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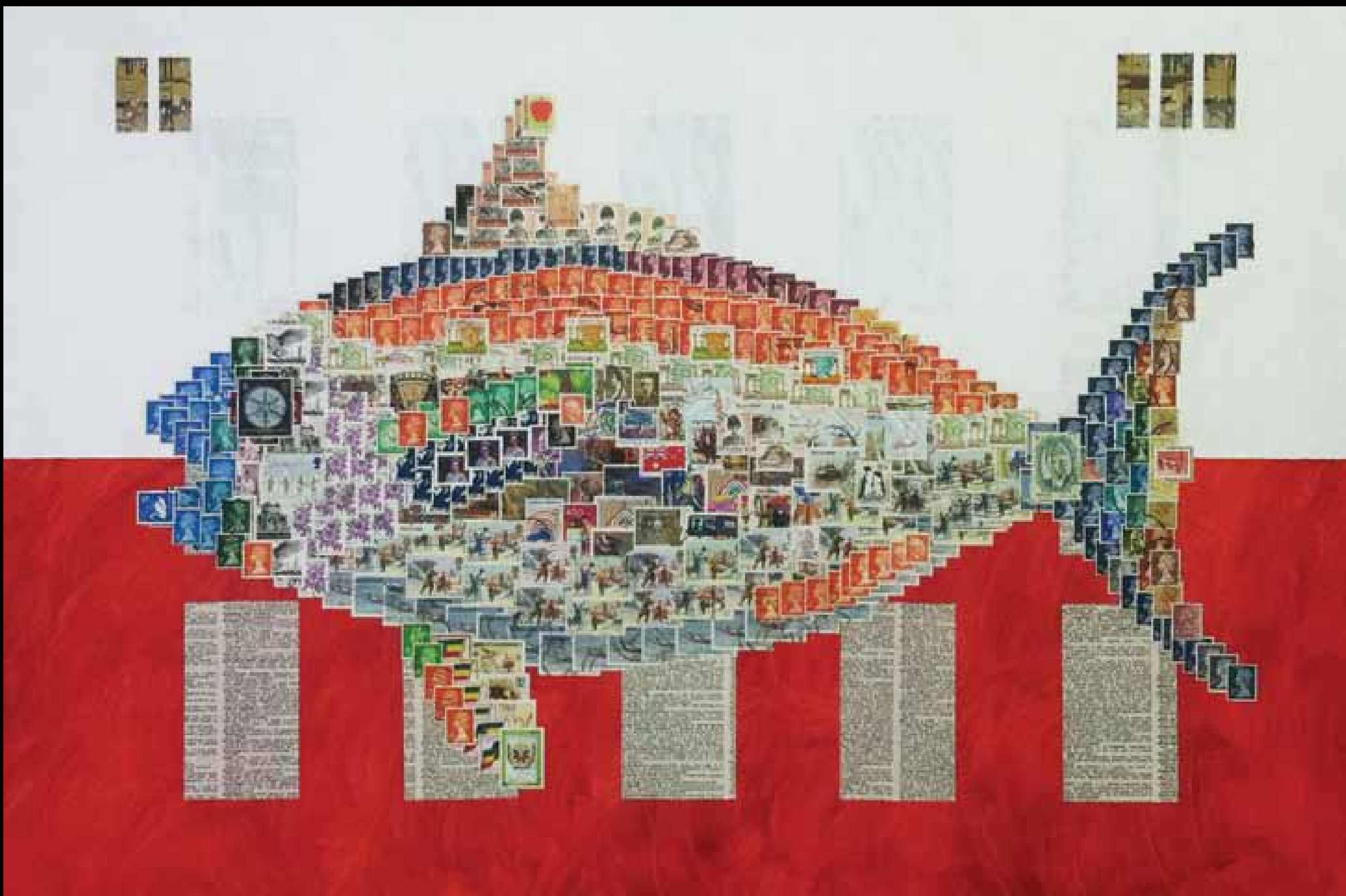

Eleven Ways to Improve Executive Management of Conflict

A Hierarchical Spatial Framework and Database for the National River Fish Habitat Condition Assessment

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Contents

Fully processed fish with biopsy wound treated with a 1:1 denture adhesive:antibiotic cream mixture and floy tag in place for individual identification

COVER: "Big Fish"
CREDIT: Mixed media, by Mark Tolson

Fisheries

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Fisheries Networks: Building Ecological, Social, and Professional Relationships

Bill Fisher, AFS President

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Growing up, my dad used to talk about the importance of networking. He was an out-going, gregarious person who developed a national reputation in the dairy industry by networking with professionals around the country and world. While I did not give this much thought when I was younger, the importance of networking became clearer to me as I have moved through my career. You cannot underestimate the importance of meeting and developing relationships with people, whether they are casual acquaintances or deep friendships. These relationships form a fabric—a network—that supports us and provides stability throughout our lives.

You cannot underestimate the importance of meeting and developing relationships with people, whether they are casual acquaintances or deep friendships.

A network is an interconnected system of people or things. Networks are pervasive throughout our society and in fisheries science. For example, AFS has a large organizational network consisting of an executive director and staff of 17 people, 5 Society officers, a 30-member governing board, 35 committees, 21 sections, 4 geographical divisions, 48 state chapters, and over 55 student subunits. This network of over 9,000 people interacts at local, regional, continental, and global scales through various forms of communication including meetings, newsletters, websites, and many, many conversations. The result of these communications and interactions are social relationships, many of which started when we were students and have lasted throughout our professional career. As fisheries scientists, we have studied networks, such as food webs, genetic relationships, and river drainages, throughout our history and continue to do so using more sophisticated analytical tools. An emerging area of fisheries science involves social networks. These networks range from small group interactions to large social groups that include fishing villages, fishers and fishing industries, and consumers. The challenge for us as a Society is to continue to build and strengthen these networks in the face of mounting fiscal challenges and social changes.

The Society's Strategic Plan, AFS 2020, identifies three goals: global fisheries leadership, education and continuing education, and the value of membership. Each of these goals involves some form of networking, whether it is seeking opportunities to build connections among members throughout the world, to understanding and modeling ecological systems, to better educating future fisheries professionals, to developing web services that better connect all members of the Society. My work plan for 2011–2012 follows the goals of AFS 2020, continues some of the initiatives in AFS President Wayne Hubert's 2010–2011 Work Plan, and sets in motion some new initiatives.

Under the strategic plan goal of global fisheries leadership, my work plan is focused on helping organize the 142nd Annual Meeting in St. Paul-Minneapolis, Minnesota on August 19–23, 2012, and promoting the 6th World Fisheries Congress in Edinburgh, Scotland on May 7–11, 2012. These conferences will bring together fisheries professionals from around the world to discuss a variety of topics including sustainable fisheries in a changing world — the theme of the 6th World Fisheries Congress — and a symposium at the Congress sponsored by AFS on the effects of catastrophic events on fisheries. An initiative to promote AFS as a global leader in fisheries is to improve our web services to members and our web presence to fisheries professionals worldwide. The Electronic Services Advisory Board will be providing recommendations based on a recent evaluation of our website by an outside contractor. These recommendations will help us improve our web service. It is vital that AFS's electronic services continue to evolve and improve.

The education and continuing education goal of the strategic plan directs AFS to facilitate life-long learning through educational resources and training for professionals. A challenge facing the natural resources profession is the training of

Continued on page 468

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NOAA's National Marine Fisheries Service Releases Status of U.S. Fisheries Report Citing Progress in Rebuilding Fisheries

Each year, NOAA's (National Oceanic and Atmospheric Administration) National Marine Fisheries Service (NMFS) issues "The Status of U.S. Fisheries" report to inform Congress and the public on the agency's progress in restoring fish stocks to sustainable population levels by tracking the population and harvesting status of many marine fisheries in the United States.

In July 2011, NMFS presented the 14th Annual Report to Congress on the Status of U.S. Fisheries ("2010 NMFS Report") which reports on the fishing activity and population level of fish stock in the country. The information in the 2010 NMFS Report generated by the NMFS, NMFS regional offices, and regional science centers was based on the most recent stock assessments as of December 31, 2010. On a positive note, overall, it found that in 2010, 84% of the stocks examined for fishing activity (213 of 253 stocks) were free from overfishing, or not fished at too high a level. However, the 2010 NMFS Report also found that 77% the stocks with known population levels (159 of 207 stocks) were above the overfished level — a level that is too low to provide the maximum sustainable yield. In particular: 1) the Georges Bank haddock; 2) Atlantic Pollock; 3) and spiny dogfish — thus increasing the number of rebuilt healthy levels of these fish stock since 2000.

The 2010 NMFS Report found other positive trends in 2010 that include:

- Four Northeast stocks were removed from the low-population list: Gulf of Maine haddock, American plaice, Gulf of Maine cod, and southern New England windowpane.
- Two stocks were removed from the list of stocks being fished at too high a level: Georges Bank yellowtail flounder and Southern Atlantic Coast black grouper.
- The Gulf of Mexico black grouper was found to be free from overfishing, and had a population above the low-population level.
- The Southern Atlantic Coast black grouper was found to have an above the low-population level.

While the above findings were positive, the 2010 NMFS Report moved other fishery stocks onto the overfishing and overfished lists this year. In so doing, the Northwestern Atlantic witch flounder, Gulf of Maine/Georges Bank windowpane flounder, and Southern New England/Mid-Atlantic windowpane flounder were all added to the list of fish that were fished at too high a level. The 2010 NMFS Report also added to the list of low-populations stocks the Northwestern Atlantic Coast witch flounder, Gulf of Maine/Georges Bank windowpane flounder, Georges Bank winter flounder, Southern Atlantic Coast red grouper, California Central Valley Sacramento (fall) Chinook salmon, and Bering Sea southern Tanner crab.

Finally, in the 2010 NMFS Report, scientists examined more stocks than they had in any previous year. In so doing, they discovered that the Pacific bluefin tuna was fished at too high a level, although its population was above the low-population level, and that the Gulf of Maine/Georges Bank Atlantic wolffish had a low-population level.

Issued annually since 1997, the NMFS Status of U.S. Fisheries Report summarizes the most up to date and prestigious scientific data for the 528 federally-managed U.S. fish stocks. The NMFS report does not report on all fishery stocks since not all stocks are targeted by commercial and individual fishermen. Rather, it collects information on the commercially and recreationally important species that comprise most of the domestic fishing activity in the country. The Sustainable Fisheries Act amendment to the Magnuson-Stevens Fishery Conservation and Management Act of 1996, mandates that the NMFS, the eight regional fishery management councils, Interstate Marine Fisheries Commission partners, as well as commercial and recreational fishermen, pool their resources to rebuild and sustain U.S. marine fisheries by ending overfishing, using annual catch limits and providing accountability measures to prevent future overfishing, and rebuilding each listed fishery stock to scientifically determined levels that provide the maximum sustainable yield.

The NMFS 2010 Status of U.S. Fisheries report is online: www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm.

NOAA's National Marine Fisheries Service is online: www.nmfs.noaa.gov

NOAA's general website: www.noaa.gov.

NMFS Lists the Largetooth Sawfish as Endangered Under the Endangered Species Act

NOAA's National Marine Fisheries Service (NMFS) listed the largetooth sawfish (*Pristis perotteti*) as endangered under the Endangered Species Act (SA) ofz 1973, as amended. This final rule became effective August 11, 2011, 50 CFR Part 224. The determination came after a NMFS review of the status of the species and an examination of the conservation efforts currently in place to protect the species. NMFS found that these determinations, coupled with both public and peer review comments, showed that the largetooth sawfish was in danger of extinction throughout its range, and should be listed as an endangered species, based on the best available scientific and commercial data. NMFS, however, does not intend to propose to designate critical habitat for the species.

The European Commission Proposes Fishing Opportunities for Anchovy Fishing in the Bay of Biscay for Spain and France

In light of recent scientific data confirming that the anchovy stock is in a good state and above safe biological limits, the European Commission proposed a total allowable catch (TAC) of 29,700 tons for anchovies during the season of July 2011–June 2012 in the Bay of Biscay.

The proposed TAC represents 30% of the estimated biomass, and will be available to fishermen from France (10%) and Spain (90%); the only two EU countries involved in the proposal. The anchovy fishery in the Bay of Biscay was re-opened in December 2009, after a five-year closure. As part of the proposal, the estimated stock size, which is close to 98,450 tons, must be confirmed by relevant scientific bodies. Therefore, in the event that the final figures change, the Commission's proposal will be updated accordingly. The catch limit proposed is in line with the Commission's proposal for a multi-annual management plan for the anchovy stock, as tabled in 2009. The plan aims at ensuring sustainable exploitation of this key stock, reducing the risk of collapse, and supporting an economically viable fishery.

American Fisheries Society's (AFS) Facebook Group Grows in Membership and Usage

The AFS Facebook Group is currently used by 1,377 members. Members use AFS Facebook Group to communicate about a wide range of topics including: job announcements, discussion of AFS books and journals, and future meetings. AFS's Facebook presence has increased, not only because of the sharp increase in membership, but also due to the addition of more AFS-related sections, specific topical areas, and the most up-to-date information on fisheries for members. These areas include, for example, AFS sections such as Physiology and services for differing types of members. The official AFS Facebook Page and Group is www.fisheries.org.

Feature: MANAGEMENT

Eleven Ways to Improve Executive Management of Conflict

Michael E. Fraidenburg

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ABSTRACT: *Conflict comes with the job of managing the public's natural resources. When I ask, fish and wildlife executives tell me they want employees with excellent conflict management skills. When I next ask what they are doing to prepare their employees to become skilled conflict managers, I regularly get a blank stare. Professionals are usually on their own to acquire these skills, largely through unguided, trial-and-error learning. Eleven actions leaders can take to improve conflict management in their organizations fall into four categories:*

1. *Conflict prevention through training, adding a "conflict resolution" dimension to employee performance evaluations, maintaining an early warning system to detect emerging conflict, and creating robust stakeholder involvement processes.*
2. *Contingency planning through systematically assessing vulnerabilities, conducting "What if. . ." strategy analyses, and maintaining a rapid response capacity for when a conflict emerges.*
3. *Crisis management through ensuring that the organization can effectively analyze a conflict situation and can efficiently stabilize a bad situation so relationships can be rebuilt.*
4. *Encouraging completed staff work by using a planning tool that teaches employees to bring a finished situation analysis and remedial plan forward at the same time they bring a conflict to the executive's attention.*

Diez Formas para Mejorar el Manejo Ejecutivo de Conflictos

RESUMEN: El conflicto es inherente a la administración de recursos naturales públicos. Al preguntarles, los ejecutivos de oficinas de pesca y vida silvestre comentan que desean empleados con excepcionales habilidades para manejar el conflicto. Pero cuando planteo la cuestión de qué están haciendo para que sus empleados se conviertan en hábiles manejadores del conflicto, regularmente no saben qué responder. Los profesionistas usualmente se las arreglan solos para adquirir estas habilidades a través de un aprendizaje, no supervisado, basado en el ensayo y error. Los líderes ejecutivos pueden adoptar una serie de once acciones tendientes a mejorar el manejo del conflicto al interior de sus organizaciones. Dichas acciones caen en cuatro categorías:

1. *La prevención del conflicto mediante entrenamiento, la adición de un campo referente a la "resolución de conflictos" en las evaluaciones del desempeño de los empleados; mantener un sistema de alerta temprana para detectar conflictos emergentes y la creación de un proceso robusto de inclusión de todas las partes involucradas.*
2. *Planeación de contingencias mediante una evaluación sistemática de vulnerabilidades; llevar a cabo análisis de estrategias basadas en "Qué sucedería sí…"; y mantener una capacidad de respuesta expedita para cuando surja un conflicto.*
3. *Manejo de crisis asegurando que la organización pueda de forma efectiva analizar una situación conflictiva y que pueda eficientemente estabilizar la situación indeseable de tal suerte que las relaciones se restablezcan.*
4. *Reconocimiento al personal por los trabajos terminados a través de una herramienta de planeación que enseñe a los patrones, a la hora de presentar un conflicto ante los ejecutivos, a mostrar también un análisis de "situación concluida" y el plan de remediación correspondiente.*

There certainly is no shortage of conflict over natural resources these days. Understandably, conflict increases as resources become scarce and demand for these resources and their habitats increases (Yaffee 1994; Wondolleck and Yaffee 2000). Unfortunately, the use of science-based management does not extricate us from conflict (Ruell et al. 2010). The importance of conservation professionals having effective 'people skills' is now widely acknowledged (e.g., Bonar 2007). Smart executives I have met define one of these, the ability to manage conflict, as a core job skill—a "must-have" they expect from employees. What I have noticed, however, is that these same executives are less successful developing these skills in their organizations and employees.

When an issue generates conflict, a manager's instinct is to take charge and fix the problem. But success does not mean always being the one doing the work. Absence of conflict indicates that the organization's conflict management system is working—and this usually occurs when staff throughout your organization are skilled conflict managers. Successful management of conflict, like other expertise in our profession, is a learned skill. But are we teaching this skill?

Most natural resource agencies do not think of conflict management as an explicit job function, one that needs to be taught. To illustrate this, I ask executives a topic-related, crisis question. For example, I might say to an agency director:

Let's run through a hypothetical situation. Suppose I am an employee. I am here to report that there is a serious fish kill in one of our rivers. Tell me, as the executive in charge, what are the first things you would do?

Typically, they can easily give me a dozen or so steps they would take to assess the situation and respond. When they are done I will say:

Let's change the scenario. This time I am here to report on a goose hunting conflict that has come up in one part of the state. Earlier, responding to harvest estimates on a protected race of geese, you issued emergency regulations to close the hunting season. Hunters and some influential carrot farmers found out that your employees made an error seriously overestimating the harvest. Alas, the employees, who discovered their mistake, did not report it up the chain of command. Now the hunters and farmers are saying there was a cover up. The hunters are mad because their season was cut short as there are plenty of geese available for harvest without creating a conservation concern. The farmers are mad because hunting is one of the few tools they have to manage depredation from the thousands of geese that descend onto their fields to eat carrots. You have lost the option to reopen the hunting season because it is now past the mandatory closing date specified in international treaties for this migratory species. And, by the way, these angry citizens have set up a meeting with you and the President of the state senate, who happens to live in their legislative district, to complain about your failure. Tell me, as the executive in charge, what are the first things you would do?

This otherwise smart agency director cannot list as robust a set of intervention steps for this problem as with the fish kill.

Does this comparison seem farfetched? It was not in the state agency where I worked. I watched my director and program executives successfully deal with the fish kill but not with the goose hunting conflict. It was not that these executives were dense. They were intelligent, like most agency executives I have met. But they were not as equipped to work with conflict as they were to work with a biological crisis like the fish kill. In their careers, conflict management had not been identified for explicit skill building. They were left on their own to acquire these skills through painful trial-and-error learning. Resolve to improve this situation in your organization. Begin with an assessment.

Assess current performance

Executive management of conflict means doing four kinds of work: setting expectations for completed staff work, prevention, contingency management, and crisis management. Arraying these as a pyramid (Figure 1) and assessing where you are on this pyramid gives insight about how well your executive management is working. At the bottom of the pyramid is setting expectations for completed staff work. Does your staff know how to bring you a completed solution recommendation when they first bring a conflict to your attention? Up the pyramid is conflict prevention. Are your employees good at conflict management once a problem emerges, and are you consistently in front of problems while you still have decision space? Further up the pyramid is contingency planning. How good are you at planning for the unplanned? At the top is crisis management. How quickly and accurately can your organization assess a meltdown and deploy interventions?

