic chemistry</td>
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<td>2.88</td>
</tr>
<tr>
<td>Animal behavior</td>
<td>2.86</td>
<td>2.83</td>
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<tr>
<td>Fish nutrition</td>
<td>2.84</td>
<td>4.63</td>
</tr>
<tr>
<td>Geology</td>
<td>2.83</td>
<td>2.00</td>
</tr>
<tr>
<td>Political science</td>
<td>2.71</td>
<td>2.08</td>
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<tr>
<td>Physics</td>
<td>2.62</td>
<td>2.46</td>
</tr>
<tr>
<td>Wildlife management</td>
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<td>2.04</td>
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<tr>
<td>Economics</td>
<td>2.44</td>
<td>2.35</td>
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<tr>
<td>Sociology</td>
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<td>1.96</td>
</tr>
<tr>
<td>Botany</td>
<td>2.42</td>
<td>2.13</td>
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<tr>
<td>Marketing</td>
<td>2.40</td>
<td>2.22</td>
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<tr>
<td>Herpetology</td>
<td>2.36</td>
<td>2.00</td>
</tr>
<tr>
<td>Psychology</td>
<td>2.19</td>
<td>2.04</td>
</tr>
<tr>
<td>Website development and programming</td>
<td>2.14</td>
<td>1.78</td>
</tr>
<tr>
<td>Mammalogy</td>
<td>2.14</td>
<td>1.88</td>
</tr>
<tr>
<td>Ornithology</td>
<td>1.98</td>
<td>1.92</td>
</tr>
<tr>
<td>History</td>
<td>1.90</td>
<td>1.78</td>
</tr>
<tr>
<td>Foreign languages</td>
<td>1.89</td>
<td>1.57</td>
</tr>
<tr>
<td>Humanities (e.g., art, music, theater)</td>
<td>1.72</td>
<td>1.70</td>
</tr>
</tbody>
</table>

* Indicates the competency is expected to be more important in 10 years than it currently is.

b Indicates recent hires have not been proficient at applying knowledge of this competency.
considered less important for hatchery biologists.

Of those competencies considered very important (with average scores of > 4.0), oral communication/speech was predicted to be more important in 10 years for both management/research and hatchery biologists. Population/community ecology and population dynamics were also expected to be more important in the future for management/research biologists. Fisheries administrators thought that recent hatchery biologist hires have not been proficient in technical writing.

Of the competencies with average scores of 3.5–3.9 (on the high end of moderately important), only mathematics/calculus and multivariate statistics were not predicted to be more important in 10 years for management/research biologists. Recent management/research biologist hires were not considered proficient in human dimensions; both management/research and hatchery biologist hires were said to have not been proficient in integrated resource management; and recent hatchery biologist hires were not thought to be proficient in adaptive management and natural resource policy.

Many of the competencies considered on the low end of moderately important for management/research biologists, including fish health, basic chemistry, water quality, genetics, and fish culture (with average scores of 3.0–3.4), were considered more important for hatchery biologists. Genetics was predicted to be more important in 10 years than it currently is for both management/research and hatchery biologists, popular writing and landscape design were predicted to be more important in a decade for management/research biologists, and fish health was forecast to be more important for hatchery biologists 10 years from now. Recent management/research biologist hires were not thought to be proficient in fish health.

All but one of the competencies with average scores of 2.5–2.9 (considered less than moderately important) for management/research biologists were also thought to be less than moderately important for hatchery biologists. However, fish health was deemed very important for hatchery biologists today and even more important in the future. Even though political science was considered less than moderately important for management/research biologists, recent hires were not considered proficient in this competency.

None of the competencies considered not very important now (scores of 2.0–2.4) were expected to be more important in 10 years. Still, recent management/research hires were not thought to be proficient in marketing.

There were four competencies with average scores of < 2.0, indicating they were considered to be less than not very important to not at all important. Even though foreign languages were not considered important, recent management/research biologist hires were apparently not proficient at speaking anything but English.

In addition to evaluating the 54 competencies, fisheries administrators also provided 16 additional competencies they thought were important for entry-level hires (Table 2). Of these, only equipment operation and maintenance/technical common sense skills, networking/working in teams/working with stakeholders, and aquatic invasive/nuisance/exotic species were mentioned by multiple fisheries administrators.

### Comparisons with American Fisheries Society professional certification requirements

To be professionally certified by the American Fisheries Society (AFS), individuals who graduated after 1 July 2002 must have had at least 30 credit hours of biological sciences (including 4 fisheries and aquatic science courses), 15 hours of physical sciences, 6 hours of mathematics and statistics, 9 hours of communications, and 6 hours of human dimensions. Competencies that administrators considered at least moderately important (scores of > 3.0) were categorized according to these five subject areas for management/research and hatchery biologists and compared (percentage) to the AFS minimum requirements for professional certification (Figure 1). Based on this comparison, it appears fisheries administrators would like entry-level management/research hires to take a greater percentage of biological sciences courses and a lesser percentage of physical sciences courses than are required for AFS certification; biological courses were even more important for hatchery biologists. There was little (< 5%) difference in the relative importance of mathematics, communications, and human dimensions between AFS minimum requirements for professional certification and fisheries administrator desires for entry-level management/research and hatchery biologist hires.

### Discussion

One of the questions behind the symposium was whether training in conservation biology would be more desired by state agencies and others than an education that concentrated on sport fisheries management. Based on this survey, it doesn’t appear state fish and wildlife agencies want conservation biologists instead of sport fisheries managers. They think knowledge of conservation biology will be more important in 10 years than it is now, but fisheries management, population/community ecology, and population dynamics, while very important now, were predicted to be even more important in the future.

#### Table 2. Additional competencies suggested by state inland fisheries administrators as being important for entry-level fisheries biologists.

<table>
<thead>
<tr>
<th>Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied research</td>
</tr>
<tr>
<td>Aquatic invasive/nuisance/exotic species</td>
</tr>
<tr>
<td>Climate change</td>
</tr>
<tr>
<td>Database development and management</td>
</tr>
<tr>
<td>Environmental permitting and review</td>
</tr>
<tr>
<td>Equipment operation and maintenance/technical common sense skills</td>
</tr>
<tr>
<td>Governmental/financial management</td>
</tr>
<tr>
<td>Lab experience</td>
</tr>
<tr>
<td>Meeting management/consensus building</td>
</tr>
<tr>
<td>Negotiation skills</td>
</tr>
<tr>
<td>Networking/working in teams/working with stakeholders</td>
</tr>
<tr>
<td>Professional ethics</td>
</tr>
<tr>
<td>Public relations</td>
</tr>
<tr>
<td>Stream mechanics</td>
</tr>
<tr>
<td>Time/administration skills</td>
</tr>
<tr>
<td>Watershed hydrology</td>
</tr>
</tbody>
</table>


It was heartening to see that popular writing was predicted to be more important for management/research biologists in 10 years than it is now. It's not enough to publish in just scientific journals. Our upcoming professionals will need to be more creative and better prepared to communicate to our constituents and the citizenry as a whole.