Successful executives spend the most time ensuring completed staff work, less on prevention, less again on contingency planning, and the least on crisis management because they have done a good job at lower levels of the pyramid. You cannot build a strong organization if you are always putting out fires and there is likelihood you will get burned. Here are eleven ways to improve your executive management of conflict.

Actions that build a prevention capacity

Prevention means detecting and restructuring the conditions that cause or favor unwanted events. Conflict is not spontaneous. In fact, there is a chain of events that lead to conflict. Prevention means intervening earlier in the chain of events. The objectives in your prevention program are to:

- mitigate risks;
- halt and reverse escalation of issues leading to open conflict;
- keep conflicts out of the executive office by delegating them to your support staff; and
- increase positive attitudes while ameliorating bad feelings about you or your program.

Figure 1. Pyramid of conflict management responses in an organization. The executive's dominant function changes in each kind of response, as does the amount of direct, hands-on work required by the executive.

Action 1. Train staff

Clearly, building staff skills is a simple prevention. In my conflict management workshops I ask participants about the availability of such training in their organizations. Their answers are uniform; typically the best fit they can find is training on customer service skills. Most do not have continuing education available that focuses on conflict management *per se*. This is especially true for dispute resolution in the context of natural resources, which is increasingly about conflicts over values, a more difficult challenge (Adler et al. 2001; Moore 1996). Imagine you need to hire a senior manager. Is the talent pool stronger if all the candidates received conflict management training and mentoring as mid-managers?

Action 2. Evaluate employee performance

Just as you now evaluate employee performance on fiscal management, technical expertise, communications, etc. add a 'Conflict Management' category to their evaluations. This will get their attention. Tying these performance audits to guided improvement plans will get you an employee skill set that keeps conflicts from escalating up to your office. A happy by-product will be more confident employees.

Action 3. Develop an early warning system

Develop some means for systematically scanning your work environment to detect emerging issues before they get out of hand. This does not have to be a sophisticated or complex system, but it does need to be consistent and effectively reported. Key questions are the following:

- What are stakeholders talking about?
- How upset are they?
- Is this a local or a broader concern?
- Are stakeholders articulating steps to act on their concerns?

In setting up an early warning system, two key directions are needed from you as the executive in charge: specify the types of information you need to detect emerging conflict, and then specify the outputs (e.g., reporting) required to make this information useful. A successful early warning system signals stress in your work environment with acceptable accuracy, is regularly collected and reported from diverse sources, and allows the organization to conceive a response appropriately timed and scaled for the issue at hand. Whatever is the right way for your organization, your executive management goal is to build a system that routinely alerts you in the early stages of conflicts.

Action 4. Work early and work often with stakeholders

A reviewer of this article reminded me of E. E. Schattschneider's quote, "The best point at which to manage conflict is before it starts" (Schattschneider 1960, p.15). In my citizen participation projects, a recurring theme is disengagement of an agency from its publics leading to a breakdown in trust and respect (Susskind and Field 1996). Consequently, a routine success tool is to restore these, usually along the two thought lines of "honorable people can honorably disagree" *and* "we are going to have to work together in the future which will be easier if we can do so as friends—or at least as respectful adversaries."

Hans and Annemarie Bleiker, in their citizen participation workshops (Institute for Participatory Management and Planning 2010), provide the key reason why this approach works. They teach that in conflicts over government proposals you do not have to attain agreement among stakeholders. All you need do is get concerned citizens to not try and veto your course of action. In other words, disgruntled citizens do not have to agree, but it is in your organization's interest to get them to refrain from activism to stop progress. If you convince them that your proposal is legitimate, credible, and created with a fair process, citizens may object, but they will rarely exercise their veto power. Thus, your prevention intervention is to take initiatives to stakeholders on your terms and in a way that proves they are legitimate, credible, and decided using a fair process. They may not like it, but they can accept it.

Example of successful prevention featuring Action 3: Employees who know how to listen

In the early 1990s I was lucky to be an interviewer for the Management Effectiveness Study (McMullin 1993). The Management Effectiveness Study was a cooperative effort of the Management Assistance Team (at that time affiliated with the U.S. Fish and Wildlife Service's Division of Federal Aid), the Organization of Wildlife Planners, and Virginia Tech. This research identified characteristics of the most effective United States fish and wildlife agencies. I was impressed by a story I heard several times in my interviews of the New York State Department of Environmental Conservation employees. The agency had a simple but effective early warning system that, according to the executives I interviewed, gave them at least a three-week head start on developing controversies. With that foreknowledge the agency could then start interventions before conflicts spiraled out of control. Simply, they required staff throughout the state to attend, in uniform, one or more stakeholder meetings a month as part of their regular job duties. These employees were then required to report to headquarters what they had heard. Negative stories cropping up in multiple stakeholder meetings became their early warning that a problem was brewing. Forewarned, interventions could be devised, usually at the local level, before major stakeholder concern or anger erupted.

Actions that build a contingency planning capacity

A contingency plan is simply an alternative course of action that can be implemented in the event your primary approach fails. It is your plan for the unplanned. Reasonable objectives for contingency planning are to:

- Predetermine the array of options you can try if a contingency actually happens.
- Identify the team or staff lead that will take on the issue if the contingency happens.
- Identify the authorities needed and how resource allocation decisions will be made.
- Define how you will know when a contingency plan is no longer needed.

Action 5. Identify Windows of Vulnerability

These are moments, usually events like elections, regulation setting, creation of new advocacy groups, or crises that threaten to rapidly change the balance in your work environment. These events can trigger conflict. Key actors may seize on these moments to move their concerns to center stage and secure attention or a power shift to force the change they want—usually excluding other points of view. For example, your staff, in their attendance at stakeholder meetings, should be listening for the concerns that lay behind the events stakeholders are talking about. These are the real triggers of stakeholder activism and usually involve underlying needs that are not being met, like feelings of increasing uncertainty about their future, exclusion from important decision making, being marginalized, or sensing a loss of autonomy and self-determination. We mediators learn to ask why an *issue* is important to a disputant. The answer we uncover is the underlying *interest* that is the real driver or concern. We build durable solutions by working with these underlying *interests*. To understand windows of vulnerability at this deeper level take an *issue* like closing the goose hunting season early and ask why that issue is important to stakeholders. By doing this you discover the stakeholders' underlying *interest*. Knowing their interests gives you intuition about how to close the window of vulnerability. This is essentially the same as the "getting to yes" principle of focusing on interests, not positions (Fisher et al. 1991). For a fuller explanation of how to work with issues and interests see Fisher et al. 1991 and Fraidenburg and Strever, 2004.

Action 6. Conduct "What if…" analysis

"What if…" analysis involves asking questions of the type, "What if X happens in our work environment, what will we do?" These hypothetical questions are used in decision making to explicitly consider possible, but not certain, future conditions. How do you select issues for this analysis? Issues that appear in your early warning system and in your windows of vulnerability analyses are candidates, especially if an issue appears on both lists. Most executives I have worked with instinctively do "What if…" analysis. The problem is that they limit it to the single most likely "What if…" possibility. Economist Herbert Simon (1956) coined the word "satisficing" to describe this behavior. Satisficing explains the tendency to select the first option that meets a given need, or select the option that seems to address most needs and at that point stop the search. Do not short stop your search. Make a conscious choice to examine an appropriate range of possibilities. The key word in the previous sentence is "appropriate." Once you choose to look at multiple alternatives it is easy to overdo it by trying to analyze everything. Successful executives still use their judgment to select a key range of alternatives for analysis instead of getting wedded to their first choice or trying to analyze everything. Keep an open mind as actual circumstances develop. As General and President Dwight D. Eisenhower was fond of saying, "Plans are worthless, but planning is everything" (Eisenhower 1957).

Action 7. Keep everyone on the same side of the table

When conflict starts to erupt, a common dynamic to manage is blaming behavior (i.e., some version of "It is your fault"). In mediation we call upon a cliché to express a better dynamic. We do not let the parties metaphorically sit across the table and hurl 'me-against-you' accusations at one another. Instead we sit the disputants, again metaphorically, on the same side of the table and put the problem on the other side thereby creating an 'us-against-the-problem' frame. This point is similar to the "getting to yes" principle of separating people from the problem (Fisher et al. 1991). In retrospect I wonder how our goose hunting conflict might have played out if the dynamic could have been changed from, "You are incompetent!" to a negotiation about "How do we, together, ensure accuracy in the future?" But, because my director was consistently placed behind the events, he could never get in front to build that kind of frame. Successful conflict managers control the framing of the conflicted conversations to be about us against the problem.

Action 8. Have a rapid response capacity

Successful executives I have met have an ability to muster and deploy people and resources when a novel event comes their way. Again, my case histories, above, of executives being able to rapidly get in front of the fish kill issue but not the goose hunting issue are contrasting success stories. In the goose hunting fracas it was painful to watch as my smart colleagues were always behind the issue, especially due to the staff's lapse in reporting their error, and had to play defense against accusations from angry stakeholders. As an executive manager of conflict, ensure that you have the ability to remove impediments to deploying people and resources in the early stages of conflict.

Example of successful contingency planning featuring Action 7: Betsy and the Snakeholders

A California Department of Fish and Game biologist and her non-game and enforcement colleagues had a surprise dropped on them by snakeholding stakeholders. These stakeholders wanted to capture rubber boas (*Charina bottae*) from the wild to use in captive breeding so they could sell the progeny over the Internet. Without a warning to the staff, at a Fish and Game Commission meeting a charismatic snakeholder used a classy PowerPoint® presentation to make this appeal to the uninformed Commissioners. He believed he had the right to capture wild snakes as part of his business and wanted the Commission to sanction that belief through regulation. He ended his show with a bit of meeting magic. With a flourish at the key moment in his performance he pulled a snake from his coat sleeve. Caught off guard the Commissioners punted the issue to staff; that is, to Betsy and her colleagues. Sensing that the agency was about to lose management scope on the issue, these employees developed a contingency plan for Betsy to have up her sleeve.

As veterans of many disputes over rare species, Betsy and her team knew there are always multiple interests with opposing views about the right way to use the animals we manage. The staff also realized that because the snakeholders did an end-run by going directly to the Commission, the agency was no longer in front of the issue. They needed to reestablish the agency as the credible management authority and find a way to mediate the unbalanced advantage of one interest group. Betsy's solution was to bring together a forum of diverse stakeholders that represented the full range of opinions about managing native reptiles. She defined the purpose of the forum as a discussion about what principles should go into a wise public policy for managing capture from the wild and managing commerce involving reptile species that exist both in the wild and in captivity. Recognizing that the way the issue came up meant the agency was not in a credible position to run this meeting, the agency hired a neutral third party (me) to facilitate. By using an outside facilitator, the agency could assure meeting participants that a fair process would be used.

The meeting led to a new policy that regulated take from the wild and imposed standards and monitoring on commercial snakeholders (Fraidenburg 2002). In short, Betsy's contingency plan used a forum of competing interests to 'mediate' advantage to one vested interest and used the neutrality of the process to restore the legitimacy of active management by the agency. She did not sit the stakeholders across the table to talk at each other as combatants over the narrow topic of rubber boas. She put the full range of stakeholders on the same side of the table and had them combat a common problem on the other side—the question of what constitutes wise public policy for the capture of native reptiles from the wild and commerce in these species.

Actions that build a crisis management capacity

Despite your best prevention efforts and your elegant contingency planning, some things are going to go wrong. A while back I had the chance to help teach Afghanistan-bound soldiers about collaborative negotiations with non-combatants. In turn, these soldiers taught me about managing a crisis. They impressed upon me that success in their work means thinking beyond the immediate crisis to the steps that will generate a positive, long-term outcome. The objectives in crisis management are to:

- analyze the situation;
- stabilize the situation;
- implement damage control;
- protect assets;
- quickly define a minimum acceptable outcome;
- start rebuilding to achieve that outcome; and
- when the immediate threat is contained, devise post-crisis steps to avoid its resurgence or even improve the situation enough to remove the threat entirely.

Action 9. Analyze the situation

Evaluate the context of the conflict. Are there long-standing concerns and your issue is just the lightning rod? Has there been a sharp change in the natural or human environment? Is there a history of conflict between the parties that was not adequately resolved? Have you done something that sparked the conflict?

Identify the key actors driving the conflict. What are they doing? Are stakeholders coalescing and able to mobilize resources? Is there a new set of decision makers above you who are more sympathetic to the old issues the existing stakeholders support? What is motivating the key actors and how might they exert their influence?

Look for core grievances. Are there social and institutional relationships that the disputants perceive as a threat to basic needs like security, livelihood, or values? Feeling threatened, whether justified or not, can convince a disputant that the deck is stacked against them. And the conflict depends on the perceptions of the protagonists, whether true or not (Adams et al. 2003). Recall the difference between issues and interests presented above. The carrot farmers may be saying they are angry over the *issue* of incorrect data, but their *interest* could be about losing control. You may not be able to re-open the hunting season, but you might be able to do something that lets them regain the sense of control over crop depredation.

Identify any mitigating factors. Is information available that may improve the understanding of the key elements in dispute? Is there a respected, neutral third-party who can provide a moderating voice? Is there an alternative forum you can use that the parties respect?

Describe opportunities for increasing or decreasing conflict. What near-term events are capable of making things worse or better? What overarching values or what call-to-action can you use that allows disputants to identify with and then choose the "larger good" over their sub-group's specific wants or sense of identity?

Action 10. Stabilize the situation and rebuild relationships

Crisis means that stakeholders believe their needs are not being met and that, rather than working with you, they are better served looking for solutions without you or in spite of you. However, you also have needs during a crisis. Assert yourself by:

- Re-engaging. Do what it takes to encourage disaffected stakeholders to build a joint future with you, even if it is only agreeing to something simple like scheduling a first meeting to talk things over.
- Ensure security. Your first priority is to protect people and resources from physical harm and then create a working environment where people feel safe talking with one another.
- Re-establish legitimacy. By definition, a crisis means your stakeholders are trying to move forward without you. Because stakeholders no longer view you or your program as legitimate, do something to encourage their acceptance of your mandate. Invite them to understand and, if possible, share your accountability to the larger community. To the degree that the broader community outside of the disputants accepts your mission, let that be known.
- Manage expectations and communication. Constant, clear communication helps manage expectations about the realities of the situation. Whoever first communicates sets the tone and direction of reconstruction. If at all possible, be the first voice that is a positive role model of temperance and a call for reconciliation.
- Reestablish accountability and transparency. Estranged stakeholders do not trust you. Through your actions, reporting, and use of third parties, like the media, promise and then follow-through with remedial actions. Doing even simple things like giving scheduled briefings about the situation count at this stage.
- Deploy resources to produce quick and visible results. A crisis usually means something is at immediate risk. Determine what these vulnerabilities are and demonstrate that things are different now and that you are trying to prevent losses. In doing this, be careful of people looking for "gotcha" moments. These are the many critics and story-hungry reporters watching for waste or misuse. Be vigilant about monitoring and accounting for the resources you deploy.
- Build an effective transition. Like it or not, a crisis means that others have taken the initiative from you. View conflict transformation as an opportunity to transition back into your ability to manage the dynamics causing conflict. Conflict transformation requires reducing the drivers of the conflict (remember issues and interests from above?) while supporting solutions that respond to the range of interests of all stakeholders, including those who feel alienated.

Example of successful crisis management featuring Action 10: When sheep came to the meeting

In a rural part of my state, farmers and ranchers were critical of my former employer's land management, especially about reluctance to use herbicides for weed control. In a public meeting to discuss the new management plan for one of our wildlife areas, our local manager was surprised by the strange behavior of a county commissioner. The commissioner brought an armful of alfalfa and several sheep into the center of the meeting room. After tossing the alfalfa to the floor and putting the sheep on it to graze, he took over the meeting. He blamed the agency for putting honest, hard-working people like local sheep ranchers at risk, citing poor weed management by the agency as the cause. Realizing that the evening was a lost cause, the Department's land manager ended the meeting. To her credit, the very next day she called the commissioner and invited him out for coffee. I don't know what was said over coffee, but she negotiated the commissioner into jointly hosting a new meeting several weeks later. The two of them facilitated a respectful community dialog about how all parties could meet their different land management responsibilities—not about spraying weeds. That second meeting succeeded. A new plan was adopted for the wildlife area that was largely unmodified from the original proposal.

In responding to the crisis created by the county commissioner, the Department's land manager quickly assessed the situation and responded in the moment by ending the meeting. Thinking forward, she could see a way through the immediate crisis to a new response. It began with rebuilding her working relationship with the key actor by having coffee with the commissioner in a setting that did not promote the grandstanding behavior a public meeting encourages. She looked even further forward and proposed a joint public meeting sponsored by the commissioner and herself, thereby turning a crisis into an opportunity to reestablish accountability and transparency in her program. Using one of the techniques from contingency planning, she changed the topic from the narrow one of whether or not to use weed killers to an 'us-against-the-problem' frame. She put everyone on the same side of the table to discuss the problem on the other side—how she and everyone else could meet their full range of responsibilities, not about whether or not to use weed killers.

Use planning to ensure that staff does most of the conflict resolution work

So, how do you, as the executive in charge but who is not the person doing the actual work, get people moving in the right direction?

Action 11. Use full-circle planning

You do it by leading planning discussions to develop responses that match the urgency and severity of the conflict you face and that also create an expectation for completed staff work—i.e., provides a thorough situation analysis and identification of intervention solutions that are ready to implement without further work by you. The best tool I have found is the Comprehensive Planning Model (Figure 2) originally described by Crowe (1983) and now used by the Organization of Wildlife Planners. This model is useful because it is simultaneously simple, comprehensive, and highly adaptable across a broad range of circumstances. Answering the model's four planning questions forms a management system you can use to design an intervention and monitor achievement.

- *Where are we?* This is the inventory step. This usually focuses on, "What happened?" immediately followed by the questions of, "Who?", "When?", "Where?", "How?", and "How much?" Think of this as a situation analysis.
- *Where do we want to go?* This defines the outputs and/or outcomes you want to produce, i.e., your goals and objectives. Implicit in making a choice about strategic direction is making a decision about priorities. You cannot do everything, so this step is where you decide. Think of this as your strategic plan for addressing the conflict.
- *How will we get there?* This is designing the inputs (staffing, materials, activities, etc.) that are needed to generate the outputs you defined in the previous step. This step converts your priorities into actions. Because you do not have unlimited resources, this is where value judgments are made about how to allocate scarce money and staff time, that is, how to achieve efficiency and effectiveness. Think of this as your operational plan for intervening to manage the conflict.
- *Did we make it?* This is the evaluation step. It is the mechanism you have for ensuring accountability. And this is where you define the need for mid-course correction by re-entering this cycle of questions with updated information and experience. Thus, this step is the launching point for making your interventions an "adaptive management" process—your way of ensuring there is a structured, iterative process of increasingly improved decisions to reduce uncertainty over time. Think of this as continuous improvement.

All you need do, as the executive directing the activities of others, is get answers to these four questions. Doing so not only gives you an action plan, it is also a training tool. Imposing this thought process will communicate your expectations for completed staff work. You will know you are succeeding when, in future conflicts, employees automatically bring you answers to these four questions when they bring a new controversy to your attention.

Why consciously improve?

Because fish and wildlife agencies are doing the public's business, conflict management is in every employee's job description, like it or not. Failure to acknowledge this reality or help employees improve their skills means conflict problems will only get worse. Preparing people to manage conflict is more than just about sending them to a training class. It is about cultivating the skill set necessary for good conflict management along with cultivating the mindset that conflict management is a valued part of the organization's culture. If you are an executive wanting to leave a legacy of improved management capacity, this is a terrific leadership opportunity. Improving conflict management by your employees decreases the number of disputes that come into your office and improves our profession. Managing scarce natural resources in a world of growing conflict is a challenge for this century. If our management institutions can conceive that conflict management is a success skill that needs to be taught, I can conceive of a brighter future for the natural resources we care about. One of your executive opportunities is to make that happen.

Figure 2. The Comprehensive (Full Circle) Planning Model. This structured process uses four key planning questions that, taken together, create a comprehensive system for identifying need, defining interventions, and monitoring progress. Begin with the question at the top and proceed in a clockwise direction.

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A Hierarchical Spatial Framework and Database for the National River Fish Habitat Condition Assessment

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ABSTRACT: *Fisheries management programs, such as the National Fish Habitat Action Plan (NFHAP), urgently need a nationwide spatial framework and database for health assessment and policy development to protect and improve riverine systems. To meet this need, we developed a spatial framework and database using National Hydrography Dataset Plus (1:100,000-scale); http://www.horizon-systems.com/nhdplus). This framework uses interconfluence river reaches and their local and network catchments as fundamental spatial river units and a series of ecological and political spatial descriptors as hierarchy structures to allow users to extract or analyze information at spatial scales that they define. This database consists of variables describing channel characteristics, network position/connectivity, climate, elevation, gradient, and size. It contains a series of catchment-natural and human-induced factors that are known to influence river characteristics. Our framework and database assembles all river reaches and their descriptors in one place for the first time for the conterminous United States. This framework and database provides users with the capability of adding data, conducting analyses, developing management scenarios and regulation, and tracking management progresses at a variety of spatial*

Base de Datos y Marco Jerárquico-Espacial para la Evaluación Nacional de Hábitat de Peces Fluviales

RESUMEN: Los programas de manejo de pesquerías, tal como el Plan de Evaluación Nacional de Hábitat de Peces Fluviales (ENHPF) demandan urgentemente de un marco conceptual y de una base de datos para la realización de evaluaciones del estado de salud y establecimiento de políticas de desarrollo para proteger y mejorar los sistemas fluviales. Con el fin de satisfacer esta necesidad, en la presente contribución se desarrolla un marco jerárquico-espacial y una base de datos utilizando la Base Nacional de Datos Hidrográficos 1:100,000. El marco conceptual toma la inter-confluencia de los ríos y la red de cuencas como unidades espaciales fundamentales. Además de una serie de descriptores ecológicos y políticos como estructuras jerárquicas que permiten al usuario extraer o analizar información en las escalas espaciales de su preferencia. Esta base de daros consiste en variables que describen las características del canal, posición y conectividad de la red, clima, elevación, gradiente y tamaño. Contiene una serie de factores naturales y antropogénicos relativos a la captación cuya influencia sobre las características de los ríos es bien conocida. El marco conceptual y la base de datos ensamblan por primera vez todos los ríos de los Estados Unidos de Norteamérica, y sus descriptores. El marco y la base de datos ofrecen al usuario la posibilidad de agregar información, realizar análisis, desarrollar escenarios de manejo y regulación y dar seguimiento a los procesos del manejo en distintas escalas espaciales. Esta base de datos provee la información esencial para cumplimentar los objetivos del ENHPF así como de otros programas de manejo,. La versión beta descargable de la base de datos está disponible en http://ec2-184-73-40-15.compute-1.amazonaws.com/nfhap/main/.

scales. This database provides the essential data needs for achieving the objectives of NFHAP and other management programs. The downloadable beta version database is available at http://ec2-184-73-40-15.compute-1.amazonaws.com/nfhap/main/.

Introduction

The National Fish Habitat Action Plan (NFHAP) is a partnership-driven, nonregulatory, and science-based effort to enhance and conserve fish habitats throughout inland and coastal waters of the United States. Its primary goals are to protect healthy aquatic systems, prevent further degradation, and reverse declines in the quality and quantity of aquatic habitats. One of the short-term objectives of the NFHAP is to conduct a condition analysis of all fish habitat within the United States and identify national priority habitats for resource allocation and management prioritization from this analysis (http://www.fishhabitat.org).

To achieve these goals and objectives, the NFHAP urgently needs a spatial framework and database that provides nationwide information on the amount of fish habitats by type, condition, and location. Such a spatial framework and database must (1) have an integrated, objective standard for nationwide habitat condition comparison; (2) allow decision makers to use available data and assessment results to quickly identify areas of highest priority and the most cost-effective locations for protection, enhancement, and rehabilitation; and (3) have a reporting framework that allows the activities and progress of regional partnerships who are addressing priority habitats to be synthesized and reported at regional and national scales. Prior to this effort, a nationwide database and spatial framework meeting such needs was not available.

During the past several decades, the assessment of national water conditions has been carried out mainly by state water quality agencies, and the results have been reported biannually to the U.S. Environmental Protection Agency (EPA) under the requirement of Section 305(b) of the Clean Water Act. This national report and associated database does not meet the needs of the NFHAP because the inventory methods and assessment criteria are inconsistent among states, and the representation of the nation's water by subsamples of sites representing only a small percentage of national waters is uncertain (General Accounting Office 2000). The EPA's Environmental Monitoring and Assessment Program and the Wadeable Stream Assessment (WSA) Program used standardized probability sampling design. Those programs provide a statistically defensible generalization of conditions of the nation's waters and have markedly improved the representation of regional data summaries (Stoddard et al. 2005; EPA 2006). However, such data are inappropriate for providing information to unsampled parts of rivers in different landscape settings.

The failure of the existing national assessment databases in meeting the NFHAP needs relates to the fact that those assessments have predominantly focused on instream sampling. Such approaches require intensive field sampling of stressors and indicators and do not provide sufficient information for all aquatic habitats nationwide. An alternative approach relies on the increased availability of regional and national databases developed with geographic information systems (GIS) to directly assess sources of habitat degradation. Recent explorations of such an approach have been shown to be feasible and of proven effectiveness at regional scales (Mattson and Angermeier 2007; Wang et al. 2008, 2010). This approach is feasible because landscape alterations associated with human disturbances are the major cause of degradation to aquatic habitats and biological assemblages (Gergel et al. 2002; Allan 2004; Wang et al. 2006), and source–stressor–indicator relationships are well established (Karr and Chu 1997; Wang et al. 2008). This approach is also effective because it uses readily available data sets and GIS techniques, which make it possible to assess all aquatic habitats nationwide within a relatively short time period.

Under the guidance of the NFHAP Board's Science and Data Committee—and with support from the U.S. Fish and Wildlife Service and the U.S. Geological Survey (USGS)—an effort was initiated in 2007 to assess the nation's fish habitat conditions of inland waters. This effort has resulted in the development of an operational database and reporting framework that have basic spatial mapping units for all streams and rivers in the conterminous 48 states. This database has a hierarchical spatial structure that allows attribution of regional data with different spatial resolutions; allows data to be synthesized and reported at various spatial scales; and is flexible for attributing additional local data and for reporting at any needed spatial scale. This effort has attributed the database with appropriate national data that describe natural variation in river conditions and human disturbances and available biological data that may indicate river health conditions. This effort has made an initial assessment of riverine habitat condition, including the amount, types, health status and causes of degradation of different river habitats in the conterminous 48 states (Esselman et al. 2011).

The objectives of this article are to (1) describe the database hierarchical spatial structure, data sources, and the GIS processes used to attribute data into the database; (2) report briefly on a riverine aquatic habitat resource and its patterns in natural variation and levels of human disturbances at different spatial scales; and (3) illustrate the utility of the database and framework. See Esselman et al. (2011) for the national fish habitat condition assessment, which will not be reported here.

Database Heirarchical Spatial Structure, Data Sources, and GIS Processes

Basic Spatial River Mapping Units and Their Network Connectivity and Catchments

To develop the hierarchy spatial framework for assessing the condition of the nation's riverine fish habitats using human disturbance sources in the place of instream stressors or indicators, we first defined the finest spatial river unit boundaries that are ecologically meaningful and mappable nationwide using GIS tools. We then defined each river unit's position and connectivity within its river network and its land and water area boundaries within which human activities affect the unit. This is because the conditions of the spatial unit of a river network are not only influenced by the physicochemical and biological condition within the unit but also by its connectivity with the network, conditions in its riparian and floodplain zones, and natural and human factors in its local and network catchments (Wang et al. 2003, 2008; Higgins et al. 2005).

We used the river networks and associated catchments of National Hydrography Database Plus (NHDPlus) as the backbone for building the spatial framework and database. The NHDPlus is a 1:100,000-scale stream-line GIS database that includes all streams and rivers captured at this resolution, which is the best available nationwide data for rivers in the United States at the time of this study. Stream lines in the NHDPlus are divided into fundamental reaches (smallest spatial units; hereafter referred to as "river reaches") that are defined from the origin of a stream to a confluence at the downstream end, from a confluence to a confluence, from a confluence to the upstream end of an impoundment, from the downstream end of an impoundment to a confluence, or from a confluence to a pour point with the sea or lakes with no outlet (Brenden et al. 2006). These river reaches are the finest spatial units in our geographic framework. Within the database, the local catchment (the land area where surface runoff flows directly into the reach) and network catchment (the entire catchment area upstream of the downstream end of the reach) boundaries of each reach are delineated. This database covers the entire conterminous United States and has a topological structure (e.g., flow direction and neighbor river unit descriptor) that makes it feasible to calculate multiple river connectivity and network position variables using GIS tools.

Selection and Attribution of GIS Data

We only incorporated data that cover the entire conterminous United States at the highest resolution available. One type of variable attributed to each river reach captures the values of natural variations in climate, elevation, geology, soil, land cover, groundwater contribution, and river size and connectivity that can serve as surrogates of reach-level natural variation in physicochemical and biological characteristics (Table 1). Some of these descriptors of natural variation such as network catchment size, Strahler order, reach length, reach mean elevation, reach gradient, and mean annual air temperature and precipitation were from the NHDPlus database. The other natural variables, such as soil permeability, types of surficial geology, and groundwater contribution were calculated based on Internet data sources (Table 1) using GIS tools. The other type of variable measures variation in human activities in the river channels, riparian and floodplain, and catchments. River reach human disturbance descriptors, representing land uses, population density, transportation, nutrient enrichment, agricultural pollutants, dams, and point source pollutions, were gathered based on various data sources (Table 1) and their known influences on river health (Wang et al. 2003, 2008). We first attributed both natural and human activity variables in the local catchment to each river reach using ArcInfo's ZonalStats function for continuous and Arc Macro Language programs for categorical variables. We then attributed network catchment data to each river reach by summarizing each variable from all local catchments upstream of each reach using the NHDPlus Catchment Attribute Allocation and Accumulation Tool (http://www.horizon-systems.com/nhdplus/tools.php).

Selection and Attribution of Ecological and Political Spatial Descriptors

In addition to the variables measuring river reach natural variations and human disturbances, we attributed key ecological spatial hierarchical classes, biological assessment ecoregions, and political boundaries to each river reach. The ecological spatial classes included Freshwater Ecoregions of North America (FENA; Abell et al. 2000) and Ecological Drainage Units (EDUs; Higgins et al. 2005; Sowa et al. 2007); the biological assessment regions included the EPA's "aggregated ecoregions" (Pont et al. 2009) and the Hydrological Unit Code (HUC; Seaber et al. 1987); and the political boundaries included the locations of the National Fish Habitat Partnerships (FHPs) that have been recognized by the National Fish Habitat Action Plan Board and boundaries of states.

Freshwater ecoregions and EDUs are widely used geospatial units for biological conservation planning. A freshwater ecoregion is defined as a relatively large area of water with associated land that contains a geographically distinct assemblage of natural communities (Abell et al. 2000). The FENAs that we used were developed by Abell et al. (2000) based on the U.S. Department of Agriculture Forest Service's mapping project (Maxwell et al. 1995). EDUs represent regional biological community distinctions within a FENA unit (Higgins et al. 2005, Sowa et al. 2007). Though EDUs are ideally defined using knowledge of biological patterns from biogeography literature or multivariate analyses of species presence and absence, in practice EDUs are frequently delineated by identifying areas with similar abiotic patterns in physiography, climate, and connectivity because high-resolution species data are often lacking across large regions (Higgins et al. 2005).

TABLE 1. Summary of natural and human disturbance data sources that were attributed to each of the river reaches and included in our database. NLCD = National Land Cover Database; NHDPlus = National Hydrography Dataset Plus; STATSGO = State Soil Geographic Database; TIGER = Topologically Integrated Geographic Encoding and Referencing System; SPARROW = Spatially Referenced Regressions on Watershed Attributes; HUC = Hydrologic Unit Code. Date = year or range of years for each data source.

Description	Source	Resolution	Date
Natural variables			
Land cover—Deciduous forest	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Evergreen forest	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Mixed forest	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Open water	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Shrub/scrub	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Grassland/herbaceous	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Woody wetlands	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Open wetlands	NLCD (http://www.mrlc.gov/)	30 m	2001
Local catchment area	NHDPlus (http://www.horizon-systems.com/nhdplus)	1:100,000	2007
Network catchment area	NHDPlus (http://www.horizon-systems.com/nhdplus)	1:100,000	2007
Mean annual air temperature	NHDPlus (http://www.horizon-systems.com/nhdplus)	4 km	1961–1990
Mean annual precipitation	NHDPlus (http://www.horizon-systems.com/nhdplus)	4 km	1961–1990
Reach elevation	NHDPlus (http://www.horizon-systems.com/nhdplus)	30 m	
Reach slope	NHDPlus (http://www.horizon-systems.com/nhdplus)	30 m	
Reach stream order	NHDPlus (http://www.horizon-systems.com/nhdplus)	1:100,000	
Reach linkage number	Calculated from NHDPlus	1:100,000	
Soil permeability	USGS STATSGO (http://water.usgs.gov/GIS/metadata/usgswrd/XML/ussoils.xml)	1:250,000	1995
Surficial lithography	Surficial geology (http://rmgsc.cr.usgs.gov/ecosystems/usa.shtml)	1 km	2009
Disturbance variables			
Cattle density on farmland	USDA Agriculture Census (http://nationalatlas.gov/mld/agcensp.html)	County	2002
Dam density	USACE National Inventory of Dams (http://crunch.tec.army.mil/)nidpublic/webpages/nid.cfm	Point data	2005
Estimated groundwater use	USGS Estimated Water Use in US (http://water.usgs.gov/watuse/)	County	2000
Estimated surface water use	USGS Estimated Water Use in US (http://water.usgs.gov/watuse/)	County	2000
Human population density	NOAA Population 2000 (http://www.ngdc.noaa.gov/dmsp/download_sprawl.html)	1 km	2000
Imperviousness	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Pasture/hay	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Cultivated crops	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Open space urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Low-intensity urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Medium-intensity urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—High-intensity urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Mining density	USGS Active Mines (http://tin.er.usgs.gov/mineplant/)	Point data	2003
National Pollutant Discharge Elimination System Density	EPA Geodata Shapefile (http://www.epa.gov/enviro/geo_data.html)	Point data	2007
Road crossing density	Census 2000 TIGER Roads (http://www.esri.com/data/download/census2000-tiger-line/index.html)	1:100,000	2000
Road length density	Census 2000 TIGER Roads (http://www.esri.com/data/download/census2000-tiger-line/index.html)	1:100,000	2000
Superfund National Priority List Density	EPA Geodata Shapefile (http://www.epa.gov/enviro/geo_data.html)	Point data	2007
Toxics Release Inventory density	EPA Geodata Shapefile (http://www.epa.gov/enviro/geo_data.html)	Point data	2007
Total phosphorus yield	USGS SPARROW (http://water.usgs.gov/nawqa/sparrow/wrr97/results.html)	8-Digit HUC	1974–1989
Total nitrogen yield	USGS SPARROW (http://water.usgs.gov/nawqa/sparrow/wrr97/results.html)	8-Digit HUC	1974–1989

The aggregated ecoregions and HUCs are commonly used for biological assessment. The aggregated ecoregions were originally formed by merging Omernik's (1987) Level-III ecoregions, in order to assess and report the condition of river systems using macroinvertebrates (EPA 2006). Each aggregated ecoregion has similar landform and climate characteristics and has been used for developing large-scale bioassessment techniques and sampling designs (e.g., Pont et al. 2009). HUCs were created by dividing and subdividing the United States into successively smaller hydrologic units that are arranged in a nested fashion (Seaber et al. 1987). The 8-digit and 12-digit HUCs we used provide a standardized base for use by water-resources organizations in locating, storing, retrieving, and exchanging data.

The FHP and state are political boundaries within which assessment and management policies are often implemented. The geographic boundaries of FHPs are areas within which the partnerships work to conserve target aquatic features or species of interest. The geographic boundaries of FHPs are variable and may nest within natural drainage units, span multiple administrative states, and, in some cases, partially overlap with one another. Generally, one FHP contains multiple states, but not all parts of all states are included (http://fishhabitat.org/).

Spatial Hierarchical Classification Framework

River reach habitat characteristics and their associated biological communities are a result of integrated influences of climate, elevation, geology, soil, land cover, river network position and connectivity, and human activities in local and network catchments and interactions across ecological spatial hierarchical units (Frissell et al. 1986; Poff 1997; Wang et al. 2006). Arguably, fish habitat characteristics and their associated biological communities are also influenced by political boundaries and biological assessment regions, because management policies and their implementations often differ among these entities.