Some competencies not thought to be very important for entry-level hires may eventually become very important, especially to employees who advance up the administrative ladder. Richard O. Anderson defined fishery management as “the manipulation of the physical, chemical, and biotic factors in aquatic environments to achieve the most satisfactory sustained production and yield of desired species of fish in a program that is regulated by sound biological, political, and economic principles and concepts.” Entry-level biologists may be able to concentrate on sound biology, but administrators most certainly have to consider political and economic aspects as well.

Sociology, marketing, and psychology were also competencies not considered very important for entry-level hires (even though recent management/research biologist hires were not thought to be proficient in marketing). Most state fish and wildlife agencies are currently trying to reverse downward trends in angler participation through programs aimed at recruiting, developing, and retaining anglers. Marketing is an important component of many of these programs and should not be left entirely to information and education personnel to develop.


According to Louv (2005), “a 1995 analysis by the College Board showed that students who studied the arts for more than four years scored forty-four points higher on the math portion and fifty-nine points higher on the verbal portion of the SAT. “So, training in the arts can help make you smarter. The arts can also make you more creative—abilities I think many fisheries biologists fail to develop!

It’s not enough to collect data, analyze data, and publish data in scientific journals. Fisheries biologists are often viewed as introverts who enjoy fish more than people. After the field work is done, they tend to “hole up” in their offices with piles of data and avoid contact with the public. As stated above, we need to communicate better and do it creatively! I don’t know if Leonardo da Vinci should necessarily be a role model, because, while he was a polymath (knowledgeable in many areas), he supposedly didn’t have very good people skills. But, it wouldn’t hurt to have more fisheries professionals with polymath or Renaissance tendencies.

Considering the educational background needed initially to land a fisheries management, research, or hatchery biologist job, and the background that might be needed later to become an effective administrator, it is obvious that an advanced degree would be almost a requirement for a fisheries professional who hopes to be promoted through the ranks. Continuing education, provided by agencies and AFS, can also help fill competency gaps not provided through formal education.

**Acknowledgements**

Steve McMullin, John Biagi, Gerry Buynak, Christopher Estes, Ken Kurzawski, Mike Staggs, and Gary Whelan helped develop the survey and Fairfield Research, Inc. formatted it and compiled the results, thanks to Gary Gabelhouse, their CEO. Richard Holland, Mark Pegg, and Kevin Pope reviewed the manuscript.

**References**


**Tennessee Chapter**

*Meets at Fall Creek Falls State Park*

The Tennessee Chapter held its annual meeting 16–17 March 2010 at Fall Creek Falls State Park near Pikeville. Approximately 63 people attended, with numerous students joining the group each day. Eleven presentations (six by students) were given covering topics such as sampling imperiled stream fishes and sturgeon, trout in reservoirs, mussel translocation, salamanders in an impaired tailwater, and hydrokinetic energy technologies. Southern Division Vice President Brian Murphy attended and addressed the Chapter during its business meeting. At the business meeting, Brad Ray was voted in as president elect and joins Jim Habera (president), Jason Henegar (secretary-treasurer) and Hayden Mattingly (past president) as Chapter officers. The Chapter voted to make $500 donations to the 2010 Catfish Symposium, Striped Bass Symposium, and to AFS 2010 in Pittsburgh. It was also agreed that the Chapter will host the 2013 Southern Division spring meeting in Nashville. At the banquet following the business meeting, Drew Russell of Tennessee Technological University received the Best Student Paper Award for his presentation on age and growth of lake trout (*Salvelinus namaycush*) in two Tennessee reservoirs, co-authored by his faculty advisor, Phil Bettoli.  

—Jim Habera

**Montana Chapter**

*Meets in Bozeman*

The 43rd Annual Meeting of the Montana Chapter of the American Fisheries Society was held in Bozeman, 8–12 February 2010. The theme of the conference was “Linkages across Landscapes: The Ecological Role of Fish in Montana.” As usual, the meeting was well attended and the quality of the presentations was outstanding.

A plenary session began with a look at the historic contexts of modern research and management pertaining to fish and human culture. The session then explored the importance of landscape and population diversity for ecosystem services
associated with fishes, examined relationships between fish and benthic communities and aquatic and terrestrial linkages, and concluded by illustrating the importance of cutthroat trout to grizzly bears in Yellowstone, and changes in aquatic species introductions with evolution from MSY to ecosystem-based fisheries management. The general meeting agenda included stimulating papers ranging from amphibians to lake trout suppression, as well as presentations on ecology to restoration.

Preceding the conference were two continuing education workshops organized by Continuing Education Chair Matthew Corsi. The topics of these workshops were “Taxonomy and Identification of Eastern Montana Prairie Fishes” and “Structured Decision Making and Adaptive Management in Fishery Management.”

Craig Barfoot, a biologist with the Confederated Salish-Kootenai Tribes, was elected to serve as president elect of the Montana Chapter. He will assume this role in September.

The opportunity to acknowledge and honor the exemplary work by individuals on behalf of our aquatic resources across Montana is unique and important role of MCAFS, and one we take great satisfaction in. Our outgoing officer, Past President Carter Kruse, was acknowledged for his tireless service to MCAFS. His substantial contributions will be missed. In addition, this year we had many exceptional nominations for our awards, especially Career Achievement and Outstanding Educator. We recognized 14 individuals and one group with the following awards:

- John Syslo (Montana State University) was presented with the “Best Student Presentation Award” for his talk “An Evaluation of Lake Trout Suppression in Yellowstone Lake, Yellowstone National Park.”
- Dan Carty (U.S. Fish and Wildlife Service) was presented with the “Best Professional Presentation Award” for his talk “Efficacy of Terramycin 200 for Fish (Oxytetracycline Dihydrate) for

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the Skeletal Marking of Rainbow Trout *Oncorhynchus mykiss*

- Justin Spinelli (Montana State University) was presented with the Fisheries Information and Technology Section Best Student Poster Award.
- Jason Blakney (University of Montana—undergraduate) and Matthew Corsi (University of Montana—graduate) were awarded the Wally McClure Scholarships.
- Mariah Mayfield received the West Slope Chapter of Trout Unlimited student research fellowship grant for her research on the Upper Clark Fork River.
- Alan Johnstone was presented with a Landowner of the Year award for his contributions to Montana fisheries.
- The Lower Clark Fork Watershed Group was awarded a Group Achievement Award for their outstanding work in the basin.
- Brad Shepard and Mike Enk were presented with Career Achievement Awards for their dedicated service to Montana’s aquatic resources.
- Jeff Everett was awarded the Outstanding Natural Resource Professional award for his work in the Big Hole Valley.
- Dave Hagengruber, Brandon Day, and Nathan Olson received awards for Outstanding Educators for their commitment to fisheries education in Montana.
- Ladd Knotek, Montana Fish, Wildlife and Parks, was presented with the 2009 Outstanding Fisheries Professional Award, the Chapter’s highest honor, for his leadership and dedication to Montana’s aquatic resources.

—Trevor M. Selch
The Hutton Junior Fisheries Biology Program is a summer mentoring program for high school students. The principal goal of the Hutton Program is to stimulate interest in careers in fisheries science and management among groups underrepresented in the profession, including minorities and women. Hutton provides students with a summer-long, hands-on experience in fisheries research with a mentor who is working in some aspect of the field. A $3,000 scholarship and an AFS student membership are provided to each student accepted into the program.