The smallest mappable spatial unit in our database is the river reach (Figure 1). Each river reach has unique local and network catchment boundaries and descriptors of river network

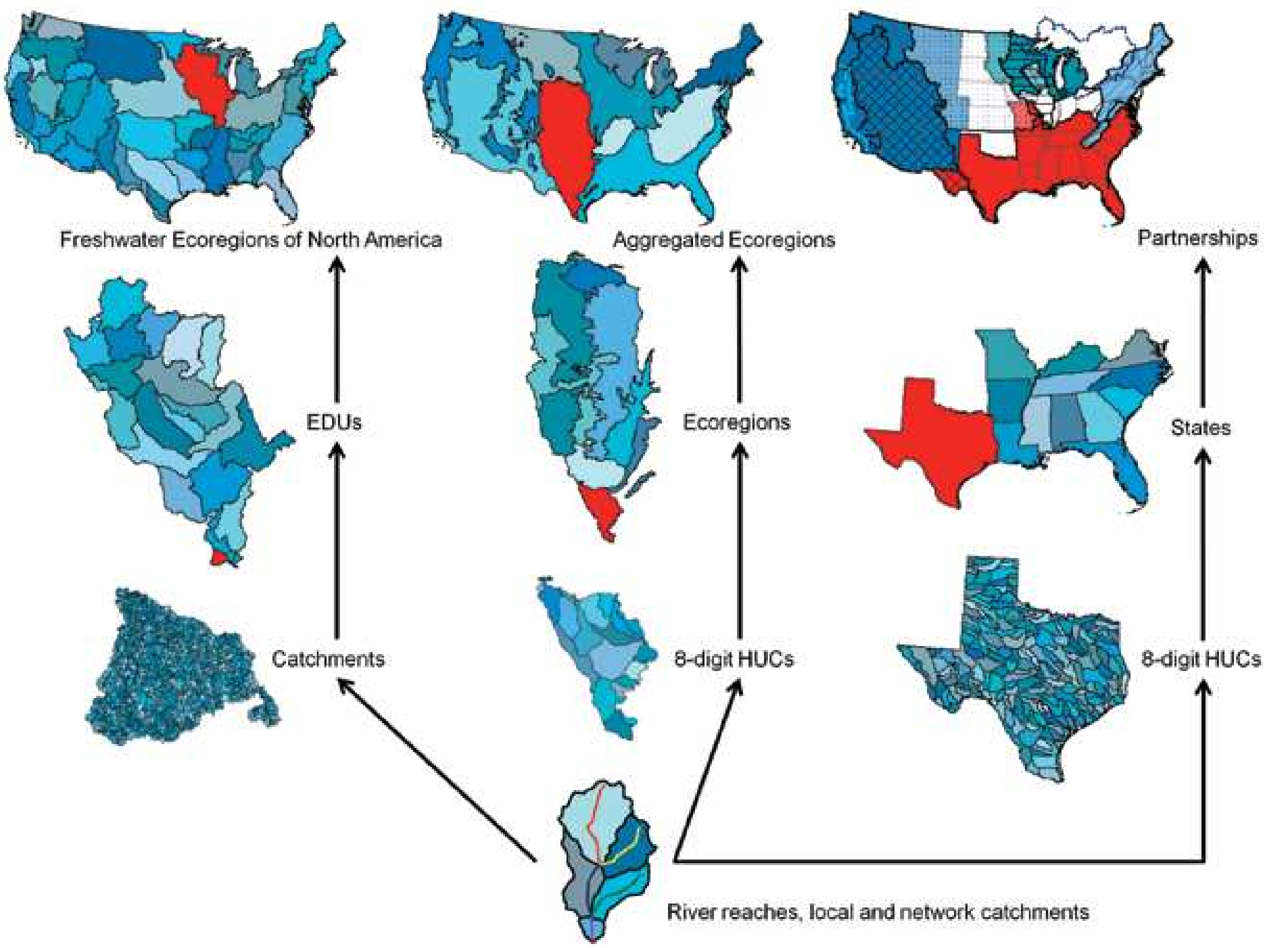

Figure 1. Database spatial framework. The smallest mappable spatial unit is a river reach and its associated local catchment. Data attributed to such river reach units can be aggregated into and analyzed at many larger hierarchal spatial scales

position and connectivity. Each river reach is associated with a unique FENA, EDU, ecoregion, HUC, FHP, and state. The river reach, local catchment, network catchment, EDU, and FENA occur as a spatial hierarchical series. The local catchment associated with a river reach is nested within a network catchment; the network catchment is often, but not always, nested within an EDU; and the EDU is often nested within a FENA. Such a nested structure reflects the notion that factors defined at lower hierarchical spatial levels may be influenced by factors defined at higher levels (Frissell et al. 1986; Poff 1997; Wang et al. 2003, 2006). This nested structure has important implications for users. When answering basic ecological questions or identifying cause–effect factors at a river reach scale, researchers can evaluate or model not only what they see or can directly measure but can incorporate influences of abiotic and human activity factors at increasingly larger spatial scales upstream. When making management decisions, policy makers and managers can consider not only lower spatial scale factors but can incorporate higher level spatial factors so that they can target management activities at high-priority spatial scales and areas.

Local catchments, HUCs, states, and FHPs also generally occur as a hierarchical series. An FHP consists of multiple states, a state consists of multiple HUCs, and an HUC consists of multiple local catchments. Such a partially nested structure not only reflects that factors at lower hierarchical spatial levels are influenced by factors at higher levels but implies that management of any particular aquatic feature and fish species for any river reach will be influenced by the state's management policies and implementation, which in turn will be influenced by collaborating efforts within an FHP. Additionally, many state and national river bioassessment programs use ecoregions and HUCs for sampling stratification and reporting. Incorporating such spatial units into our database provides the flexibility and efficiency of linking with the existing state and national river assessment programs.

The spatial hierarchical structure of our database can be visualized as a data table or a spreadsheet with many rows and columns. Each row in the table represents a river reach, and each column represents a variable that describes the river reach. This table includes all river reaches and contains all available attributes that describe the river reach channel conditions, network position and connectivity, local and network catchment natural and human disturbance conditions, and spatial hierarchical ecological and political boundaries. This table also provides users with the flexibility of adding new data (add more columns) that are available only to the region where the users are interested.

Such a spatial hierarchical database structure has several important implications. First, the river reaches in our database are mapped and riverine habitat condition assessment can be done for all rivers for the given mapping resolution. This contrasts with the commonly used river condition assessment approaches, such as the EPA's Wadeable Stream Assessment (EPA 2006), which only applies to a small percentage of the rivers in a specific region but cannot provide condition assessment on all river reaches. Second, our database links every river reach with all available potential human disturbances at local and network catchments, which not only allows river assessment to be done for all reaches but permits assessments based on disturbance sources within landscapes rather than stressors within the rivers. The landscape-based assessment is especially helpful to managers for pinpointing dominant sources of disturbances on which management activities can focus. Last, the hierarchical spatial structure of our database provides the capability to summarize data at different spatial scales (Figure 1).

Riverine Resource Physical Characteristics at Different Spatial Scales

Our database consists of boundaries for 46 FENAs, 272 EDUs (a region where EDUs were not yet delineated was counted as one EDU), 9 aggregated ecoregions, 85 Level-III EPA ecoregions, 13 FHPs, 48 states, 2,104 8-digit HUCs, and about 2.6 million river reaches. Because catchment size, precipitation, air temperature, elevation, gradient, and groundwater contribution are critical factors that determine river physicochemical and biological characteristics and are often used for river habitat classification (e.g., Brenden et al. 2008; Lyons et al. 2009), we summarized the river reach characteristics using these six factors to describe the overall natural variation in river landscape conditions across the conterminous United States.

River Reach Natural Characteristics across the Conterminous United States

To describe the characteristics of the six natural descriptors, we classified each factor into four to six groups. These groupings were intended to describe the spatial distribution patterns of these factors and to provide a coarse-level understanding of the diversity of the resource at a national scale rather than to generate a meaningful ecological classification.

Based on literature review, we grouped the river reaches into six size classes based on network catchment area. We classified streams with catchments less than 10 km^2 as headwaters, 10 to 100 km^2 as creeks, 100–1,000 km^2 as small rivers, 1,000–10,000 km^2 as medium rivers, 10,000–25,000 km^2 as large rivers, and greater than 25,000 km^2 as greater rivers. River reaches having no network connection were classified as disconnected. Of the 5.6 million kilometers of streams and rivers (including artificial water lines flowing through ponds, lakes, reservoirs, wetland, and intermittent streams), the majority of reaches are headwaters (58.9%) and creeks (27.0%); small and medium rivers consist of 9.1% and 3.5% and large and greater rivers consist of 0.6% and 0.9% total stream and river length. When only free-flowing waters are included, the conterminous United States has about 4.9 million kilometers of streams and rivers, of which about 55.4% are headwaters, 29.9% are creeks, 9.8% are small rivers, 3.5% are medium rivers, 0.6% are large rivers, and 0.8% are greater rivers (Figure 2).

The five mean annual precipitation river reach classes were identified using a multivariate classification and regression tree analysis based on fish abundance data (De'ath and Fabricius 2000). The fish data were collected by the EPA's Environmental Monitoring and Assessment Program, the USGS's National Water-Quality Assessment Program, and the states' monitoring and assessment programs and included 4,450 river reaches across the 48 states. The river reaches in our database were repeatedly split into paired classes based on fish variables that minimize the sum of squared error between the observation and the mean in each class. We chose the least squares method to simply split river reaches into a maximum of five

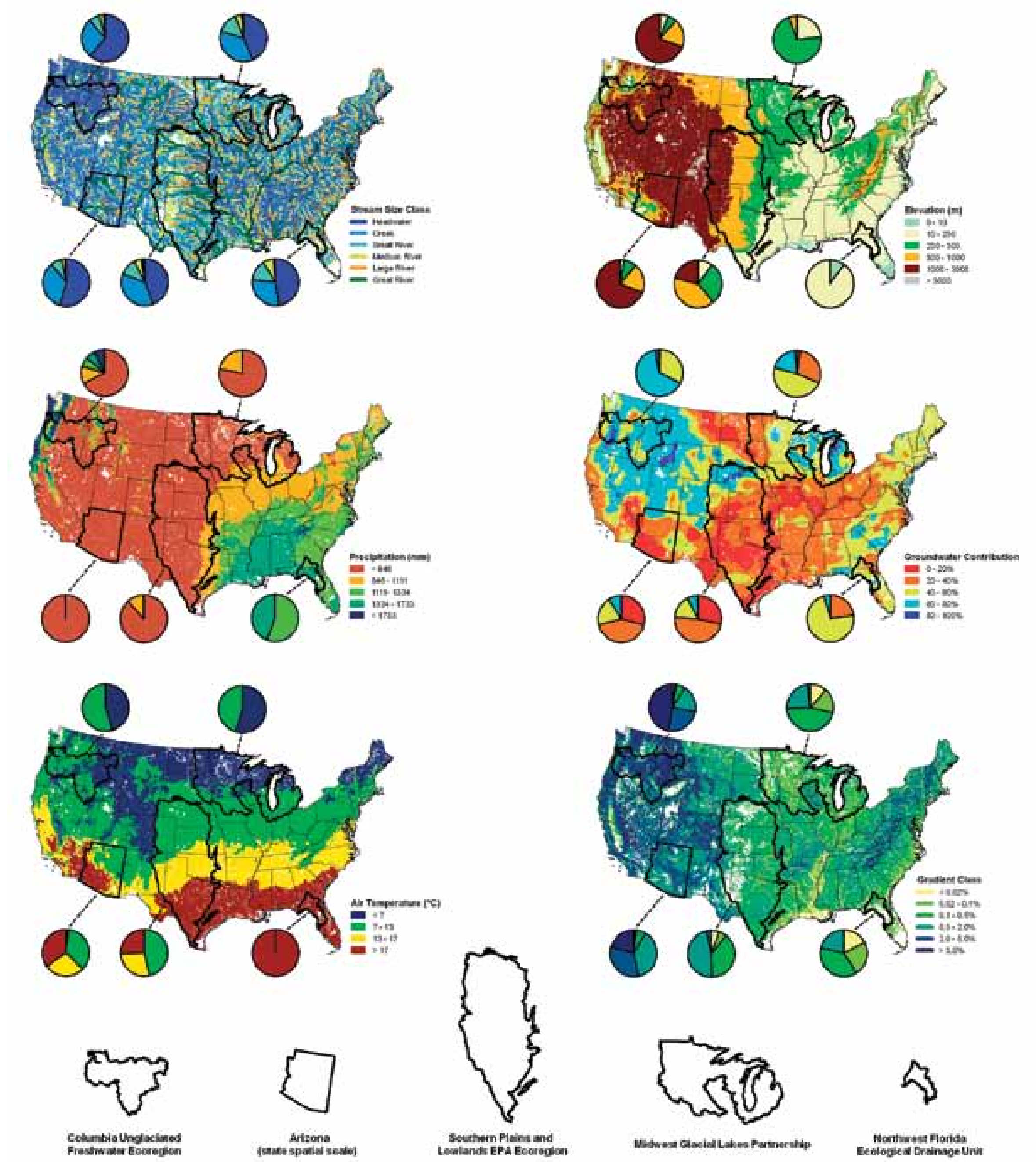

Figure 2. The six natural factors used for characterizing river reach natural variation across the conterminous United States. For river size class maps, impoundments are not shown. The pie charts are examples of data that were summarized at different spatial scales.

classes to describe the spatial distribution patterns rather than to generate a meaningful ecological classification. We then applied the precipitation values that defined the classes to river reaches that do not have fish data. About 56% of river length receives less than 846 mm annual precipitation, 19% between 846 and 1,111 mm, 14% between 1,111 and 1,334 mm, 10% between 1,334 and 1,733 mm annual precipitation, and 1% receives greater than 1,733 mm. The class of rivers with the highest precipitation in their catchments occurs primarily in the western coastal areas. The precipitation pattern in the eastern third of the lower 48 states is increasing from north to south, and precipitation for two-thirds of the middle states largely belongs to the lowest precipitation class (Figure 2).

The four mean annual air temperature river reach classes were identified based on multivariate classification and regression tree analysis using the same fish abundance data described above. About 27% of all river length flows through regions with mean annual air temperatures less than 7°C, 41% between 7°C and 13°C, 21% between 13°C and 17°C, and 11% flows through regions with temperatures greater than 17°C. As expected, mean annual air temperature shows a southward increasing pattern except for the Rocky Mountain region, which has high elevation (Figure 2).

Six elevation river reach classes were identified starting with a low-elevation class of less than 10 m above sea level suggested in the literature (McGranahan et al. 2007) and then subjectively dividing the rest of the elevation range into five groups. In the conterminous United States, about 3% of river reach length is within an elevation of less than 10 m, 30% between 10 and 250 m, 22% between 250 and 500 m, 17% between 500 and 1,000 m, 29% between 1,000 and 3,000 m, and less than 1% at elevations greater than 3,000 m. The higher elevation groups are mainly found in the western third of the country and the low-elevation groups are mainly distributed in the Midwest and Southeastern regions (Figure 2).

Six river reach gradient classes were identified based on criteria proposed by the Northeast Habitat Classification and Mapping Projects by The Nature Conservancy (http://www.glrc.us/documents/habitatworkshops/pdf/NYWorkshop/Tomajer090324.pdf). About 12% of total river length has a gradient less than 0.03%, 6% between 0.02% and 0.1%, 21% between 0.1% and 0.5%, 33% between 0.5% and 2.0%, 15% between 2.0% and 5.0%, and 13% has gradient greater than 5.0%. The high-gradient streams are mainly distributed in the western areas and the low-gradient streams are mainly located in the midwestern areas of the conterminous United States (Figure 2).

We grouped the river reaches into five groundwater contribution classes using equal range values. About 18% of total river length has groundwater contribution less than 20%, 33% between 20% and 40%, 29% between 40% and 60%, 19% between 60% and 80%, and less than 1% has groundwater contribution greater than 80%. The highest groundwater contribution areas are sparsely distributed in Michigan, Idaho, Oregon, and Nebraska. The high-groundwater contribution areas are located in the northwestern areas and low-groundwater contribution areas are in the south-central areas of the conterminous United States (Figure 2).

The six natural factors described above interactively influence river thermal and hydrologic regimes, substrate and channel characteristics, and physicochemical properties and consequently determine the national patterns of fish habitat distribution. The majority of the reaches (over 85% in length) are headwaters and creeks (less than 100 km^2 catchment area), implying that great attention needs to be given to those reaches in order to maintain the health of the entire river systems in the United States. The lower air temperature resulting from high elevation in the Rocky Mountains and high altitude in northern regions and the spotted higher groundwater contribution areas are where the major relatively stable thermal and hydrologic habitats are found for various size streams and rivers. In contrast, it is generally expected that headwaters and creeks have habitat with varied temperature and flow regimes, small and medium rivers have moderately stable temperature and flow regimes, and large rivers have more stable temperature and flow regimes.

River Reach Natural Characteristics Described by Different Spatial Scales

Our database allows us to summarize natural descriptors attributed to reaches at various spatial units from individual river reaches and their associated local catchments to the entire nation. At the largest spatial scale (conterminous United States), the median values of temperature, elevation, gradient, groundwater contribution, and precipitation are 11°C, 358 m, 0.8%, 42%, and 885 mm, respectively. At the intermediate spatial scales such as the aggregated ecoregions, the median values of the five variables are 10°C, 307 m, 1.2%, 41%, and 887 mm. At the finer spatial scales such as the 8-digit HUCs, the median values of the five variables are 11°C, 376 m, 1.1%, 43%, and 819 mm, respectively.

These factors summarized at different spatial scales show a dependency of central tendency and variability depending on the units chosen (Table 2). In general, FENA has the highest median values for air temperature, elevation, and river reach gradient and Level-III ecoregions have the highest median values for groundwater contribution and precipitation. For the six river size classes, the values for mean annual air temperature increased as river size increased. The values of river reach elevation, gradient, and precipitation generally decreased as river size increased. In contrast, the values for groundwater contribution did not show a clear trend (Table 2).

TABLE 2. Summary statistics of natural factors at different spatial scales, including the conterminous United States (CUS), aggregated ecoregion (AgEco), Freshwater Ecoregions of North America (FENA), state, Level-III ecoregion (Ecoreg), ecological dranage unit (EDU), 8-digit hydrologic unit (HUC-8), and the six river size classes. HWT = headwater, CRK = creek, SRV = small river, MRV = medium river, LRV = large river, and GRV = greater river. See text for the river size classification criteria.

		CUS	AgEco	FENA	State	Ecoreg	EDU	HUC-8	HWT	CRK	SRV	MRV	LRV	GRV
Air temperature (°C)	90%	17	17	20	17	17	18	18	17	18	18	18	18	19
	Median	11	10	13	11	11	10	11	11	11	11	11	10	12
	10%	5	6	6	5	5	5	5	5	5	5	6	6	7
Elevation (m)	90%	1,792	1,502	1,757	1,744	1,689	1,751	1,752	1,845	1,808	1,683	1,525	1,462	1,131
	Median	358	307	393	337	262	307	376	360	381	331	287	283	243
	10%	64	60	71	75	49	65	52	73	64	50	27	9	5
Gradient (%)	90%	6.4	7.3	7.3	7.4	4.5	5.5	6.2	9.7	3.4	1.2	0.5	0.3	0.2
	Median	0.8	1.2	1.7	1.2	1.0	1.1	1.1	1.4	0.5	0.1	0.0	0.0	0.0
	10%	0.0	0.4	0.4	0.2	0.4	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0
Groundwater Contribution (%)	90%	68	62	65	66	60	68	68	68	69	68	69	72	67
	Median	42	41	41	42	47	46	43	42	43	43	45	47	43
	10%	19	30	22	22	26	22	18	20	18	19	21	23	22
Precipitation (mm)	90%	1,396	1,328	1,433	1,357	13,57	1,414	1,384	1,412	1,381	1,369	1,343	1,310	1,271
	Median	885	887	776	917	1042	920	819	929	839	835	805	626	632
	10%	316	338	776	361	415	366	346	336	302	295	271	251	254

Landscape Disturbances to Riverine Resources at Different Spatial Scales

The physicochemical and biological conditions along with their controlling processes of rivers in the conterminous United States have been substantially modified by landscape human activities, such as agricultural, urban, recreational, commercial, industrial, and transportation land uses; river network fragmentations; and point source pollutions (e.g., Paul and Meyer 2001; Wang et al. 2006, 2008). We summarized the percentages of agricultural, urban, and impervious land uses and densities of population, road crossing, road length, dams, and toxic release inventory sites to characterize human landscape disturbances at different spatial scales and river size classes. Although our database contains many more landscape human disturbance measures, the following summary of selected variables provides an overview of the patterns of riverine landscape disturbance across the conterminous United States.