The Class of 2010 includes 24 outstanding students who are currently working with mentors in 16 states (Alabama, Alaska, Arizona, California, Colorado, Connecticut, Massachusetts, Michigan, Missouri, Montana, New Jersey, Oregon, South Dakota, Tennessee, Washington, and Wisconsin). Of the exceptional students chosen for the Hutton Program this summer, nearly half are minorities, and two-thirds are females.

The program is evaluated through the Annual Hutton Alumni Survey. The ultimate success of the program is determined by the number of students that enter the fisheries profession. According to the 2009 survey, 55% of Hutton alumni are studying or considering studying fisheries, biology, or environmental science; 20% have received undergraduate degrees in fisheries or biology and of those students, 59% are pursuing advanced degrees in fisheries or biology.

Ivan Kho works at East Bay Regional Park District, Oakland, California.

Kathryn Winkler
Hutton Program Coordinator Winkler may be contacted at Kwinkler@fisheries.org.

Simone Barley-Greenfield works on dissolved oxygen titrations at the Seattle Aquarium.

2010 Hutton Program Supporters
- NOAA Fisheries Service
- USDA Forest Service
- U.S. Fish and Wildlife Service
- Wisconsin Department of Natural Resources
- Lake Superior State University
- Fisheries and Wildlife Club
- Michigan Chapter AFS
- Minnesota Chapter AFS
- NWFSC/NOAA
- and many AFS members.
<table>
<thead>
<tr>
<th><strong>Hutton Class of 2010</strong></th>
<th><strong>Location</strong></th>
<th><strong>Hutton Mentors and Host Agencies/Organizations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ronald Aparicio</td>
<td>Denver, CO</td>
<td>Scott Gilmore, CO Division of Wildlife</td>
</tr>
<tr>
<td>Simone Barley-Greenfield</td>
<td>Seattle, WA</td>
<td>Janice Mathisen and Angela Smith, Seattle Aquarium</td>
</tr>
<tr>
<td>Aldis Berezowskyj</td>
<td>Madison, CT</td>
<td>Jose Pereira, NOAA Fisheries</td>
</tr>
<tr>
<td>David Bernasconi</td>
<td>Fairhope, AL</td>
<td>Anthony Ford and Ben Ricks, U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Gina Bioni</td>
<td>West Haven, CT</td>
<td>David Nelson and Dylan Redman, NOAA/NMFS/NEFSC</td>
</tr>
<tr>
<td>Lisa Burton</td>
<td>Flagstaff, AZ</td>
<td>Charles Benedict, Matt Rinker, and Scott Rogers, AZ Game and Fish Dept.</td>
</tr>
<tr>
<td>Jare Chriss</td>
<td>Pegram, TN</td>
<td>Kimberly Elkin, TN Wildlife Resources Agency</td>
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<tr>
<td>Emily Churchill</td>
<td>Far Hills, NJ</td>
<td>John Farrell, SUNY-ESF, Thousand Islands Biological Station</td>
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<tr>
<td>Nicole Farnham</td>
<td>Fairbanks, AK</td>
<td>Trent Sutton, University of Alaska Fairbanks</td>
</tr>
<tr>
<td>Reilly Hannigan</td>
<td>Kent, WA</td>
<td>Thomas Good, NOAA</td>
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<td>Sophie Holtzman</td>
<td>Yankton, SD</td>
<td>Thomas Kent, U.S. Fish and Wildlife Service</td>
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<td>Gloria Hayoung Hong</td>
<td>Amherst, MA</td>
<td>Francis Juanes, David Stormer, UMass Amherst</td>
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<tr>
<td>Ivan Kho</td>
<td>Oakland, CA</td>
<td>Leigh Ochikubo Chan, East Bay Regional Park District</td>
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<tr>
<td>Thressa LaHaye</td>
<td>Wellston, MI</td>
<td>Chris Eilers and Archie Martell, Little River Band of Ottawa Indians</td>
</tr>
<tr>
<td>Myya McGregory</td>
<td>Middletown, NJ</td>
<td>Chris Chambers, NOAA</td>
</tr>
<tr>
<td>William Zachary Morris</td>
<td>Nixa, MO</td>
<td>Hope Dodd, National Park Service</td>
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<td>Cheyana Phillipp</td>
<td>Prineville, OR</td>
<td>Michael Harrington, OR Dept. of Fish and Wildlife</td>
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<tr>
<td>Anthony Redden</td>
<td>Prineville, OR</td>
<td>Michael Harrington, OR Dept. of Fish and Wildlife</td>
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<tr>
<td>Amy Springer</td>
<td>LaCrosse, WI</td>
<td>David Vetrano and Jordan Weeks, WI Dept. of Natural Resources</td>
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<tr>
<td>Lac Ta</td>
<td>Seattle, WA</td>
<td>Janice Mathisen and Angela Smith, Seattle Aquarium</td>
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<tr>
<td>Kaitlin Tanner</td>
<td>Missoula, MT</td>
<td>Shane Hendrickson, U.S. Forest Service</td>
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<td>Shana Thang</td>
<td>San Diego, CA</td>
<td>Sherri Charter, Heidi Dewar and Owyn Snodgrass, NOAA</td>
</tr>
<tr>
<td>Megan Wheeler</td>
<td>Baldwin, MI</td>
<td>Jim Cline, U.S. Forest Service</td>
</tr>
<tr>
<td>Ruel Wiles</td>
<td>Denver, CO</td>
<td>Scott Gilmore, CO Division of Wildlife</td>
</tr>
</tbody>
</table>

Thressa LaHaye surveys with Dan Mays at Little River Band of Ottawa Indians, Wellston, Michigan.

Lisa Burton (right) with Pilar and Kristy at West Fork Oak Creek, Arizona Game and Fish Department, Flagstaff.
column and you can find the detailed plan on the AFS website, but here are some of the major efforts that are planned.

In the realm of fisheries leadership, a primary activity will be our 141st Annual Meeting 4–8 September 2011 in Seattle, Washington, with a program and events that support sound science and networking opportunities. The local arrangements and program committees are well underway in planning what could be the largest AFS meeting ever. Substantial effort will be made to assure that we communicate sound science by assuring that quality scientific papers are published in our journals, moving further toward electronic publications that can reach a worldwide market, improving databases of archival and unpublished literature, and creating online access to new information vetted for scientific quality through the AFS website.

The second goal of the AFS 2010–2014 strategic plan is to facilitate lifelong learning through world-class educational resources at all academic levels and provide training for practicing professionals in all branches of fisheries and aquatic sciences. One activity in regard to the future of higher education is a retreat of the AFS Governing Board in conjunction with the 2010 meeting. This retreat will identify the role of the Society relative to fisheries education and develop strategies to achieve the goal. A second activity will be the organization of a topic-oriented meeting involving the four societies banded together in the Coalition of Natural Resource Societies (i.e., The Wildlife Society, Society for Range Management, Society of American Foresters, and AFS), all of which have members concerned with the training of professionals into the future.

The third goal identified in the strategic plan is to enhance the value of membership in the society. President Don Jackson focused heavily on developing methods for “virtual meeting attendance” by members unable to attend annual Society or Division meetings. This thrust is off the ground and will be developed further during the upcoming year. Additionally, I am asking the Electronic Services Advisory Board to develop recommendations for improving the AFS website so it better meets the needs and interests of our members.

New frontiers in fisheries management and ecology will continue to unfold as the year of my presidency proceeds, and I will do my best in collaboration with our officers, Governing Board, Divisions, Chapters, Sections, executive director, and outstanding staff in Bethesda to lead the way in a changing world. I look forward to serving you.

**NEWS: FISHERIES**

**Continued from page 421**

**WWF trout aquaculture standards**

Draft standards sponsored by the World Wildlife Fund and designed to help minimize the potential negative impact freshwater trout aquaculture may have on the environment and society have been released for the first of two public comment periods. The standards are the product of the Freshwater Trout Aquaculture Dialogue, a 200-person roundtable including trout aquaculture industry leaders, scientists, conservationists, and others from several trout-producing countries.

“We have tried to engage a lot of people in the process and, while we have made some progress, it is very important that we get input from more trout producers,” said dialogue steering committee member David Bassett, a representative of the British Trout Association. “During the public comment periods, we are hoping to receive the advice and guidance we need to improve the first draft of the document so we end up with a meaningful set of standards.”

The first comment period will end on 27 September 2010. The second comment period will begin approximately two months later. The dialogue participants hope to finalize the standards by the end of 2010. For more information, see www.worldwildlife.org/what/globalmarkets/aquaculture/troutdialogue.html.

**New web site provides guidelines for monitoring salmon populations**

A free online knowledge base called the “Salmon Monitoring Advisor” (www.salmonmonitoringadvisor.org) has just been released. It provides advice and guidelines to help users design monitoring programs that are cost-effective; reliably estimate changes in abundance, productivity, and diversity of Pacific salmon populations and their habitats; and facilitate sharing of data across jurisdictions. The web site is designed for people who determine funding levels for monitoring programs, design monitoring programs or analyze their resulting data, implement monitoring programs in the field, or use results of monitoring programs to make decisions. Monitoring programs can be expensive, yet there is no comprehensive and easily accessible source of information on the pros and cons of different monitoring designs for collecting salmon and habitat data. By using the 7-step framework of the “Salmon Monitoring Advisor” web site, decision makers will benefit from higher-quality data to make better-informed decisions, which in turn will increase the chance of maintaining productive salmon populations that produce social and economic benefits. This web site was developed by a team of 14 North American scientists with 275 person-years of experience in monitoring from Alaska through California. The work was funded by a grant from the Gordon and Betty Moore Foundation through the U.S. National Center for Ecological Analysis and Synthesis (NCEAS).

—Randall Peterman
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<tr>
<th>Date Range</th>
<th>Event Description</th>
<th>Location</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep 5-9</td>
<td>Sixth International Symposium on Aquatic Animal Health: Global Strategies for a Changing Environment</td>
<td>Tampa, Florida</td>
<td>Andy Kane, <a href="mailto:Kane@ufl.edu">Kane@ufl.edu</a></td>
</tr>
<tr>
<td>Sep 8-11</td>
<td>Fish Sampling with Active Methods Meeting</td>
<td>Ceske Budejovice, Czech Republic</td>
<td><a href="http://www.fsam2010.wz.cz">www.fsam2010.wz.cz</a></td>
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<tr>
<td>Sep 12-16</td>
<td>American Fisheries Society 140th Annual Meeting</td>
<td>Pittsburgh, Pennsylvania</td>
<td><a href="http://www.fisheries.org/afs10/">www.fisheries.org/afs10/</a></td>
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<tr>
<td>Sep 22-23</td>
<td>Electrofishing Class</td>
<td>Vancouver, Washington</td>
<td><a href="http://www.smith-root.com">www.smith-root.com</a></td>
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<tr>
<td>Sep 20-24</td>
<td>ICES Annual Science Conference 2010</td>
<td>Cite des Congres, Nantes, France</td>
<td><a href="http://www.ices.dk/iceswork/asc/2010/index.asp">www.ices.dk/iceswork/asc/2010/index.asp</a></td>
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<td>Sep 28-30</td>
<td>Wild Trout Symposium</td>
<td>West Yellowstone, Montana</td>
<td><a href="http://www.wildtroutsymposium.com">www.wildtroutsymposium.com</a></td>
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<td>Oct 3-8</td>
<td>Aquatic Resources Education Association Biennial Conference</td>
<td>Omaha, Nebraska</td>
<td><a href="http://www.areanet.org">www.areanet.org</a></td>
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<tr>
<td>Oct 19</td>
<td>Institute of Fisheries Management 41st Annual Conference: Fisheries in Transition from Source to Sea</td>
<td>Portsmouth, United Kingdom</td>
<td><a href="mailto:adrian.saunders@environment-agency.gov.uk">adrian.saunders@environment-agency.gov.uk</a></td>
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<td>Oct 26-28</td>
<td>Sportfishing Summit</td>
<td>Fort Lauderdale, Florida</td>
<td><a href="http://www.asafishing.org/shows_events/summit">www.asafishing.org/shows_events/summit</a></td>
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<td>Nov 7-12</td>
<td>Eastern Marine Biology of Fisheries Research Institute</td>
<td>Taitung, Taiwan</td>
<td><a href="http://www.tfrin.gov.tw">www.tfrin.gov.tw</a></td>
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<td>Nov 11-14</td>
<td>Western Society of Naturalists Annual Meeting</td>
<td>San Diego, California</td>
<td><a href="http://www.wsn-online.org">www.wsn-online.org</a></td>
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<td>Dec 10-13</td>
<td>Fifth Shanghai International Fisheries and Seafood Exposition—The Best Opportunity to Explore Chinese Market</td>
<td>Shanghai, China</td>
<td><a href="http://www.sifse.com">www.sifse.com</a></td>
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<tr>
<td>Dec 12-15</td>
<td>North Central Division, joint with Midwest Fish and Wildlife Conference</td>
<td>Minneapolis, Minnesota</td>
<td><a href="http://www.midwest2010.org">www.midwest2010.org</a></td>
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<tr>
<td>Jan 13-16</td>
<td>Spring AFS Southern Division Meeting</td>
<td>Tampa, Florida</td>
<td><a href="http://www.sdafs.org/meetings/meethome.htm">www.sdafs.org/meetings/meethome.htm</a></td>
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<td>Jan 26-28</td>
<td>Aquaculture Association 41st Annual Trade Show and Conference</td>
<td>Bay City, Texas</td>
<td>Cindy Schmiid, <a href="mailto:tinnyroo@aol.com">tinnyroo@aol.com</a></td>
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<td>Feb 13-18</td>
<td>American Society of Limnology and Oceanography Aquatic Sciences Meeting</td>
<td>San Juan, Puerto Rico</td>
<td><a href="http://aslo.org/meetings/sanjuan2011">http://aslo.org/meetings/sanjuan2011</a></td>
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<tr>
<td>Mar 27-31</td>
<td>103rd Meeting of the National Shellfisheries Association</td>
<td>Baltimore, Maryland</td>
<td><a href="http://shellfish.org/node/78817">http://shellfish.org/node/78817</a></td>
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<td>Mar 14-18</td>
<td>Fifth International Zooplankton Production Symposium: Population Connections, Community Dynamics, and Climate Variability</td>
<td>Pucon, Chile</td>
<td><a href="http://www.pices.int/zooplankton2011.aspx">www.pices.int/zooplankton2011.aspx</a></td>
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<tr>
<td>Apr 9-12</td>
<td>Kodiak Area Marine Science Symposium</td>
<td>Kodiak, Alaska</td>
<td><a href="http://seagrant.uaf.edu/conferences/index.html#coming">http://seagrant.uaf.edu/conferences/index.html#coming</a></td>
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<tr>
<td>May 14-18</td>
<td>Second International Marine Conservation Congress</td>
<td>Victoria, British Columbia, Canada</td>
<td>www2.cedarcrest.edu/imcc/index.html</td>
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Fish biologists and ichthyologists enjoy the arrival of any new “Fishes of…” book. These books are our main tools when a strange fish is found in a seine during a class trip or when unidentified fishes are brought to our offices by local anglers. With the fish in question laid out on a table, we reach for and begin opening our state and regional fish books, often stacking multiple open books on top of each other as we compare species accounts and distributions in our quest to figure out the mystery fish. Admittedly, there is usually a significant amount of redundant information among books, especially when dealing with widespread species. But often the most valuable help for indentifying the fish will come from that one book that has a little bit more information or perhaps includes a more timely reference than the others. Obviously as more “Fishes of…” books are produced and more information is put at our fingertips, we feel better equipped to take on challenging fish identifications.