Landscape Disturbance to River Reaches across the Conterminous United States

Statistics on river length that are impacted both heavily and minimally by each of the major landscape human disturbances provide a national perspective on the conditions of fluvial systems for the conterminous 48 states. Based on literature-reported thresholds of landscape human disturbance levels (e.g., Paul and Meyer 2001; Wang et al. 2003, 2008), about 1.1% of river length is strongly impacted by network catchment agricultural land use (>75%) and 2.3% by urban land use (>10%) across the conterminous United States. In contrast, about 14.5% of river length is minimally affected by catchment agricultural land use (<10%) and 11.8% by urban land use (<1%). Similarly, about 0.5% of river length is strongly impacted by catchment impervious land (>5%), 1.7% by human population (>50 people/km^2), 2.1% by roads density (>2 km/km^2), and less than 1% by dam density (4 dams/100 km^2) or point source pollution (5 permits/100 km^2). In contrast, about 1.1% of river length is minimally impacted by impervious land (<0.1%), 5.6% by population density (<1 person/km^2), 1.9% by roads (<0.5 km/km^2), 1.1% by dams (0 dam/100 km^2), and 3.3% by point source pollution (0 permit/100 km^2; Figure 3).

Although the percentage of rivers that are strongly impacted by each disturbance alone appears small, the sum of the river lengths that are impacted by the eight disturbances is substantial (14.7%). Additionally, the percentages of rivers that are jointly impacted by the accumulative influences of the disturbances could be magnified, although the actual level of each individual disturbance may be low or moderate.

In general, urban land use, impervious land, and population density are intercorrelated, and the majority of the impacted rivers are distributed in the eastern third of the United States and the western coastal states (Figure 3). Catchment agricultural land impacted a large number of rivers in the Midwestern states. Although road density and road crossings impacted the entire United States, they impacted more rivers in the eastern half of the country. Dam densities are particularly high for the Mississippi River drainage, and densities of both dams and point source pollution are high in the eastern portion of the United States.

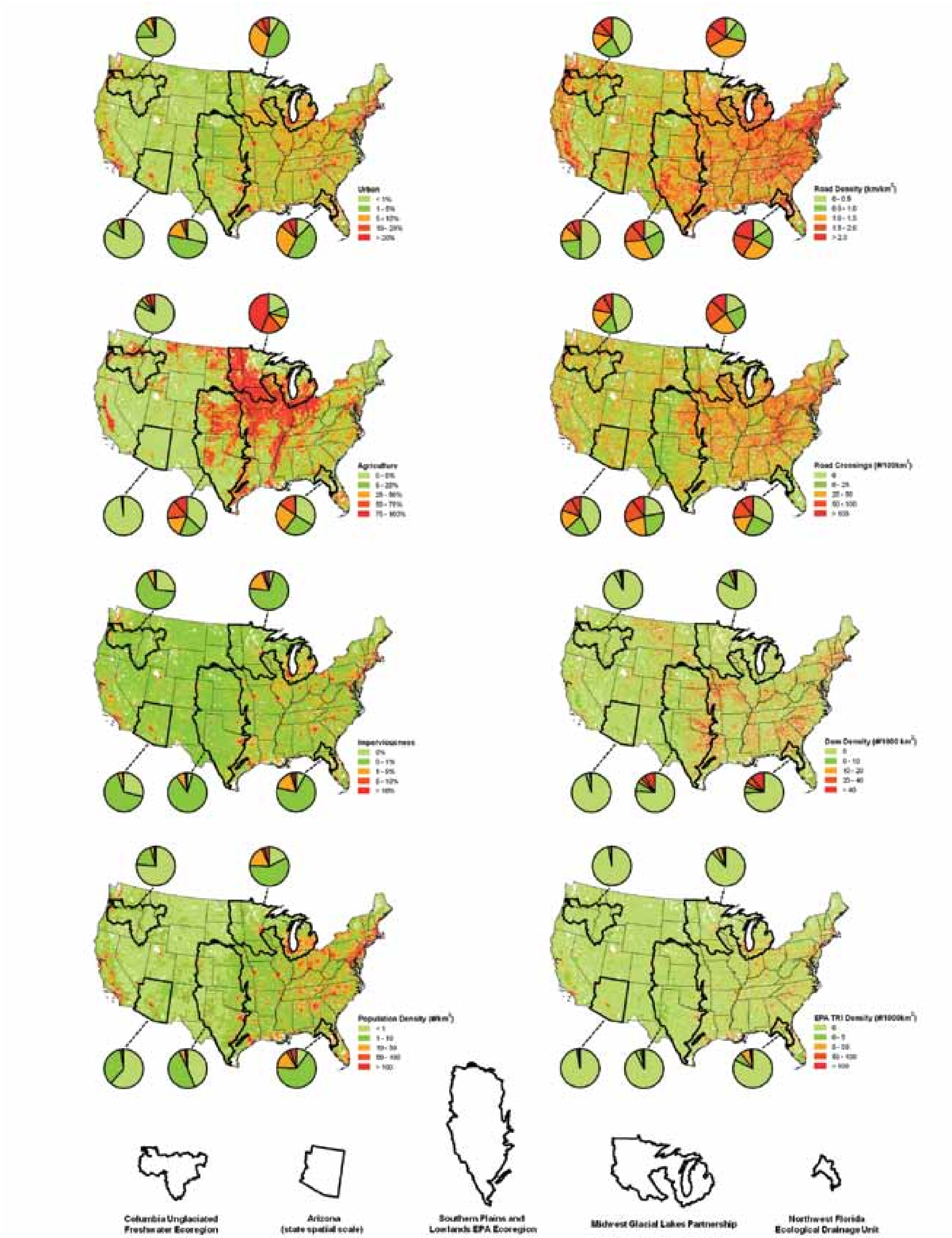

Figure 3. The eight human disturbance variables used for characterizing river reach conditions across the conterminous United States. The pie charts are examples of data that were summarized at different spatial scales.

Landscape Disturbance to River Reaches at Different Spatial Scales or Stream Classes

Our database allows us to summarize landscape human disturbances attributed to reaches at any of the spatial units. At the largest spatial scale (conterminous United States), the median values of agriculture, urban, imperviousness, population, road crossings, road length, dams, and point source permits in the catchments of river reaches are 7.5%, 2.9%, 0.3%, 2.4 people/km^2, 32.0 crossings/100 km^2, 11.2 km/100 km^2, 0.0 dams/1,000 km^2, and 0.0 permits/1,000 km^2, respectively (Table 3). At the intermediate spatial scales such as the aggregated ecoregions, the median values of the eight variables are 23.0%, 6.1%, 1.2 %, 17.1 people/km^2, 63.8 crossings/100 km^2, 13.2 km/100 km^2, 19.7 dams/1,000 km^2, and 5.1 permits/1,000 km^2. At the finer spatial scales such as the 8-digit HUCs, the median values of the eight variables are 13.6%, 4.0%, 0.5%, 5.4%, 45.4 crossings/100 km^2, 12.5 km/100 km^2, 5.2 dams/1,000 km^2, and 0.8 permits/1,000 km^2, respectively.

The levels of catchment disturbances summarized at different spatial scales vary according to the spatial units chosen (Table 3). In general, the aggregated ecoregion scale has the highest median values for agriculture, urban, imperviousness, road crossings, dams, and point source permits and the state scale has the highest median values for agriculture and road length density. For the six river size classes, the median values for agriculture, imperviousness, population density, and dam density increased and that of road crossing density decreased as river size increased. There were no clear relationships between river size and the median values of urban land, road length density, and point source permits (Table 3).

The conterminous United States consists of varied levels in these catchment disturbances, and the variability of the levels is spatial unit-size dependent (Table 3). The 10th and 90th percentile values of agriculture, urban, imperviousness, population, road crossings, road length, dams, and point source permits in the catchments of river reaches across the 48 states are 0.0% and 77.8%, 0.0% and 9.4%, 0.0% and 1.6%, 0.0 and 24.7 people/km^2, 0.0 and 105.0 crossings/100 km^2, 0.4 and 22.9 km/100 km^2, 0.0 and 17.8 dams/1,000 km^2, and 0.0 and 0.0 permits/1,000 km^2, respectively. In general, data summarized at the state scale have the highest 10th and 90th percentiles for imperviousness, population, road length, dams, and point source permits and at the 48-state scale the highest 90th percentiles for agriculture and road crossing density. The 90th percentile values of agriculture land, road crossing density, road density, and dam density (except headwater) decreased, and that of population density increased as river size increased. The 90th percentile values of urban land, imperviousness, and point source permits did not show a clear relationship with river size (Table 3).

Utility of the Spatial Framework and Database for NFHAP and Other Research and Management Programs

Our hierarchical spatial framework and database assembles in one place all stream and river reaches and their associated descriptors for channel positions, network connectivity, and local and network catchment natural variation and human disturbances for the first time for the conterminous United States. This hierarchical spatial framework and database has a broad array of uses for NFHAP to achieve its goals and can help meet many other research, assessment, and management needs at national, regional, and local scales.

The framework and database provides NFHAP with the best available information about the amounts, types, and locations of natural and human landscape influences on the nation's river resources. This information is available for any specific stretch of a river; for entire river networks; and for rivers located within a specific local area, planning district, state, multistate region, FHP partnership region, or the entire conterminous United States. Such information can meet the needs of local stakeholders who are interested in only their local river reaches; watershed groups who are interested in specific catchments; local governments and planners who are managing counties or districts; state governments who are responsible for rivers within their state boundaries; partnerships who have common interests in regionally featured river resources; and the efforts of NFHAP in identifying and reporting national river resources within political or ecological boundaries by river types or by socially and economically important biological communities.

Our database not only provides information about rivers themselves but describes river reaches' network connectivity, position, and natural conditions of local and network catchments, which has very broad utilities for achieving NFHAP's goals and for other research, assessment, and management activities. This information is extremely important because the natural physicochemical and biological habitat characteristics of a river reach are largely determined by the geomorphic, land cover, and climate conditions at the channel, riparian, and local and network catchment scales, in addition to a river reach's network position and connectivity (e.g., Frissell et al. 1986; Poff 1997; Wang et al. 2006). An important potential use of our database is for ecological classification of ecosystem and macrohabitat types. River reach classification and physicochemical and biological expectation establishment are critical for natural resource policy-making, regulation, and scientific hypothesis testing. Previously, such classification and expectation were developed conceptually or based on selected river sites with sampled data (e.g., Frissell et al. 1986; Hawkins et al. 1993), which does not allow mapping of all river reaches into classes for a region. More recently, such a classification has been expanded to have the capability of mapping all river

TABLE 3. Summary statistics of human disturbance factors at different spatial scales, including medians (Med), 90th percentiles (90%), and 10th percentiles (10%), for agricultural land use (Ag, %), urban land use (Urb, %), imperviousness (Imp, %), human population density (Pop, #/km^2), road crossing density (RdC, #/100 km^2), road density (RdL, 100 m/km^2), dam density (Dam, #/1,000 km^2), and toxic release inventory sites density (TRI, #/1,000 km^2) for conterminous United States (CUS), aggregated ecoregion (AgEcor), Freshwater Ecoregions of North America (FENA), state, Level-III ecoregion (Ecoreg), ecological drainage unit (EDU), 8-digit hydrologic unit (HUC-8), and the six river size classes. HWT = headwater, CRK = creek, SRV = small river, MRV = medium river, LRV = large river, and GRV = greater river. See text for the river size classification criteria

		CUS	AgEco	FENA	State	Ecoreg	EDU	HUC-8	HWT	CRK	SRV	MRV	LRV	GRV
Ag	90%	77.8	69.6	40.0	51.0	61.9	65.1	68.8	79.5	77.6	76.1	71.2	60.1	49.5
	Med	7.5	23.0	12.5	21.9	13.9	17.6	13.6	5.6	7.5	11.6	13.4	12.9	16.5
	10%	0.0	1.7	0.3	2.5	0.3	0.6	0.1	0.0	0.0	0.0	0.1	0.8	2.3
Urb	90%	9.4	7.9	9.6	18.0	12.4	10.9	10.5	9.8	8.9	8.8	8.8	9.8	8.5
	Med	2.9	6.1	4.0	5.8	4.4	4.7	4.0	2.6	3.1	3.6	3.9	3.4	3.2
	10%	0.0	1.4	0.5	0.8	0.6	0.5	0.3	0.0	0.0	0.0	0.4	0.5	0.8
Imp	90%	1.6	1.6	2.7	4.7	3.3	2.6	2.4	1.5	1.6	1.7	1.7	2.1	1.8
	Med	0.3	1.2	0.7	1.0	0.6	0.7	0.5	0.2	0.3	0.4	0.5	0.5	0.5
	10%	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.1	0.1	0.2	0.2
Pop	90%	24.7	41.9	49.3	141.1	61.7	51.4	48.7	21.8	24.3	29.5	31.9	44.8	37.8
	Med	2.4	17.1	8.8	19.9	10.2	9.6	5.4	2.4	2.1	2.9	4.8	4.7	6.2
	10%	0.0	0.6	1.1	1.4	0.7	0.5	0.2	0.0	0.0	0.0	0.2	0.4	1.0
RdC	90%	105.0	80.2	94.9	102.2	99.2	99.8	103.6	135.7	76.9	65.8	58.7	49.1	41.3
	Med	32.0	63.8	54.3	62.0	63.6	53.7	45.4	35.4	31.5	31.9	29.2	27.0	21.3
	10%	0.0	30.6	28.3	36.0	30.9	27.1	19.9	0.0	4.8	9.5	11.2	10.0	15.7
RdL	90%	22.9	17.7	18.9	26.5	18.9	20.6	19.8	25.0	21.1	19.5	18.8	19.4	17.4
	Med	11.2	13.2	12.1	14.5	12.8	12.7	12.5	10.7	11.4	12.0	12.2	11.9	10.6
	10%	0.4	6.8	5.9	6.9	5.8	5.4	5.1	0.0	2.7	4.2	4.9	4.8	6.2
Dam	90%	18.7	23.9	28.7	42.1	26.1	35.2	32.5	0.0	46.8	35.5	28.4	27.4	18.3
	Med	0.0	19.7	6.5	12.4	6.7	7.3	5.2	0.0	0.0	4.2	5.7	6.0	6.5
	10%	0.0	2.2	1.0	2.9	1.4	1.0	0.2	0.0	0.0	0.0	0.6	1.5	1.8
TRI	90%	0.1	11.6	10.5	17.2	16.0	14.2	11.7	0.0	0.0	10.5	12.2	15.2	11.9
	Med	0.0	5.1	1.3	4.7	1.8	2.3	0.8	0.0	0.0	0.0	1.0	1.1	1.0
	10%	0.0	0.1	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2

reaches for multistate regions (e.g., Brenden et al. 2008; Lyons et al. 2009). Using such an approach, our database makes it feasible to classify and map all river reaches across the conterminous United States.

Our database contains various human disturbance measures for each river reach at different spatial scales, which includes not only urban and agricultural land uses but many other measures, such as road and dam densities, point source pollutants, and nutrient loading (Table 1). This database integrates the majority of the best data sets currently available and consistently defined at a national scale. These human disturbance measures from multiple spatial scales are extremely valuable for conducting river health assessment for the entire conterminous United States (e.g., Esselman et al. 2011).This is because quantification of the influence of individual disturbance factors on river health for specific bodies of water is difficult as a result of the complexities in disturbance sources, types, and pathways. The common approach for measuring human disturbance on streams is through multimetric biological, physical, or chemical indicators. Using such an approach, river health can only be assessed for areas for which those data are available, which may comprise only a fraction of total river reaches within a region. Also, many of the currently used indicators lack connection with specific human disturbances, making it difficult to pinpoint sources of ecosystem change and to prescribe preventive or restorative management actions (e.g., Norris and Hawkins 2000; Suter et al. 2002). In contrast, our database provides the essential data for quantifying human disturbance levels that could be applied to all river reaches without requiring field sampling within a given region, for pinpointing specific source of degradation, and for identifying reference conditions, which is a critical step in assessing human disturbances of stream health (Danz et al. 2007; Wang et al. 2008, 2010).

Our database is not without weakness. Data spatial resolution and availability of nationwide data are the two major obstacles for our database development. For example, although the database enables us to map all river reaches and calculate their positions and connectivity based on 1:100,000 NHDPlus, their accuracy could be improved substantially when the 1:24,000 NHDPlus becomes available nationally. Some of the data attributed to each river reach, such as reach position, connectivity, and land use/cover are suitable for uses at all scales, whereas others, such as nutrient yield and water use data, are suitable only for analyses and reporting at larger spatial scales. Our database does not include local-scale data, such as bank erosion, farm animal grazing, and trampling data that require field measurement and other local point and nonpoint source disturbance data that can be obtained from local agencies. Such data do exist for many regions of the nation and can be incorporated into the database by regional or local users. Additionally, the human disturbances in the database describe only a temporal snapshot of the health conditions of the river, which do not take into account legacy effects and future human activities (Wang et al. 2008).

Overall, our database provides the essential data for achieving the NFHAP objectives and for meeting the needs of many other research, assessment, and management programs. The utility of the database can be improved by incorporating additional detailed localized information that is not available at a national scale. Presently, many additional data layers and data layers with better resolution are available only at a regional scale. Adding those data to our national database by regional agencies or partnerships will provide them with the needed information that otherwise could not be supplied by the national database. This database can also be improved by incorporating more updated or new national data layers, projected land use changes, and predicted river physicochemical and biological conditions under projected climate changes. The downloadable beta version database is available at http://ec2-184-73-40-15.compute-1.amazonaws.com/nfhap/main/.

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A Network Approach to Addressing Strategic Fisheries, Aquaculture, and Aquatic Sciences Issues at a National Scale: An Introduction to a Series of Case Studies from Canada

Sponsored by the Canadian Aquatic Resources Section of the American Fisheries Society

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ABSTRACT: *Traditional funding programs for fisheries, aquaculture, and aquatic research provide short-term support for an individual or small research team to test a specific hypothesis, often having only limited spatial applicability. To tackle more complex issues existing at larger spatial scales (national or continental), other approaches are necessary. In Canada, the Natural Sciences and Engineering Research Council has developed the Strategic Network Grants (SNGs) program that enables multi-institutional teams of academics (typically 10 to 20 co-principal investigators) to work with industry and government partners on large-scale, multidisciplinary research projects in targeted research areas. The network model is intended to create unique training opportunities and enable researchers to study problems at spatial and temporal scales that could not be addressed with traditional funding. Currently, six of the 30-plus SNGs in Canada are focused on fisheries, aquaculture, and aquatic sciences issues, namely, impacts of hydropower on fish and fish habitat, capture fisheries, integrated multitrophic aquaculture, healthy oceans, and the spatial ecology of aquatic vertebrates in coastal waters. Here we introduce five case studies that will examine the motivation, scientific research objectives, and operation of networks in detail. In addition, we explore the perceived benefits and challenges with the research network–funding model with specific reference to the advancement of large-scale studies in fisheries, aquaculture, and aquatic sciences.*

Introduction

In Canada the traditional model for granting programs (i.e., Natural Sciences and Engineering Research Council of Canada; NSERC) has focused on awarding monies to individuals or small groups of researchers studying a common issue (Table 1),with funds being tenured for relatively short periods of time (3–5 years). This model for dispensing public funds for scientific research results in sums of money being granted to many scientists carrying out important fundamental science and training highly qualified individuals but often leads to researchers working in relative isolation on specific scientific questions that maybe criticized for their reductionism. Typically those questions are not of a national or international interest. Nevertheless, the questions can be of great importance for the advancement of knowledge and the explanation of novel phenomena. Though we tend to believe that the research and training funded by autonomous grants are vital to the development of science, science may also benefit from more holistic approaches to funding that enable larger collaborative, interdisciplinary, and integrative research projects. By altering the way in which some public funds are distributed among scientists, governments may be better equipped to solve, or mitigate, pressing large-scale and complex environmental issues such as climate change, collapsing fisheries, and invasive species.