So I was pleased when I received my copy of Freshwater Fishes of South Carolina. In fact, my first response as I took the book from its box was, “Oooh…a chunky fish book with a nice-looking clupeid on the front. This is going to be good.” In general, I remained pleased with the book after reading the introductory material and the species accounts. As with similar texts, the South Carolina book begins with a history of ichthyology in the state, then moves to six introductory chapters covering habitats, geography, conservation, fish collecting methods, and explanations of the keys and accounts. The second part of the book consists of the species accounts divided into families with a key for each family at the beginning of each chapter. The book ends with a small overview of estuarine fishes that may occur in state fresh waters and a short (three page) glossary of useful terms. While all of this is fairly typical of state fish books, the smaller page size of the South Carolina book (19 X 26 cm) separates it from other books that more closely resemble large cumbersome photo albums. I imagine that the smaller, chunkier book will be easier to handle and more likely taken along when heading out with a class or pursuing research in the field.

Fortunately, a concern and passion for conserving and understanding fishes as whole organisms pervades the South Carolina book, more so than most other state fish books. The introductory material is especially rich with information that encourages both scientists and amateurs to use fishes wisely. I particularly enjoyed the section describing proper seining techniques. As fish biologists we know all of this by heart, but the book provides a clear summary of how it is done for students who have never seined before. In a later section, students are also encouraged to discover needed fish reproductive data because so little is known about many of our southeastern freshwater fishes. This type of essential information can be collected by those with just a basic knowledge of fishes: “A hobbyist can make worthwhile observations.” There is also a section on what to do with live fishes when they are no longer needed which correctly warns not to release even native fishes back into the wild. Instead of preaching to the ichthyological choir, the authors are reaching out to those people (students and fish hobbyists) who can better help us conserve these animals in the future.

Interesting and useful material is also scattered throughout the species accounts. Many pond managers in the Southeast stock gizzard shad (Dorosoma cepedianum) as prey for game fishes. The authors correctly point out, though, that this species grows so quickly that it is only suitable as prey for a short portion of its life. While the much maligned creek chub (Semotilus atromaculatus) can be the bane of trout fishermen because of its large mouth and appetite, the authors put a positive spin on this species, pointing out it is a “spunky fighter.” The species account for the robust redhorse (Moxostoma robustum) relates the story of how this species had been lost to science for 122 years. Starting from the species’ original discovery by Edward Cope to its rediscovery by Bob Jenkins and finally to the establishment of the Robust Redhorse Conservation Committee, the reader is again shown the links between the work of dedicated ichthyologists and the actual conservation efforts carried out by managers, agencies, and non-government organizations.

The species distribution maps and photographs also contribute to the overall usefulness of the book. The
high detail of the point maps allows for easy recognition of specific water bodies and the statewide coverage is extensive. These maps also show the fall line that separates the Coastal Plain from the Piedmont provinces, allowing the reader to better understand which fishes are in which habitats. For the most part, the fish photographs are high quality and accurately represent the life colors of the specimens. Photographs can be particularly useful (more so than line drawings) when comparing the morphology of closely related species, such as the comparison of sturgeon mouths (page 68) and sucker lips (page 185). Some species accounts contain helpful multiple photographs, allowing the reader to either compare males to females or adults to juveniles. The only drawback to this approach is that once I saw it used for the centrarchids and some other groups, I wished it had been used consistently throughout the book for all the species.

*Freshwater Fishes of South Carolina* is a fine addition to my collection of state fish books. In making the book readable for non-ichthyologists, the authors have not compromised the quality and quantity of worthwhile information on South Carolina fishes. My hope is that future fish books will, like this one, do a better job of linking scientific information to a passion for species conservation. Such an approach can inspire people who are not fish biologists and ichthyologists to respect and better protect our native freshwater fishes.

—Martin T. O’Connell
Department of Earth and Environmental Sciences
University of New Orleans
New Orleans, LA 70148

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Community Ecology of Stream Fishes
Concepts, Approaches, and Techniques

Keith B. Gido and Donald A. Jackson, editors

Stream fish community ecology is an exciting field of research that has expanded rapidly over the past two decades. Both conceptual and technological advances have increased our ability to characterize patterns of community structure across multiple scales and evaluate processes that regulate those patterns. A main focus of this book is to synthesize those advancements and provide directions for future research.

Chapters are grouped into five main themes: macroecology of stream fishes, stream fish communities in landscapes—importance of connectivity, conservation challenges for stream fishes, structure and dynamics of stream fishes, and role of fishes in stream ecosystems. An international group of renowned authors have contributed chapters and theme summaries that provide examples of current research within each of five themes as well as ideas for new research directions.

664 pages, index, paper
List price: $79.00
AFS Member price: $55.00
Item Number: 540.73P
Published August 2010

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It's already time to start planning your trip to Seattle for the AFS 141st Annual Meeting! The meeting’s theme, “New Frontiers in Fisheries Management and Ecology: Leading the Way in a Changing World,” promises to bring forth the latest and greatest information and discussions regarding the huge challenges facing fishery resource managers today. The AFS 2011 meeting will be 4-8 September 2011 at the Washington State Convention Center and neighboring Sheraton Hotel, in downtown Seattle. We look forward to seeing you in Seattle!

**GENE RAL INFORMATION**

Aquatic resource professionals at all levels and backgrounds, especially students, are invited to submit symposia proposals and abstracts for papers in all relevant topics and disciplines. The scientific program of the meeting consists of three types of sessions:

1. **Symposia**, 2. **Contributed Papers**, and 3. **Posters**.

Oral presentations except a limited number of symposium presentations, will be limited to 20 minutes (15 minutes for presentation plus 5 minutes for speaker introduction and questions). All oral presenters are expected to deliver PowerPoint presentations.