Natural Sciences and Engineering Research Council of Canada large-scale network-type grants have existed since the 1980s, when they were called "collaborative special projects," later morphing into "research networks." In 2006, the NSERC decided to link research networks to strategic target areas; thus the program became known as "strategic network grants." Identified target areas had high potential to improve Canada's economy, society, and/or environment within 10 years. Funds for the networks would also contribute toward the research and training of highly qualified personnel in areas of key national importance (e.g., hydropower impacts on fish habitat), thereby improving the pool of skilled individuals available for solving the next generation of scientific and technical problems. In general, it was envisaged that the focus of the networks would entail funding critical science to find solutions to problems with strategic importance on a national scale.

The Strategic Network Grant (SNG) program requires that the problem be of importance at the national scale and that industry be explicitly and actively involved (Table 1). Grants have been awarded to networks with topic focuses rooted in fundamental science (e.g., the Canadian Barcode

TABLE 1. A comparison of NSERC discovery grant and strategic network funding

	DIscovery grants	NSERC Strategic Network Grants
Research	Incremental research that builds toward a stated long-term objective as defined by the researcher. Projects must fall within the limits of funding body portfolios and may relate to either theoretical or applied problems	Research must fall within predefined strategic target areas (e.g., environment and health) considered to be of national importance
Spatial scale	Can be any scale but often practically limited to regional or local scales by funding	Typically regional to national
Temporal scale	Typically 3–5 years	Typically 5-year grant with possibility of re-application at the end of the 5 years
Number of institutions	Typically one	Industry and/or government end-user partnerships required
Type of partners	Not required	In first 5-year terms, no partner cash required, only in-kind contributions and support. If re-applying for a second 5-year term, end-user partners must provide a minimum of $1 for every $3 from NSERC

of Life Network) and applied science (e.g., sustainable energy initiatives like the NSERC Wind Energy Strategic Network) and to programs designed to enhance business competiveness in Canada (e.g., the Business Intelligence Network). Because Canada is a nation with abundant water and seafood resources, a number of fisheries, aquaculture, and aquatic sciences networks have been funded. These networks include programs aimed at studying the effects of hydropower on fish and fish habitat (NSERC HydroNet), the impacts of capture fisheries (NSERC Canadian Capture Fisheries Research Network), the development of integrated multitrophic aquaculture systems (NSERC Canadian Integrated Multi-Trophic Aquaculture Network), the implementation of an ocean tracking network (Ocean Tracking Network Canada), and the development of scientific guidelines for the conservation and sustainable use of marine biodiversity resources (Canadian Healthy Oceans Network). To date these networks have garnered over $30 million in NSERC support and each consists of 10-plus academic researchers and additional government and industry scientists. Each network is guided by a highly qualified, mid- or late-career scientist supported by an administrative structure that includes a research management committee to oversee the scientific research program being carried out by the network and a board of directors that draws on external business and administrative experience to ensure the efficiency and relevance of network activities. In following issues of *Fisheries*, the scientists leading these networks will explain the objectives, scope, research activities, and future directions of these multidisciplinary research programs.

Benefits and Challenges of Networks

The use of a network approach has its benefits and challenges, and the associated change in the allocation of research funds has attracted positive and negative comments. With that in mind, we explored the perceived benefits and challenges of the network funding model to advance large-scale studies in fisheries, aquaculture, and aquatic sciences (Table 2). We polled the leaders and key personnel involved with each of these five SNGs and have summarized the benefits and challenges reported. One obvious benefit of the approach anticipated in the program name is networking for the lead researchers and students involved. All networks consist of over 10 researchers, who come from a variety of institutions and disciplinary backgrounds. The mix of skills provides obvious possibilities for synergistic research interactions that might not otherwise come about because of the isolation associated with individual granting and study. For students, the network provides opportunities to be involved in multidisciplinary research likely to increase their understanding of the complexity of large research questions. Such understanding can help students to appreciate the passively invoked *ceterus paribus* of traditional research and to actively consider how other disciplinary experience may be used to solve the research problems they are working on. Students are also presented with opportunities to actively participate in the planning of meetings and workshops that form a core of network activities. Furthermore, students are able to deal directly with the network partners, and that experience with industry and government scientists provides direct experience with real-world project development and implementation. The mix of top-down driven determination of national-level research priorities and bottom-up responses in the form of network grant applications exposes both university researchers and students to and engages them in the development and implementation of science policy. Thus, these networks have the potential to produce more well-rounded science graduates with an appreciation of the social relevance of their research and what science may be needed to address as critical needs in the future in Canada and elsewhere.

TABLE 2. Benefits and challenges of the strategic network approach

Benefits	Challenges
Interdisciplinary networking possibilities	Administrative obstacles associated with network start-up that delay actively addressing identified research questions
Facilitates research synergism among participating disciplines	Administrative burden and consumption of funding resources to meet accountability requirements and to ensure that the network achieves its overarching goals
Improved opportunities for student involvement with applied science problems	Coordination with end-user partners required to ensure common vision
Improved opportunities to tackle large-scale problems	Scale of research questions encouraged may exceed ability of available funding to be successfully addressed
Exposure to the science–policy and science–commercial interfaces	Maintaining a unity of purpose among a diverse set of researchers more used to individual research projects
Increases Canada's international reputation in the funded fields of research	Management steering committee and scientific advisory committee in place to ensure that the network achieves its overarching goals

As is the case with most large-scale granting opportunities, there are challenges. The size and multiparty nature of the grant structure necessarily involves a lot of administrative setup. The intellectual rights of researchers to publish must be balanced with concerns about proprietary information that may be supplied by network partners. Detailed research agreements outlining the duties and responsibilities of all participants need to be written, reviewed, and signed. Accountability demands that each network establish internal review processes and have decision structures in place to ensure that they meet their stated objectives. All of these controls come at a cost and invariably involve the use of funds and time for other than direct research costs. Thus, though network grants may appear large, not all funds received are available for actual research. In contrast, the reporting for individual grants does not entail the construction of resource-consuming parallel bureaucracies (~15% of funds are allocated to network administration and management costs, such as meetings, communications, etc.). The demands of internal bureaucracy should not be underestimated. Network leaders can easily become subsumed in the details of running the network organization and quickly lose their ability to functionally carry out their individual research projects in the network. Although most universities offer secretarial staff and administrative assistance to deal with the monetary side of grant administration, leaders and members of the various research management committees are left to deal with the day-to-day scientific administration, which can require a considerable time commitment.

In addition to the time commitment involved in grant administration, there is an inherent challenge of solving the "big questions" posed by the network. Big questions often have many unknowns, involve the study of highly variable phenomena, and require difficult and costly experimental designs. The requirement to tackle problems at the largest scale can require resources that outstretch the capacity of even the most effective research team. Furthermore, the need to involve multiple partners requires time be spent explaining the necessity and benefit of complex science methods to groups often more focused on the short-term performance and applied approaches. However, these end-users are an essential part of the networks because they are ultimately responsible for the use and implementation of the network outcomes.

Outline of Canadian Strategic Grant Networks Series

In the coming months, *Fisheries* will present five case studies that will examine the motivation, scientific research objectives, and operation of fisheries, aquaculture, and aquatic-related networks in detail. This project is sponsored by the Canadian Aquatic Resources Section of the American Fisheries Society and is intended to highlight these prominent national research initiatives that are attempting to address large-scale problems. The five case studies are based on the following five networks: HydroNet is focused on a national research network designed to promote sustainable hydropower and healthy aquatic ecosystems; Ocean Tracking Network Canada is focused on understanding the movements and spatial ecology of continental shelf marine animals relative to environmental variability, change, and human activities; the Canadian Integrated Multi-Trophic Aquaculture Network is focused on developing balanced production systems for complementary cultured species for environmental sustainability, economic stability, and social acceptability; the Canadian Capture Fisheries Research Network is focused on ensuring that Canadian commercial fisheries are sustainable; and the Canadian Healthy Oceans Network is focused on providing biodiversity science for the sustainability of Canada's three oceans. The networks are at various stages of maturity and thus some will be able to report on research plans and preliminary results, whereas others will be able to summarize research output and, in some cases, how their findings have already informed management or led to technological innovations that have improved the Canadian environment and economy. Although decidedly Canadian in geographic focus, the case studies we will present address issues that are also of global significance. Transfer and dissemination of information is an important goal of these networks, and this series will contribute to reaching that goal. The individual case studies will address the benefits and challenges of this new approach to funding. It is our hope that these case studies will be of broad interest to the readership of *Fisheries*.

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New AFS Members

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Kelly Walker
Michael Wilkin
Larry Witzel
Lauren Yamane
Ben Yanofsky

From the Archives

Prof. Goode: I beg to propose that the name of the "American Fish-Cultural Association" be changed to the "American Fisheries Association."

...

Mr. Worth: I am rather opposed to calling it "The American Fisheries Association." I can suggest nothing better, I admit, but it seems as if there may be some intermediate and appropriate name. The Term "Society" strikes me as more suitable than "Association."

...

Mr. Mather: If we could offer a name that would embrace the whole purpose of the Association -- perhaps "The American Fish, Fisheries, Oyster, Lobster, and Fish-Cultural Association" -- it would be well, but it would take a great deal of ink. I should prefer to call it a "Society," because there are fewer letters in it than in "Association," and the Secretary has less writing to do.

Mr. James Benkard, et al, Transactions of the Thirteenth American Fish-Cultural Association, 1884

First Call for Papers: Twin Cities 2012

The Minnesota Chapter of the American Fisheries Society would like to announce the first call for papers for the 142nd Annual Meeting of the American Fisheries Society in the Twin Cities of Minneapolis and St. Paul, Minnesota! The meeting's theme, "Fisheries Networks: Building Ecological, Social and Professional Relationships", promises to bring forth up-to-date and relevant information and discussions about ecological networks and trophic food webs, social networks that inform human-fisheries interactions, and professional networks that support and enhance interactions among fisheries scientists as well as other issues facing aquatic resource professionals. AFS 2012 will be **19-23 August 2012** at the RiverCentre Convention Center and neighboring Crowne Plaza Riverfront Hotel, in downtown St. Paul. The sister Twin City of Minneapolis will provide additional exciting activities for the meeting. We look forward to seeing you in St. Paul and Minneapolis!

General Information

Fisheries professionals are invited to submit symposia proposals and abstracts for papers in a range of topics and disciplines, particularly those that focus on the meeting theme. We encourage participation by professionals at all levels and backgrounds, and especially students. The scientific program consists of three types of sessions: Symposia, Contributed Papers, and Posters.

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. The Program Committee also encourages integrative symposia that span freshwater and marine systems (e.g. food web ecology, climate change, stock assessment methods, biotelemetry and other bioengineering methods). Topics that bring inland (especially Great Lakes) scientists and managers together with their marine colleagues will fit well into the "Networks" theme for the meeting.

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. The Program Committee will work with symposium organizers to incorporate appropriate presentations that were submitted as contributed papers. 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 will be strongly encouraged to convert some oral presentations to posters (see further information in Poster section below). 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 **6 January 2012**. All symposium proposal submissions must be made using the AFS online symposium proposal submission form available on the AFS website (www.fisheries.org). The Program Committee will review all symposium proposals and notify organizers of acceptance or refusal by **27 January 2012**. If accepted, organizers must submit a complete list of all confirmed presentations and titles by **2 March 2012**. Symposium abstracts (in the same format as contributed abstracts; see below) are due by **9 March 2012**.

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 one hour of poster viewing).

5) Chairs: Supply name(s) of individual(s) who will chair the symposium.

6) Presentation requirements: Speakers should 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 on: potential presenters, tentative titles, and oral or poster designations.

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

Contributed Papers and Posters

The Program Committee invites abstracts 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. Oral presentations for contributed papers 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.

We encourage poster submissions because of the limited time available for oral presentations. The program will include a dedicated poster session to encourage discussion between poster authors and attendees. In addition, the Program Committee is exploring alternative presentation methods for posters. For example "Speed Presentations", short oral presentations of poster highlights, are being considered. This format elevates the profile of posters and encourages interaction at the poster session. Speed presentations can be an effective way to disseminate information and foster one-on-one interactions among participants and poster presenters. See *Fisheries* 32(12):576 for more information on the format. Other alternatives being considered include having authors be present at their posters on a rolling basis, highlighted by announcements of topics of the hour (rather than all at once). Also, the feasibility of having symposia posters exhibited within the same room as oral symposia presentations is being explored. The Program Committee will welcome creative ideas for presenting posters. Further details will be provided in subsequent calls for papers.

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 poster papers must be received by **10 February 2012**. All submissions must be made using the AFS online abstract submission form, available at 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;
- Provide a summary of your findings and restrict your abstract to 200 words.

All presenters will receive an email confirmation of their abstract submission and will be notified of acceptance and the designated time and place of their presentation by **13 April 2012**.

The Program Committee will group contributed papers thematically based on the title and two keywords you will choose and prioritize during the abstract submission process.

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 (afs2012.org) in **May 2012**; register early for cost savings.

Format for Abstracts

Title: An example abstract for the AFS 2012 Annual Meeting
Format: Oral
Authors:
Anderson, Charles. Minnesota Department of Natural Resources, 500 Lafayette Road, St. Paul, MN 55155; 651-259-5188; charles.anderson@state.mn.us
Jacobson, Peter. Minnesota Department of Natural Resources, 27841 Forest Lane, Park Rapids, MN 56470; 218-699-7294; peter.jacobson@state.mn.us
Presenter: Charles Anderson
Abstract: Abstracts are used by the Program Committee to evaluate and select papers for inclusion in the scientific and technical sessions of the 2012 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

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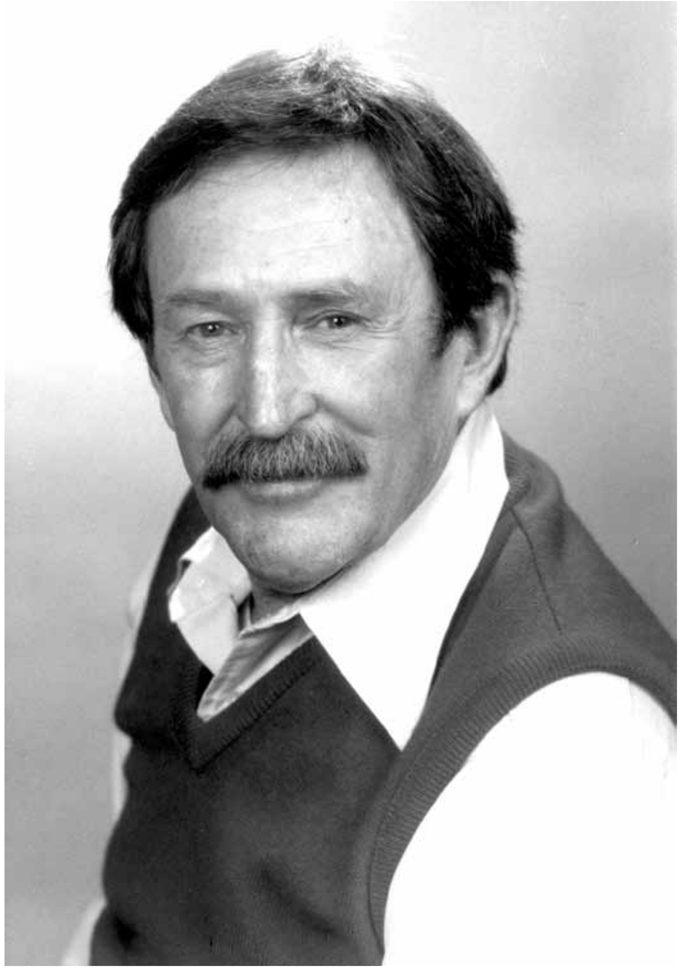
American Fisheries Society
Minnesota Chapter

In Memoriam:
DAVID "HOMER" BUCK



Long-time fisheries biologist Dr. David "Homer" Buck passed away on April 30, 2010. He was 89 years old. Homer was born in Clifton, Arizona, on December 31, 1920. He was the second son of David Upton Buck and Nellie Chilton Buck. Homer enjoyed a long career as a researcher in fisheries biology. He received his B.S. from Texas A&M University in 1943 and Ph.D. from Oklahoma State University in 1951. He served as a pilot in the U.S. Marine Corps in World War II (1942–1946) and during the Korean conflict (1952–1953).

Homer Buck began his career at the Texas Game and Fish Commission as a fisheries biologist (1946–1948) and while pursuing his Ph.D. worked as a reservoir biologist for the U.S. Corps of Engineers (1948–1951). He worked at the Oklahoma Game and Fish Commission (1954–1956) before heading to the Max McGraw Wildlife Foundation in Dundee, Illinois, to head a cooperative project among the Illinois Natural History Survey (INHS), Illinois Department of Conservation, and the North American Wildlife Foundation, leading research activities in 15 one-acre ponds. He later began a long tenure at the Sam Parr Biological Station of the INHS, where he served as a research scientist until he retired in August 1986.

Dr. Buck played a major role in the INHS's Aquatic Biology Section. His scientific competence and sincere enthusiasm were a rare and treasured combination. During his 20-plus years of exemplary leadership and guidance, he helped elevate the INHS to the forefront of fisheries research. Homer was best known for his studies on the use of manures, hydrogen peroxide–treated straw, and other agricultural by-products as sources of carbon and energy for fish/prawn polycultures and for his evaluation of hybrid crappies as sport fishes. A journal publication from this research on carp production in ponds received the Best Paper Award in *Transactions of the American Fisheries Society* (1970, Vol. 99).

Even at the end of his life, Dr. Buck continued his interest in the field. He was very concerned with the issue of world hunger and saw ways in which his research and knowledge of carps could contribute to that need through international and domestic aquaculture. Overcoming obstacles was in Homer's nature, and even with severe visual impairment and unsteady hands, he published an article on fish as a solution to the food crisis in the December 2009 issue of the journal *World Aquaculture*. He and his wife Ruth retired to Durham, North Carolina, to be near family, and there he continued to maintain contact with fellow fishery scientists and to follow developments in the profession.

Family was always important to Homer. He and his wife of nearly 56 years, Ruth McNeilly Buck, were blessed with three daughters and a son. He is survived by his wife and all four of his children, Julie Potenziani (Dave) of Durham, North Carolina; Debra Alexander (Richard) of Libertyville, Illinois; Susan Buck (Lenore Champion) of Durham, North Carolina; and David Buck of Urbana, Illinois, as well as eight grandchildren.

Homer was always a social guy and able to span cultural boundaries; he never missed a chance to converse with old friends and meet new ones, whether established professionals or budding students. And he loved the socials—on his final day, he was still planning a fish fry. Perhaps his daughter described Homer best in a poem read at his memorial service entitled "Wherever You Find Homer, There's a Party Going On." He will be missed and remembered for his love of life!

– Dr. David H. Wahl, Dr. Tom Kwak, Dr. Rich Noble, Mike Hooe, and Ruth Wagner

Collaborative Research Between Current and Future Fisheries Professionals: Facilitating AFS Subunit Participation

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The American Fisheries Society (AFS) student subunits have the potential to train fisheries biologists and to benefit participating faculty as well. In order for this potential to be realized, subunit student and faculty members must demonstrate strong leadership and enthusiasm to encourage and maintain the participation of those around them. Collaboration between student subunit members and fisheries professionals contributes to the core AFS mission of "advancing fisheries and aquatic science and promoting the development of fisheries professionals." Here we describe how a recent collaboration between the Colorado State University (CSU) subunit and natural resource management agencies from the state of Colorado is helping meet the AFS mission. With the guidance of CSU faculty and the determination of the subunit officers, the research project facilitated student involvement and professional collaboration that resulted in multiple oral and poster presentations and the development of a manuscript currently in review for a peer-reviewed journal.

The CSU student subunit of the Colorado–Wyoming chapter was established in 1969, making it the first student subunit in AFS. Like many subunits, CSU–AFS participation varies from year to year, making it critical for officers to facilitate involvement by conducting inspiring projects and developing motivating activities. The CSU subunit has a strong history of encouraging subunit involvement through activities such as river cleanup days, conducting northern pike *Esox lucius* population studies at College Lake on the CSU campus, hosting an

Figure 1. Upper left: Colorado Division of Wildlife crews assisting with electrofishing of northern pike *Esox lucius*. Upper right: Performing gastric lavage. Lower left: Ensuring that all diet contents are removed from the mouth before recording fish weight. Lower right: Fully processed fish with biopsy wound treated with a 1:1 denture adhesive:antibiotic cream mixture and floy tag in place for individual identification.

annual fishing derby, and organizing kids fishing days with the local boys' and girls' clubs. Although these activities are typical of subunits and have been beneficial to CSU–AFS, the university, and the local communities, they were not effective at facilitating individual and group professional development to the extent of the collaborative research project between the CSU subunit and state of Colorado natural resource management agencies. The CSU subunit offered an innovative approach to encouraging and maintaining professional involvement of undergraduates interested in fisheries science and management by conducting a scientifically relevant research project with human health and management implications. The project provided opportunities to work collaboratively with fisheries biologists and researchers from multiple agencies and CSU. Additionally, the project included a variety of undergraduates who were not specifically interested in fisheries or the subunit (e.g., CSU Zoology Club members) prior to the initiation of the research.

Several agencies in the state of Colorado have identified mercury (Hg) bioaccumulation as a threat to human health through the consumption of contaminated sport fish. As a result, several studies have been initiated to investigate and potentially remediate the effects of Hg contamination in Colorado. In 2009, a member of the CSU student subunit obtained

Figure 2.Volunteers associated with College Lake Study. Back row from left to right: Kat Hille (CSU–AFS subunit member), William Stacy (CSU fisheries undergraduate and AFS subunit secretary), Nathan Cathcart (CSU fisheries undergraduate and AFS subunit president), Kristoph Kinzli (CSU fisheries graduate student and AFS subunit member), Willow Hibbs (CSU–AFSsubunit member), Dr. Jesse Lepak (CSU fisheries postdoc and AFS subunit member), and Eric Fetherman (CSU fisheries Ph.D. candidate and AFS subunit member). Front row from left to right: Zachary Underwood (CSU fisheries undergraduate and AFS subunit treasurer), Stacie Grannum (CSU–AFS subunit member), Adam Hansen (CSU fisheries undergraduate and former AFS subunit president), and Eric Gardunio (CSU fisheries graduate student and AFS subunit vice president).

support to conduct a whole-system manipulation in College Lake to address Hg bioaccumulation in sport fish. Working in collaboration with CSU faculty, the Colorado Division of Wildlife (CDOW), the Colorado Department of Public Health and Environment (CDPHE), and dozens of volunteers, the subunit evaluated the effects of stocking forage fish with high caloric content and low Hg concentrations as a means of reducing northern pike Hg concentrations through biomass dilution. Previous work at College Lake by the subunit marking individual northern pike with floy tags provided a population estimate to determine the number of forage fish necessary to test the hypothesis that stocking would reduce Hg concentrations in northern pike. During the experiment, we captured and marked 250 northern pike by gill netting, electrofishing, trap netting, beach seining, and angling. Fish were individually weighed and measured following gastric lavage to obtain samples indicating what northern pike diets were prior to the manipulation. Tissue biopsies were taken from individuals to obtain initial Hg concentrations. Unmarked fish were marked with floy tags to allow for repeated measures analysis of Hg concentrations before and after the manipulation. Following the initial sampling event, the lake was stocked with 150-mm rainbow trout *Oncorhynchus mykiss* serving as a high-energy, low-Hg food source to facilitate biomass dilution of Hg in northern pike. After approximately 2 months, 30 fish were recaptured and biopsied again to obtain posttreatment Hg concentrations. This project represented the first time that Hg biomass dilution had been examined on individual fish in a naturally reproducing population. As such, the project conducted by the CSU subunit in collaboration with CDOW and CDPHE was highly relevant from a scientific, fisheries management, and human health perspective and provided a unique opportunity for student and faculty professional development.

The project had numerous benefits for those involved and bolstered long-term subunit participation. Participants gained valuable experience in numerous field (e.g., gill netting, electrofishing, trap netting, beach seining, gastric lavage, tissue biopsies) and laboratory (e.g., stomach content analysis, fish aging) techniques. Undergraduate students also gained experience working together with more experienced graduate students and faculty on project design, data analysis, and oral and written presentation of the results. Additionally, students learned about establishing and managing working relationships with potential future employers, including CSU faculty, multiple agencies, institutions, and volunteers, which provided excellent preparation for occupations in fisheries. Finally, our findings were presented to the CDPHE to aid in the development of fish consumption advisories and were subsequently used to develop a manuscript for submission to a peer-reviewed journal. Although a core group of undergraduate and graduate students was primarily involved in the study design, data analysis, presentation preparation, and manuscript writing, a wide range of students benefited from the project. A testament to

Figure 3. College Lake on the Colorado State University campus, Fort Collins, Colorado

the success of the project was that whereas previous subunit activities (e.g., river cleanups, fishing derbies, kids' fishing days) tended to attract a handful of fisheries students for a day or a few hours, over 20 undergraduate students from both the CSU subunit and the CSU Zoology Club participated in activities described here for several days or weeks over the course of the project, which took more than a year to complete.

Not only was this project successful at attracting new students to the fisheries profession (over a dozen students who were not formerly subunit members volunteered for the project), it also aided in the advancement of the careers of essentially all those closely involved and solidified their participation in AFS. All 10 of the student authors strengthened their fisheries science and communication abilities by participating in the project and manuscript preparation. Three authors have been appointed to permanent positions in fisheries-related fields (two with the CDOW and one with Florida Gulf Coast University), one advanced from an M.S. to a Ph.D. program in fisheries at CSU, and three others advanced from undergraduate degree programs to M.S. programs in fisheries (two at CSU and one at the University of Washington).The remaining three student authors are currently undergraduates continuing to study fisheries science and are actively pursuing fisheries-related graduate school opportunities. The same three undergraduates have all been offered technician positions with the CDOW as a direct result of this collaboration. To date, the 12-author paper has resulted in five oral presentations (including best professional paper; Colorado–Wyoming AFS Meeting, Fort Collins, Colorado, February 2011) and six poster presentations (including a best student poster award at the Western Division AFS Meeting in Salt Lake City, Utah, March 2010) by undergraduates, graduate students, and a postdoctoral fellow.

Developing innovative methods for increasing subunit participation holds the potential to aid in the growth and development of AFS. Projects similar to those described here can enhance fisheries and aquatic science and promote the advancement of fisheries professionals (e.g., subunit members), thus fulfilling the society's core mission. The subunit project on experimental biomass dilution of Hg in northern pike of College Lake attracted over a dozen non-fisheries participants who would have otherwise not been exposed to fisheries techniques. Previously active subunit members gained invaluable new experiences with an unusually high level of scientific rigor. Further, professionals from a variety of institutions gained valuable insights about Hg bioaccumulation and potential methods for reducing the impacts of Hg contamination on human health. This collaborative effort benefited multiple participants and provided unique and valuable interactions between students and future employers.

Student subunits are prone to experiencing an ebb and flow in enthusiasm and participation that depends on faculty and student involvement. Additionally, student dedication and enthusiasm can be difficult to sustain. The strong leadership exhibited by CSU faculty advisors and officers allowed subunit members to develop unique and interesting opportunities for students in fisheries-related activities. They helped bolster participation and provided valuable professional development opportunities for all those involved. In order for the project to be completed successfully, the combined and consistent effort of subunit officers and CSU faculty was necessary. Although these efforts were time consuming and often challenging, the benefits were soon realized as both subunit participation and the level of individual involvement increased. As this project demonstrated, a small group of highly motivated students and faculty can strengthen AFS subunits by conducting projects that provide experience in fisheries work while fostering camaraderie among subunit members and making connections with established fisheries professionals.

Acknowledgments

We thank the Colorado Division of Wildlife, Colorado Department of Public Health and Environment, Quicksilver Scientific, the Colorado State University student subunit of the American Fisheries Society, the Colorado State University Zoology Club, P. Barrel, and numerous volunteers for their assistance throughout the project. We also thank Dr. Brett Johnson for reviewing this manuscript.

Fostering the Development of Conservation Leadership at Minority-Serving Institutions

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Background

Between 1996 and 2006, non-white Hispanic, African American, and Native American/Alaska Native students (collectively called "underrepresented students" [URS]) made up only 7% of students graduating with a conservation or conservation-related degree (National Science Foundation [NSF] 2008), despite the fact that in 2000 non-white Hispanics, African Americans, and Native Americans/Alaska Natives made up 27% of the U.S. population (U.S. Census Bureau 2002a, 2002b, 2002c). In comparison, the fields of sociology, education, math, and computer and information sciences graduated more than twice as many URS for the period 1996–2006. White non-Hispanic students earned 90% of all conservation-related degrees from 1996 to 2006 (NSF 2008). Although no longer a matter of legal concern, for URS the effects of educational discrimination are still felt at all educational levels. When URS begin school, many enter into the science, technology, engineering, and mathematics pipeline: a system of training that begins in primary school and ends with the graduated qualified working scientist (Hanson et al. 1996). For a variety of reasons, a high percentage of URS egress, or "leak," from the science, technology, engineering, and mathematics pipeline (Anderson and Kim 2006) before completing their training. These reasons can include academic tracking (the specific process of separating students along specific curricular paths like college-bound or vocational training; Gilbert and Yerrick 2001), lack of academic preparedness, academic isolation, and social isolation. The capacity challenge in the conservation workforce thus can be attributed to a combination of historical, educational, social, and financial barriers that URS face in becoming professional conservation scientists (Aikenhead 1997; Nettles and Millett 1999; Burdman 2005).

The Capacity Challenge

What are the barriers that URS face to becoming conservation science professionals? Historical barriers rooted in the separate but equal policies of the past continue to have lasting negative effects on URS (National Center for Public Policy Research 2006). There is also the historical reality, however, that many people of color enter the environmental arena with a focus on human relationships to the environment, as in the environmental justice movement, rather than with a focus on transcendental ideations of wilderness, wildlife, and recreation (Taylor 2002). It is therefore only recent that some URS are coming into the physical environmental sciences in addition to their work in the social and activist aspects of environmental issues. The legacy effects of educational discrimination as constructed through de facto and statutory separate but equal policies in addition to the modern educational problems of tracking, academic isolation, and lack of rigorous college preparation are persistent educational barriers that URS face as well (Kao and Thompson 2003; Burris and Welner 2005; Anderson and Kim 2006). The social isolation that URS undergraduates report on campuses across the country and the lack of culturally competent mentorship that many URS experience in their science training continues to be a sufficient enough barrier to prevent URS students from continuing science studies (Alexander et al. 1997; Haring 1999; Watkins and Gayle 2005). Additionally, not unlike many non-URS, financial barriers such as an aversion to take on loans and a burdensome number of work hours per week set up additional and costly educational barriers (Burdman 2005; Perez and Gong 2005; Anderson and Kim 2006).

Preliminary Results of a Minority-Serving Institution Faculty Needs Survey

In October 2008, the Enhancing Diversity in Conservation Science Initiative (DI), a project of the Center for Biodiversity and Conservation (CBC) at the American Museum of Natural History, asked faculty members from minority-serving institutions (MSIs) throughout the United States to gauge their impressions of diversity in conservation biology at their respective institutions and to identify their interest in the DI's proposed activities. The majority of the respondents were professors who classified their colleges as Hispanic-serving institutions followed by those who identified with historically black colleges. Forty-one percent of the faculty believed that it was unlikely to expect more than 10% of their students to enter careers in the field of conservation. Many of the respondents replied that there was great need to enhance their current syllabi with active teaching and active learning strategies. Of the number of activities, workshops, and resources proposed for implementation, great interest was expressed in attending a workshop designed to foster the development of leaders in conservation and conservation-related fields at MSIs. More than half of the respondents agreed that tomorrow's successful conservation leaders should possess the ability to use an interdisciplinary approach to problem solving, cross-cultural learning and team-building skills, and program management strategies.

Building Conservation Leadership

In addition to the survey, ongoing conversations between CBC staff and MSI faculty members have revealed a number of insights on conservation leadership. The CBC has come to understand that the goal within the conservation community should be not only to increase the number of URS in conservation but also to foster the development of conservation leadership among URS so that they can in turn participate in shaping the future of the field. Manolis et al. (2009) described two types of conservation leadership: research (in which we include teaching as a form of educational research) and integrating conservation (here we also include ecology) science into policy, management, and society-at-large. In our discussions on conservation leadership with MSI school administrators and MSI faculty working inside schools of environmental and ecology studies, faculty and administrators have expressed various leadership perspectives. The perspectives break out into three overarching themes:

1. Changing curricula is the way to begin bringing awareness to university administration about ecology and conservation leadership.
2. Curriculum change can also be an effective way to begin to build conservation leadership among students.
3. Some schools still lack a tradition or culture of environmental sustainability, despite extensive conservation and ecology curricula.

Despite what may be a lack of a tradition or culture of environmental sustainability, MSIs can play an especially critical role in conservation leadership within teaching and research. Because leadership involves cultivating and targeting diversity as a priority (Claremont et al. 2005; Manolis et al. 2009), a practice in which MSIs have been engaged in as a mission, MSIs are in the unique position of having been on the cutting edge of these areas of leadership for decades. For example MSIs have offered URS various leadership opportunities (Raines 1998), as well as an opportunity for URS to respond to community needs. Furthermore, MSIs offer a place for URS to be part of empowering communities (Pavel et al. 2001).

A Model for Leadership Development

Our hypothesis at the CBC is that conservation leadership at MSIs can increase the representation of students from underrepresented groups if we work to leverage the experience shown by MSIs in the areas of academic preparation, social integration, and financial support for URS with the experience shown by conservation organizations in the areas of cutting-edge research, leading cooperative efforts between conservation institutions, and professional development for the conservation community. Recognizing the need to increase diversity in the field, the CBC has initiated the enhancing diversity in conservation science initiative. The DI's current efforts are dedicated to various aspects of relationship building with MSIs, the recruitment and retention of URS in conservation science, as well as inspiring, developing, and supporting tomorrow's emerging conservation leaders. Our model is to generate interest in and provide professional development for MSI faculty in the areas of education research and active pedagogical methods as well as to develop a conservation science teaching community. Moreover, this model is supported by collaboration across institutions to maintain the sense of community praxis that scientific teaching and active teaching require. Ultimately, the DI aims to reach into the areas of student support through culturally competent mentoring, access to research opportunities, and access to financial support.

Summary

Leadership of any kind requires a similar set of skills. Some of those skills include the following:

1. Acquiring and assessing core leadership skills and competencies
2. Communicating and bringing attention to a specific ecological or conservation problem
3. Managing time, projects, people, and resources effectively
4. Bringing diverse people, talents, and views to bear on the issues
5. Assessing progress regularly and changing course when appropriate

Though cultural competencies can mediate the style of leadership used by individuals or institutions, there is likely a great deal of leadership variety at the interpersonal level between, say, colleagues and students, more so than between institutions. If the conservation community builds on the strength of these variations of leadership, it is likely to find a greater number of supporters for any number of important conservation efforts, a more informed conservation constituency, and ultimately a more diverse conservation workforce.

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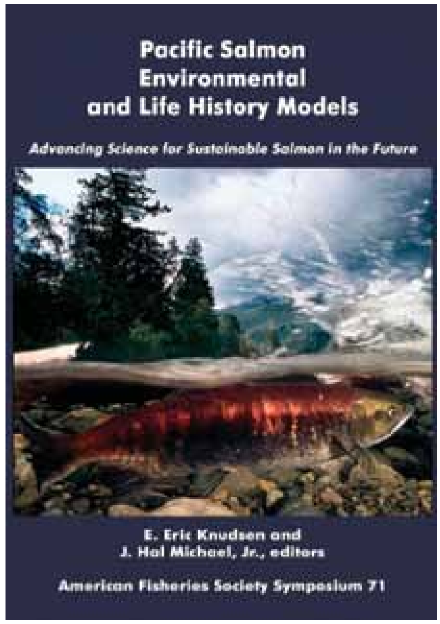
Pacific Salmon Environmental and Life History Models: Advancing Science for Sustainable Salmon in the Future

Edited by Eric E. Knudsen and J. Hal Michael, Jr. American Fisheries Society, Symposium 71. Bethesda, Maryland. 2009. 464 pages. $69.00.



Pacific salmon are a cultural icon in the Pacific Northwest and are possibly rivaled only by the bald eagle as a symbol of environmental quality. However, a myriad of factors including exploitation, land use, and coastal development over the past century appear to be causing serious declines and even extinction of some Pacific salmon populations. A future that includes wild salmon will therefore require targeted action aimed at restoring essential habitat, reducing adverse interactions with artificially reared salmon, and better management of fisheries. Models are integral to all of these activities because they help us develop testable hypotheses or management prescriptions in complex, highly uncertain systems. Even where our questions go unanswered due to lack of data, models help us to identify gaps where targeted research or monitoring is needed.