**SYMPOSIA**

The Program Committee invites proposals for symposia. Topics must be of general interest to AFS members, and topics related to the meeting theme will receive priority. Symposium organizers are responsible for recruiting presenters, soliciting their abstracts, and directing them to submit their abstracts and presentations through the AFS online submission forms. A symposium should include a minimum of 10 presentations and we encourage organizers to limit their requests to one-day symposia (about 20 oral presentations). Symposia with more than 20 presentations are strongly discouraged because of time constraints. The Program Committee will work with symposium organizers to fill unused time slots with appropriate presentations that were submitted as contributed papers.

Traditionally, symposia have been dominated by oral presentations and sometimes supplemented by posters. If posters are part of a symposium, they can be complemented by “Speed Presentations,” short oral presentations of the highlights of posters. This format elevates the profile of symposium posters, shortens the time required for symposia, and encourages interaction at the poster session. Speed presentations can be an effective way to disseminate information and foster one-on-one interactions among symposium participants and poster presenters. See *Fisheries* 32(12):576 for more information on this format.

Regular oral presentations are limited to 20 minutes, but double time slots (i.e., 40 minutes) may be offered to keynote speakers. Symposium proposals must be submitted by 14 January 2011. All symposium proposal submissions must be made using the AFS online symposium proposal submission form, which is available on the AFS website (www.fisheries.org). If you do not receive confirmation that we have received your proposal by 21 January 2011, please contact the Symposium Subcommittee (see contact information below). The Program Committee will review all symposium proposals and notify organizers of acceptance or refusal by 11 February 2011. If accepted, organizers must submit a complete list of all confirmed presentations and titles by 4 March 2011. Symposium abstracts (in the same format as contributed abstracts; see below) are due by 11 March 2011.

**FORMAT FOR SYMPOSIUM PROPOSALS**

(Submit using AFS online symposium submission form)

When submitting your abstract, include the following:

1. **Symposium title:** Brief but descriptive.
2. **Organizer(s):** Provide name, address, telephone number, fax number, and e-mail address of each organizer. Indicate by an asterisk the name of the main contact person.
3. **Description:** In 300 words or less, describe the topic addressed by the proposed symposium, the objective of the symposium, and the value of the symposium to AFS members and participants.
4. **Format and time requirement:** Indicate the mix of formats (oral and poster). State the time required for regular oral presentations (i.e., 20 minutes per speaker) and the time required for speed presentations and poster viewing (3 minutes per speaker plus 1 hour of poster viewing).
5. **Chairs:** Supply name(s) of individual(s) who will chair the symposium.
6. **Presentation requirements:** Speakers are required to use PowerPoint for presentations.
7. **Audiovisual requirements:** LCD projectors and laptops will be available in every room. Other audiovisual equipment needed for the symposium will be considered, but computer projection is strongly encouraged.
8. **Special seating requests:** Standard rooms will be arranged theatre-style. Please indicate special seating requests (for example, “after the break, a panel discussion with seating for 10 panel members will be needed”).
9. **List of presentations:** Please supply information in the following format:
   - **Presenter’s name:**
     1. ________________________________
     2. ________________________________

   (All confirmed presentations will be included in the symposium program.)
Tentative title of presentation:
1. ________________________________
2. ________________________________
Confirmed: Yes/no
Format (regular or speed presentation):
1. ________________________________
2. ________________________________

10. Sponsors: If applicable, indicate sponsorship. Please note that a sponsor is not required.

**Contributed Papers and Posters**

The program committee invites abstracts for presentations for contributed paper and poster sessions. Authors must indicate their preferred presentation format:
1. Contributed paper only,
2. Poster only,
3. Contributed paper preferred, but poster acceptable.

Only one contributed paper presentation will be accepted for each senior author. We encourage poster submissions because of the limited time available for contributed papers. The program will include a dedicated poster session to encourage discussion between poster authors and attendees.

**Student Presenters**

Student presenters must indicate if they wish their abstract to be considered for competition for a best presentation (i.e., paper or poster, but not both) award. If they respond “no,” the presentation will be considered for inclusion in the Annual Meeting by the Program Committee, but will not receive further consideration by the Student Judging Committee. If students indicate “yes,” they will be required to submit an application to the Student Judging Committee. Components of the application will include an extended abstract and a check-off from their mentor indicating that the study is at a stage appropriate for consideration for an award.

**Abstract Submission**

Abstracts for contributed papers and posters must be received by **11 February 2011**. All submissions must be made using the AFS online abstract submission form, which is available on the AFS website (www.fisheries.org). When submitting your abstract:

- Use a brief but descriptive title, avoiding acronyms or scientific names in the title unless the common name is not widely known;
- List all authors, their affiliations, addresses, telephone numbers, and e-mail addresses; and
- Provide a summary of your findings and restrict your abstract to 200 words.

All presenters will receive a prompt e-mail confirmation of their abstract submission and will be notified of acceptance and the designated time and place of their presentation by **15 April 2011**.

The Program Committee will, as much as possible, group contributed papers thematically. To assist in this, you will have the opportunity during the abstract submission process to indicate which one or two of the following general topic areas best fit the concept of your abstract. Topics include:

- Bioengineering
- Communities and Ecosystems
- Contaminants and Toxicology
- Education
- Fish Culture
- Fish Health
- Fish Conservation
- Freshwater Fish Ecology
- Freshwater Fisheries Management
- Genetics
- Habitat and Water Quality
- Human Dimensions
- Marine Fish Ecology
- Marine Fisheries Management
- Native Fishes
- Physiology
- Policy
- Population Dynamics
- Statistics and Modeling
- Species-Specific (specify)
- Other (specify).

Late submissions will not be accepted. AFS does not waive registration fees for presenters at symposia, workshops, or contributed paper sessions. All presenters and meeting attendees must pay registration fees. Registration forms will be available on the AFS website (www.fisheries.org) in May 2011; register early for cost savings.

**FORMAT FOR ABSTRACTS**

**For Symposium Abstracts**

(must be solicited by symposium organizer):

Enter Symposium title:
1. ________________________________
2. ________________________________

Specify format:
1. Oral
2. Speed presentation (accompanied by poster)

**For Contributed Paper and Poster Abstracts**

Enter 2 choices for topic:
1. ________________________________
2. ________________________________

1. Contributed paper
2. Poster
3. Contributed paper preferred, but poster acceptable

**FOR ALL ABSTRACTS, FORMAT AS IN THE FOLLOWING EXAMPLE**

**Title:** An example abstract for the AFS 2010 Annual Meeting

**Format:** Oral

**Authors:**
Busack, Craig. NOAA Salmon Recovery Division, 1201 NE Lloyd Blvd., Suite 1100, Portland, OR 97232; 503/230-5412; craig.busack@noaa.gov

Ward, Dave. Columbia Basin Fish and Wildlife Authority, 851 SW Sixth Avenue, Suite 300 Portland, OR 97204; 503/274-7285; dave.ward@cbfwa.org

**Presenter:** Craig Busack

**Abstract:** Abstracts are used by the Program Committee to evaluate and select papers for inclusion in the scientific and technical sessions of the 2010 AFS Annual Meeting. An informative abstract contains a statement of the problem and its significance, study objectives, principal findings and application, and it conforms to the prescribed format. An abstract must be no more than 200 words in length.

**Student presenter?** No

**Program Committee Contacts**

**Program Co-Chairs**

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dave.ward@cbfwa.org

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Columbia Basin Fish and Wildlife Authority
503/274-7285

dave.ward@cbfwa.org

**Symposia Subcommittee Chair**

Peter A. Bisson
USDA Forest Service
360/753-7671

pbisson@fs.fed.us

**Posters Subcommittee Chair**

Steve Schroder
Washington Department of Fish and Wildlife
360/902-2751

steve.schroder@dfw.wa.gov

WWW.FISHERIES.ORG/AFS2011
our fellow AFS members are and the great work that is being done. This was a humbling experience that gave us a greater desire to contribute even more to AFS and the confidence to do so.

We were interested in the AFS mentee program to help us gain an understanding of how AFS Governing Board meetings are run. We had witnessed board meetings of AFS Chapters and other professional societies, but the AFS Governing Board meeting was a new experience for all of us. The AFS Governing Board was larger than anything we had previously experienced. The collection of more than 30 fisheries scientists, educators, and administrators not only had vast areas of expertise but also expressed a wide array of opinions. It was interesting to watch them debate, following Robert’s Rules of Order, to reach conclusions that benefit fisheries and aquatic resources. The knowledge gained after participating in the mentee program will be useful throughout our careers, whether in societal roles or as fisheries professionals. Among those of us working with non-game species, the importance of working with the traditional fisheries managers to find that common ground that benefits all species became more evident to us.

As observers of the monthly Management Committee calls, we became aware of how AFS activities are conducted throughout the year, the level of commitment of AFS officers at all the levels of the Society, and the hard work of the AFS executive director and staff in Bethesda. AFS has such a large membership and there are so many fisheries-related issues that must be resolved. We became aware of how Society-wide decisions are made using a structured process that benefits members of AFS. It was amazing to learn that each individual member of AFS truly has clout when it comes to making decisions. Although most AFS members do not have direct authority to vote during Governing Board meetings, each Section of AFS (i.e., Fisheries Management Section, Education Section, Fish Culture Section) has a representative who uses their Section members’ thoughts and ideas to make an informed decisions and cast votes on behalf of their Section. Additionally, Chapters are represented by the president and president elect of the four Divisions of AFS. As such, if you are a member of any of the unique Sections of AFS or are involved in a Chapter, you can contribute to the overall happenings of the entire Society.

Overall, this program was a unique experience that demonstrated the commitment of AFS leadership in developing the emerging cohort of young professionals. Institutional knowledge is a very valuable commodity that can be quite difficult to maintain. We believe this program is an excellent tool for passing institutional knowledge to active young professionals in AFS and that it should pay dividends for years to come. Would we be active in the future of AFS had we not participated? Probably. Would we be nearly as prepared to serve? Definitely not. As the mentor program continues to develop, it should become more effective and inclusive of a larger number of young folks. We encourage leaders of AFS Units (i.e., Chapters, Divisions, and Sections) to nominate outstanding young professionals for participation in this program and to find funding to enable a larger number of young professionals to participate. You will be glad you did.

We thank the AFS Units that nominated each of us: Felipe Amezcua was nominated by the International Fisheries Section, Tom Lang and Quinton Phelps were nominated by the Fisheries Management Section, and Jeremy Tiemann was nominated by the Illinois Chapter. We thank our mentors at the Governing Board meeting: Cecil Jennings of the Southern Division, Ron Essig of the Fisheries Management Section, Lourdes Rugge of the International Fisheries Section, and Jessica Mistak of the North Central Division. We greatly appreciate the Past Presidents Advisory Council for partially supporting the travel for three mentees and the Fisheries Management Section for partially supporting a mentee to attend the AFS meeting in Nashville and observe Governing Board activities. Finally, we thank Wayne Hubert and Bill Fisher for leading the committee that developed this initiative and Don Jackson for all of his support and guidance throughout our year as mentees.
William M. Lewis, 88, died on 15 May 2010 of a chronic illness in Sampson, North Carolina. Lewis was born in Faison, North Carolina, and was the youngest of nine children born to Mac Colon Lewis and Blanche McGowan Lewis. He obtained his bachelor’s degree in zoology from North Carolina State University. He attended Officer Training School at Notre Dame, and became a Lieutenant JG in the U.S. Navy. In 1944, he married Sue D. Sparks of Lexington, Kentucky, a zoologist specializing in the study of insects. He became a gunnery officer on the battleship U.S.S. Colorado, where he served during 1944 and 1945. He was wounded at the Battle of Leyte Gulf and, after recuperation in the Solomon Islands, returned to the U.S.S. Colorado as the occupation of Japan began.

After his discharge from the Navy, Lewis attended Iowa State University where he obtained M.A. and Ph.D. degrees in zoology specializing in fisheries science. In 1950 he took a professorship at Southern Illinois University (SIU), where he founded and directed the SIU Cooperative Fisheries Research Program. The mission of the program is to study the fishes of Illinois and to train graduate students in fisheries science. Lewis and his students published extensively on native and stocked fish populations and on fish culture. His students now occupy positions throughout the Midwest and the southern states in the field of fisheries. Lewis also served for a time as chair of the Department of Zoology at SIU and was elected president of the American Fisheries Society shortly after his retirement in 1983.

Lewis built two fish farms in southern Illinois so that he could pursue his interest in aquaculture and, after retirement, built a fish farm in Pender County, North Carolina, and another, the Carolina Fish Farm, near Faison. After retirement, he remained active in managing his fish farms and maintained research ties to SIU. Lewis remembered fondly by his many friends in North Carolina and Illinois and he will be missed by his fisheries colleagues throughout the United States.
OBITUARIES:
CHARLIE MOSELEY

AFS Journals Manager

Charlie Moseley, 64, died 5 August 2010, after a short battle with pancreatic cancer. A native of New Orleans, Moseley received a BA in English at Louisiana State University in Baton Rouge. After graduation, he headed to the Midwest, where he obtained a masters degree in English at the University of Chicago.

Curiosity and a desire to learn new things led Moseley into journalism and book editing in Washington, D.C., in the 1980s. He worked as a journalist at the Congressional Quarterly where he had an inside look at the U.S. political process and honed his editorial skills. From there, Moseley moved on to Beacham Publications where he edited the World Wildlife Fund Guide to Endangered Species of North America.

Moseley became a technical editor at AFS in 1994 and also served as the coordinator for The Progressive Fish-Culturist. He became journals manager in 2000. As journals manager, Moseley was responsible for coordinating publication of the five AFS journals in conjunction with the editorial boards, copy editors, and the printer. Moseley also shepherded the changeover to online peer review with the Allentrack system, eliminated a persistent backlog of accepted but unpublished manuscripts, initiated posting manuscripts online as they were completed, and managed a steadily increasing quantity of manuscript submissions while still maintaining the high standards of the Society’s journals. His motivation to enhance the quality of manuscripts as they passed through the peer-review and publication process is exemplified by a statement he made in a May 1998 staff profile in Fisheries, “We always try to add editorial value to manuscripts we handle.”