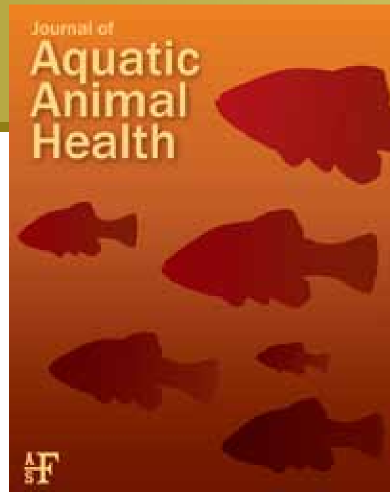
In this symposium volume, editors E.E. Knudsen and J.H. Michael advance salmon research and modeling approaches that have (or may have) practical application for estimating salmon production capacity and appropriate harvest levels, as well as informing habitat remediation projects.

The book consists of an introductory chapter followed by 21 subsequent chapters arranged into six thematic sections including: perspectives, biology and information, statistical models, habitat-related life history models, incorporating uncertainty into decisionmaking, and management applications. Individual chapters within Section 1 provide an interesting contrast between the practical challenges to improving salmon models. Life history models, and some important philosophical issues in which our biased viewpoint on salmon life history may ultimately limit our ability to identify and respond to the real problems confronting sustainability, are an important focus here. Sections 2 and 3 collectively consist of six chapters that provide both empirical and theoretical models of salmon population variability. Several chapters within this section show how the paleoecological record, growth, and long-term abundance data can be used to assess the role of large-scale climatic features in driving variation in salmon abundance and productivity. Section 4 contains chapters describing the technical details underlying three habitat-related life history modeling tools, including SHIRAZ modelling framework for integrated analysis of habitat, hatchery and harvest impacts on salmon, the unit characteristic method, and ecosystem diagnosis and treatment. The section also includes example applications of each model to real management questions. The opening chapter in Section 5 applies sensitivity analysis to the ecosystem diagnosis and treatment model, which provides a useful quantification of the uncertainties involved in all of these complex models. The other chapter in this section examines how to best communicate these uncertainties to managers. Finally, Section 6 contains several chapters that show how ecological factors such as marine-derived nutrients, spatial population structure, and habitat restoration can be taken into account when developing salmon escapement goals and recovery plans.

Pacific Salmon Environmental and Life History Models will appeal to researchers interested in the most recent approaches to linking life history to environmental and habitat change. Although this is not a recipe book on fish life history modeling, it does provide a broad enough range of concepts and techniques to get any reasonably creative individual started in developing his own model of fish–habitat interactions. The book will also help fishery and habitat managers improve their understanding of salmon habitat and life history interactions and how this knowledge is incorporated into life history–based planning models. The obvious strength of the book lies in the contributions of its many prominent authors, who have an enormous collective experience on the subject.

Sean Cox
School of Resource and Environmental Management
Simon Fraser University
Burnaby, British ColumbiaV5A 1S6, Canada

Journal Highlights:
Journal of Aquatic Animal Health



Volume 23, Number 1, March 2011

Volume 23, Number 2, June 2011

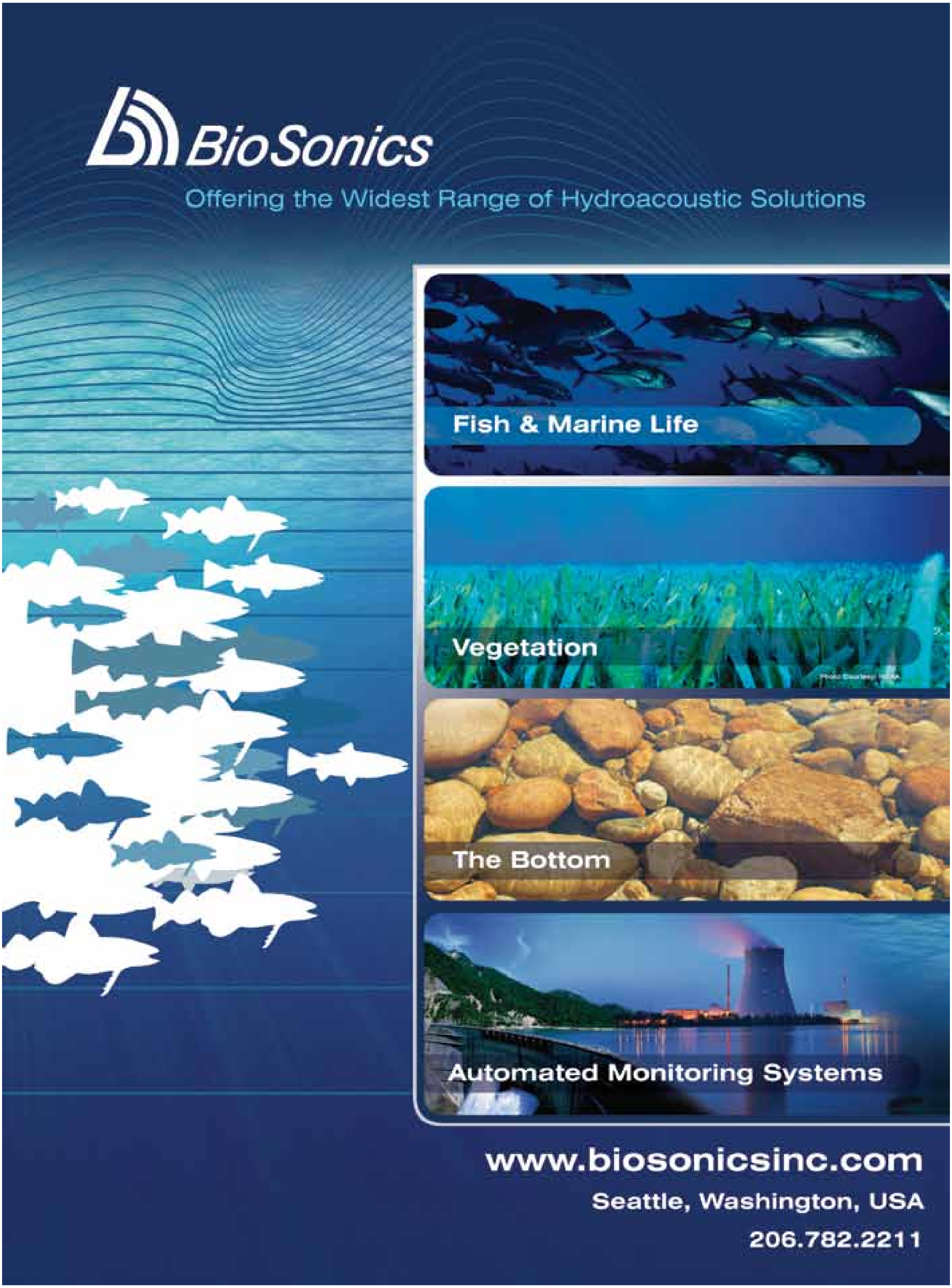
Calendar:
FISHERIES EVENTS

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

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

More events listed at www.fisheries.org

DATE	EVENT	LOCATION	WEBSITE
Sept 25–27, 2011	Atlantic International Chapter Annual Meeting	Lac Delage, Quebec, Canada	http://www.fisheriessociety.org/aic/conference-registration.html
Oct 18-20, 2011	IFM Institute of Fisheries Management 2011 42nd Conference	Oxford, UK	http://www.ifm.org.uk/events/
Oct 18-21, 2011	Aquaculture Europe 2011	Rhodes, Greece	https://www.was.org/EasOnline/Default.aspx
Oct 26-27, 2011	The Lakes Ecosystem Conference (SOLEC)	Erie, Pennsylvania	http://ec.gc.ca
Oct 30-31, 2011	NPAFC International Workshop on Explanations for the High Abundance of Pink and Chum Salmon and Future Trends	Nanaimo, British Columbia, Canada	http://www.npafc.org/new/index.html
Nov 5-10, 2011	The Wildilfe Society 18th Annual Conference	Waikoloa, Hawaii	http: www.wildlifesociety.org
Nov 8-11, 2011	Europort 11	Rotterdam, Zuid-Holland	http://europort.nl
Nov 14-18, 2011	Annual Alaska Chapter Conference	Girdwood, Alaska	htpp://www.fisheriessociety.org/afs-ak/
Dec 4-7, 2011	72nd Midwest Fish and Wildlife Conference	Des Moines, Iowa	http://www.midwest2011.org
Dec 6-8, 2011	62nd Northwest Fish Culture Conference 2011	Victoria, BC	www.gofishbc.com/nwfcc_2011.htm
Dec 6-8, 2011	62nd Northwest Fish Culture Conference 2011	Victoria, BC	www.gofishbc.com/nwfcc_2011.htm
Jan 31–Feb 2, 2012	Virginia Tech Chapter of the AFS	Blacksburg, Virginia	www.vtafs.org.vt.edu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Continued from page 425

future resource managers and scientists. State and federal agencies are concerned about the future availability of employees who can address ongoing needs and emerging issues because some universities that once offered traditional natural resource education and training are no longer doing so. As a result, graduates at some universities are no longer receiving the necessary training and skills required to meet the needs of state and federal agencies, tribes, or NGOs. To address this situation, the Coalition of Natural Resource Societies — which is composed of AFS, The Wildlife Society, Society of American Foresters, and the Society for Range Management — is convening a Natural Resource Education-Employment Conference to take place September 19–21, 2011 in Denver, Colorado. This conference will bring together leaders from colleges and universities, state and federal agencies, and professional/scientific societies to review the issues and develop an action agenda. Another element of my work plan will be to address recent committee recommendations for the AFS Professional Certification Program. The merits of the program and its relevance to today's fisheries professionals, particularly given the changes in fisheries education, need careful evaluation.

Maintaining and improving the value of AFS membership — an ongoing goal of our strategic plan — is a key element of my work plan. Earlier this year, Past President Wayne Hubert and I identified a long-standing issue in AFS — affiliate memberships. The AFS has over 9,000 members worldwide that pay regular, student, young professional,professional or retired member dues. Many of these members are also members of state chapters and/or sections in North America. However, in many state chapters and some sections, members belong only to the chapter or section but not to the society. We have indentified these chapter- and section-only members as "affiliate members" and conducted a survey to determine how many there are in state chapters and sections. This was the topic of the 2011 Governing Board retreat in Seattle, and our goal was to identify how AFS may better serve affiliate members, including enticing them to become members of AFS or creating an official affiliate membership category. Another issue that arose several years ago is virtual attendance at AFS meetings, including the annual meeting and Governing Board meetings. I will be working with our committees and AFS staff to identify ways to implement virtual attendance so more members can participate. Lastly, it has been over ten years since AFS last conducted a salary compensation survey for fisheries professionals. We will enlist the help of an outside contractor to conduct this survey in a comprehensive and unbiased fashion.

Through the large AFS network, I will be working with members across North America and around the world to accomplish our society's mission advancing sound science, promoting professional development, and disseminating science-based fisheries information for the global protection, conservation, and sustainability of fisheries resources and aquatic ecosystems. I look forward to meeting, working and networking with many of you this year as we move our society forward.

September 2011:
JOBS

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

Fisheries Biologist/Aquatic Scientist | Smith Root, Inc., WA | Permanent

Salary: Commensurate with Experience

Closing: Until filled

Responsibilities: Incumbent would serve as a team member and fisheries professional who reports to the head of the company's Science Department. Expected duties: Provide a high level of knowledge and expertise in areas such as fish physiology, fish behavior, fish life history and habitat requirements, and in the use of electrofishing-related applications for sampling various fish species and life stages. Conduct applied research and studies in both lab and field settings to support the development, testing and evaluation of new electrofishing-related products and their efficacy and safety for the fisheries science community. Work with the company's electronics engineers and other professionals on the development and testing of innovative applications. Analyze and interpret study results to develop defensible conclusions and recommendations. Prepare written scientific reports and visual presentations of study results. Prepare grant proposals that address specific funding mandates or needs. Participate in professional fisheries conferences, maintain a high caliber of knowledge of the peer-reviewed fisheries literature on electrofishing applications and effects, and create a level of expertise sufficient to help technology users with queries, issues and requests for assistance. Interact with agency and non-governmental organizations on study planning and technology needs. Manage and participate in field efforts to collect scientific data. Assist other company departments as needed.

Qualifications: Applicants must have a graduate degree either M.S. or Ph.D. in fisheries science or in a closely related field. Those having wide familiarity and experience in the use of electrofishing and/or electrofishing-related technologies are strongly encouraged to apply as are those with previous publications from aquatic resource studies addressing or incorporating the use of electrofishing technologies. We seek a self-motivator with excellent interpersonal communication and organizational skills to implement and lead applied research projects with minimal supervision in a team environment. In addition to excellence in verbal communication, incumbent must also have excellent written communication skills. He or she must be willing to travel frequently and must be able to balance multiple ongoing projects. The successful candidate will be able to demonstrate his or her capabilities in the design and analysis of complex research studies, familiarities with diverse analytical tools, software packages and statistical techniques, and the ability to prepare technical reports of findings that meet established deadlines. Additional years of professional work experience, grant-writing skills and/or experience in areas such as fish physiology, fish behavior, fish passage, fisheries engineering or related fields will be considered a plus. We admire those having a passion for converting research projects into solutions that solve real-world issues.

Contact: Please send qualifying details to Carl Burger, Senior Scientist, at the e-mail address below. Include a copy of your CV or resume and a cover letter addressing how you meet the positions qualifications. Smith-Root, Inc. is an Equal Opportunity, Affirmative-Action Employer. Web Link: www.oceanassoc.com/jobs/job-list.html

Web Link: http://www.smith-root.com

Contact Email address: cvburger@smith-root.com

PHD Graduate Assistantships (2) | Auburn Univ, AL | Student

Salary: $18,900/year, plus tuition waiver to qualified applicants.

Responsibilities: To study ecology, movements, habitat use, age structure, fecundity, and nursery habitats of marine fishes in the northeast Gulf of Mexico. Also, how these ecological functions relate to the recent oil spill in the northern Gulf of Mexico. A requirement is scuba diving ability. In addition, frequent offshore trips 5-10 per month, 10 to 40 km for the purposes of SCUBA visual counts, trapnets, gill net, hook-line, and ultrasonic track reef fishes will be part of the prospective students responsibility, and can be used for thesis completion.

Qualifications: M.S., in biology or related science, minimum GPA of 3.0 undergrad , and GRE of 1000 verb math . Review will begin immediately. Dec 2011. Start date 1/1/12 flexible.

Contact: For applicant consideration send by e-mail (do not send by mail) CV, copy of undergraduate and graduate transcripts, and GRE scores to Dr. Stephen T. Szedlmayer

Contact Email: szedlst@auburn.edu

Fisheries/Aquatic Ecologist Technician | Kaskaskia Biological Station, IL | Permanent

Salary: $11.00 - $12.00/hour

Responsibilities: Kaskaskia Biological Station, Illinois Natural History Survey. Employer: Division of Illinois Natural History Survey INHS . Assist with field work in lakes and streams, laboratory behavioral experiments, lab maintenance, fish care, and data processing and analysis. Responsibilities include assisting with research projects evaluating recruitment, behavior, reproductive strategies and management of largemouth bass, population ecology of muskellunge and stream and river ecology restoration. Work will be conducted in conjunction with faculty, graduate students, and other research assistants.

Qualifications: B.S. degree in fisheries or biology.

Contact: For full consideration, applications should be received by 9/15, but position will remain open until filled. Electronic applications required. To apply, please send cover letter, resume, copy of college transcripts and names and contact information of three references to below email. Reference MDiana in subject line Direct technical questions to Dr. David Wahl, dwahl@uiuc.edu 217-728 4400. The Univ of Illinois is an Affirmative Action, Equal Opportunity Employer

Contact Email: hroffice@inhs.uiuc.edu

Great Lakes Fishery Biologist | Little Traverse Bay Bands of Odawa Indians, MI | Permanent

Salary: $36,121-$48,870 D.O.E.

Responsibilities: Maintain the fisheries program and budget. Supervise and oversee Fishery Program staff. Oversee the Department's Fish hatchery. Analyze data to provide statistics on important fish stocks. Written analysis of catch and assessment to determining population status. Represent the Tribe on interagency committees. Design and implementation of field research and assessment projects on Great Lakes fish populations. Explore and describe data using statistical software. Integrate data into Geographic Information Systems GIS . Design and implementation of field research and assessment projects on Great Lakes fishes. Familiar with relevant federal/state/inter-tribal court orders or agreements.

Qualifications: B.S. in Fisheries, Aquatic Ecology and minimum of two years experience. Master of Science degree preferred.

Contact: Denise Petoskey, Human Resources Director, 7500 Odawa Circle, Harbor Springs, MI 49740

Web Link: https://ltbbodawa-nsn.gov

Contact Email: dpetoskey@ltbbodawa-nsn.gov

Director,FisheriesEcologyDivisionSouthwestFisheries Science Center | CA | Permanent

Salary: $134,647. The ZP-5 is equivalent to the GS-15.

Responsibilities: This position is located at the National Marine Fisheries Service, Southwest Fisheries Science Center's Santa Cruz, CA location. The position will serve as the Fisheries Ecology Division Director. The individual selected for this position will manage, supervise, and lead a large research organization with the goal of conducting scientific research to conserve and manage fish species and other living marine resources and their habitats for ecological purposes to benefit society and coastal communities.

Qualifications: Job advertised under multiple series and will be open to both status applicants and all qualified U.S. citizens. Go to below link to view and apply for position.

Contact: Kristen Koch at below email. The United States Government does not discriminate in employment on the basis of race, color, religion, sex, national origin, political affiliation, sexual orientation, gender identity, marital status, disability and genetic information, age, membership in an employee organization, or other non-merit factor.

Web Link: http://www.usajobs.gov

Contact Email: Kristen.C.Koch@noaa.gov

SeniorFisheriesScientist/EngineeringManagerWOLF Environmental Group, Inc | AK | Permanent

Salary: Open, depending on experience. Relocation paid for the right individual but would prefer someone in the business market presently.

Responsibilities: TManage existing client base and expand in very busy Alaska fisheries and natural resources practice. Our client is a leader in technical support in the relicensing or licensing of hydroelectric projects, water rights, development of Habitat Conservation Plans HCPs , Natural Resource Damage Assessments NRDAs , Environmental Impact Statements EISs, Environmental Assessments EAs , and Environmental Site Assessments and project implementation. Their clients including utilities, mining companies, timber companies, water agencies, irrigators, municipalities, federal and state government agencies, and tribes.

Qualifications: MS or Ph.D in any natural resources sciences or engineering discipline. Have contacts in Alaska, possess a technical, projecting management and consulting background
Contact: Judy Stockton 1-800-668-9653

Web Link: https://wolfenv.com

Contact Email: judy@wolfenv.com

From the Archives

The most numerous of these birds are cormorants, which live chiefly upon fish; though I have sometimes found shell fish in their stomachs. Being gregarious, they habitually roost at night in large colonies; selecting one or two islands for that purpose, from among a large cluster, without any apparent reason for such preference; and they do not abandon them unless greatly disturbed by man. I think two or three thousand cormorants would be a moderate estimate for the number resorting to one of those islands; and I consider a half pound of fish for each, per day, within the limits of their consumption, as they are very voracious.

I have frequently examined their stomachs, which were always found to be well supplied with fish. Near the mouth of Crystal river I have lately seen four of those island rookeries, and I believe the cormorants in that vicinity consume more than five thousand pounds of fishdaily.

Joseph Willcox, Thirteenth Annual Meeting, Fish-Cultural Association


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