Moseley lived with his wife Ella (Kit) Angell in Silver Spring, Maryland. A voracious reader since childhood, he was both intellectual and a man of action. He loved the outdoors and was a mush-roomer, range officer for the Bethesda-Chevy Chase chapter of the Izaak Walton League, birder, and, above all, an avid fisherman. He was a movie buff, accomplished photographer, gourmet who especially loved the cuisine of his native New Orleans, and a baseball fan. He was known for his great sense of humor and love of dogs. Without a doubt, however, his greatest passion was for fishing. He said, “It doesn’t take much to get me out on the water—fresh or salt—going for bluefin tuna, striped bass, trout, or bluegills. My obsession with fishing and my editing dovetail nicely.”

Memorials may be sent to the Bethesda-Chevy Chase Izaak Walton League of America (designate the donation is for the Land Fund), P.O. Box 542, Poolesville, MD 20837, www.bcciwla.org or to Montgomery Hospice, 1355 Piccard Drive, Suite 100, Rockville, MD 20850, www.montgomeryhospice.org/support.

From AFS editors:

“My appreciation for him as a professional is vast, but it hardly holds a candle to my appreciation of Charlie, the whole man, to whom we could all relate in some special way, be it fishing, boating, birding, dogs, heirloom tomatoes, good food, good wine. He had a great sense of humor. He was just a wonderful person, and I can’t begin to express how much I will miss him.”
—Carolyn Griswold, co-editor, North American Journal of Fisheries Management

“The enormous contribution that Charlie made to the AFS journals program cannot be overestimated, and was probably not appreciated by many due to the fact that he did his job so well.”
—Stephen Riley, co-editor, North American Journal of Fisheries Management

“I think that Charlie cared deeply about the process of publishing science in a way that respected the author as well as the reputation of the Society and the journals.”
—Richard Beamish, co-editor, Transactions of the American Fisheries Society

“He was a consummate professional, implementing his clear vision of an ever-shifting target of getting out good papers within a limited budget—superbly playing an intermediary role between responding to sometimes unrealistic demands from above and the requirements of timely inputs from a hugely diverse group of editors, authors, and reviewers from below. Although his foresight has permitted continuity of these processes, he cannot be replaced.”
—Fred Utter, co-editor, Transactions of the American Fisheries Society
**Assistant Professor**, Department of Watershed Sciences, Utah State University.

**Salary:** To be determined.

**Closing:** 27 September 2010.

**Responsibilities:** Fill a nine-month, tenure-track position in physical geography or aquatic science. Contribute to both the watershed and aquatic sciences and physical geography programs. The division of activities will be approximately 50% research, 40% teaching, and 10% service.

**Qualifications:** Ph.D. in physical geography, watershed sciences, aquatic ecology, or a closely related natural resources or environmental sciences discipline; demonstrated expertise in physical geography or related discipline. A record of peer-reviewed publication appropriate to career stage. Evidence of excellence in teaching or the ability to develop into an excellent teacher. Applicants must have interest in the integration of physical and ecological science within a watershed context and how that knowledge can be used in a management and policy context. Postdoctoral experience is preferred, but not necessary.

**Contact:** https://jobs.usu.edu; requisition ID 052010, chuck.hawkins@usu.edu.


**Salary:** Excellent salary and benefit package.

**Closing:** 27 September 2010.

**Responsibilities:** Develop and conduct studies on anadromous and resident fish, involvement in collecting and reporting water quality information associated with Wells Dam. Design and implement fishery resource studies related to implementation of the Wells Anadromous Fish Agreement HCP and Aquatic Settlement Agreement. Duties may include anadromous fish survival and passage studies, sturgeon life history and supplementation studies, lamprey passage evaluations, construction of major fish passage and rearing facilities, resident fish and water quality sampling, bull trout incidental take and passage monitoring, and aquatic invasive species sampling.

**Qualifications:** M.S. degree in fish biology or equivalent aquatic science required. Strong background in fisheries biology/ecology. Applied understanding of statistical and analytical principles. Excellent technical writing and oral communication skills. Experience working on large hydroelectric projects and with anadromous fish is desirable, as is experience participating in multi-party collaborative processes.

**Contact:** See www.douglaspud.org.

**Fisheries Conservation Manager**, Environmental Defense Fund, Austin, Texas.

**Salary:** Negotiable commensurate with experience.

**Closing:** 16 September 2010 or until filled.

**Responsibilities:** Oversee and coordinate catch shares projects in the Gulf of Mexico, including Texas, Louisiana, Mississippi, Alabama, and the west coast of Florida. Partner with federal, state, and other elected officials; fisheries managers and chief scientists; catch share program administrators, council members, and local fishermen to implement these and other projects. Research and analysis of project-related information.

**Qualifications:** Graduate degree in science, policy, economics, or law in areas related to environmental or marine resources policy or sciences or a minimum of 5 to 7 years equivalent professional experience. Thorough understanding of state/federal policy and political processes. Good people and project management skills. Strong written/verbal communications skills.

**Contact:** See www.edf.org/jobs. Contact jobs@edf.org. EOE.

**Associate Director**, New York Sea Grant Institute (NYSGI), College of Agriculture and Life Sciences, Cornell University, New York.

**Salary:** Depends on experience.

**Closing:** 19 January 2010.

**Responsibilities:** Lead a dynamic, highly-rated, university-based Sea Grant Extension program that addresses critical marine and Great Lakes coastal issues. Serve as a member of the senior management team engaged in administering, prioritizing, and expanding the NYSGI Program. Secure additional funding to complement the institute’s current $4M of support. Collaborate in establishing program direction and developing and maintaining contacts with academic units, key agencies, and legislative liaisons throughout New York State. Collaborate in formulating research and outreach priorities and directions. Collaborate in maintaining institute advisory mechanisms and groups. May serve as NYSGI liaison with specific agencies and programs. Serve as the assistant director for Cornell Cooperative Extension, providing leadership and administration for Sea Grant Extension and coastal programs, supervising Sea Grant Marine and Great Lakes District...
program coordinators and other Sea Grant staff, and overseeing grant proposal development, submission, and reporting requirements. Develop, implement, and evaluate a substantive extension education program in her or his area of expertise that supports Sea Grant Extension Program priorities. Program may include relevant applied research and development of grant proposals to support the appointees extension and research activities. Program is a SUNY-Cornell partnership funded mainly by federal NOAA and New York State sources.

**Qualifications:** An earned Ph.D. with at least 5 years professional outreach and administrative experience in aquatic science, natural resource, or conservation management or other appropriate environmental sciences or a M.S. with 10 years programmatic and progressive administrative experience in the above fields and demonstrated leadership experience. Substantive professional experience in university-based outreach or non-formal education programs, as well as management or coordination of such programs. Demonstrated skills and success in program leadership, management, grant-writing, budget development, and staff supervision. Experience with issues of importance to marine and/or Great Lakes coasts or resources.

**Contact:** To apply, send cover letter, resume, and transcripts to Nancy Greenawalt, New York Sea Grant, 112 Rice Hall, Cornell University, Ithaca, New York 14853. Review of applications begins 23 August 2010. For full position description see www.seagrant.sunysb.edu/article.asp ArticleID 357 or contact Nancy Greenawalt at nag3@cornell.edu or 607/255-2832. AA. EOE.
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