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AFS

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Demonstration Flow Assessment: Judgement and Visual Observation in Instream Flow Studies

Management Concerns about Known and Potential Impacts of Lead Use in Shooting and Fishing Activities

Bringing Back Winter Flounder

Hatchery reared winter flounder are tagged with fluorescent red Visible Implant Elastomer to distinguish them from wild fish after release. Dr. Fairchild releases the flounder into shallow coastal waters at a length of about 40 mm.

The winter flounder *Pseudopleuronectes americanus* is an important commercial and recreational fish along much of North America's Atlantic coast. Inshore habitat degradation and overfishing contributed to stock declines throughout their range, leaving catches at a fraction of historical levels. Reducing fishing mortality and protecting essential habitat have helped stocks to begin recovery, but they still have a long way to go.

To accelerate the recovery of winter flounder, researchers in New Hampshire, led by Dr. Elizabeth Fairchild, are developing and evaluating a stock enhancement program. They have established the culture techniques for winter flounder, determined the optimal size for releasing juveniles for predator avoidance[1] and evaluated release sites[2]. They are now evaluating how well the released fish contribute to the natural populations and developing strategies to maximize post release survival[3].

An essential aspect of the investigation is the ability to identify individuals derived from the release program. This is achieved using NMT's Visible Implant Elastomer (VIE). Critical characteristics of VIE include the ability to tag small fish, the capacity to identify different batches of fish, the rapid rate of tagging that can be achieved, and the low cost tag.

Please contact us to discuss our systems for tagging aquatic organisms.

1. Fairchild EA, Howell WH. 2000. J. Sea Research 44(1-2):81-90.
2. Fairchild EA et al. 2005. Aquacul. Res. 36(14):1374-1383.
3. Fairchild EA, Howell WH. 2004. J. Fish Biol. 65:69-87.

Northwest Marine Technology, Inc.

www.nmt.us

Shaw Island, Washington, USA

Corporate Office
360.468.3375 office@nmt.us

Biological Services
360.596.9400 biology@nmt.us

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EDITORIAL / SUBSCRIPTION / CIRCULATION OFFICES
5410 Grosvenor Lane, Suite 110 • Bethesda, MD 20814-2199
301/897-8616 • fax 301/897-8096 • main@fisheries.org

The American Fisheries Society (AFS), founded in 1870, is the oldest and largest professional society representing fisheries scientists. The AFS promotes scientific research and enlightened management of aquatic resources for optimum use and enjoyment by the public. It also encourages comprehensive education of fisheries scientists and continuing on-the-job training.

Dues and fees for 2008 are $76 in North America ($88 elsewhere) for regular members, $19 in North America ($22 elsewhere) for student members, and $38 ($44) retired members. Fees include $19 for *Fisheries* subscription. Nonmember and library subscription rates are $106 ($127). Price per copy: $3.50 member; $6 nonmember. Fisheries (ISSN 0363-2415) is published monthly by the American Fisheries Society; 5410 Grosvenor Lane, Suite 110; Bethesda, MD 20814-2199 Periodicals postage paid at Bethesda, Maryland, and at an additional mailing office. A copy of Fisheries Guide for Authors is available from the editor or the AFS website, www.fisheries.org. If requesting from the managing editor, please enclose a stamped, self-addressed envelope with your request. Postmaster: Send address changes to Fisheries, American Fisheries Society; 5410 Grosvenor Lane, Suite 110; Bethesda, MD 20814-2199.

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COVER: Small lead sinkers may be more likely to be consumed by waterfowl than larger sinkers.
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COLUMN:
PRESIDENT'S HOOK

Mary C. Fabrizio
AFS President Fabrizio can be contacted at mfabrizio@vims.edu.

Who are We? Initiating a Dialogue to Define Our Core Values and Purpose

Professional associations reflect the collective desires and ideas of their members; successful associations are those that adapt to membership changes and the new ideas or desires associated with such changes. For example, the American Fisheries Society grew from an association primarily comprised of fish culturists (in the 1870s) to an association with members who practiced fisheries science in all its diversity; this growth was accompanied by changes in the desires of the Society. Instead of promoting a single discipline (i.e., aquaculture of fish species), AFS promoted aquaculture, fisheries management, fish health, freshwater ecology, marine fisheries, and so forth. This integrated view of fisheries science enhances our understanding of fisheries and encourages broader scientific perspectives and increased awareness of important findings from related disciplines. In a general sense, the identity of the AFS changed with the change in its membership. But perhaps a more important observation is that this change was a manifestation of the transformation of fisheries science. Today, AFS represents a broadly diverse membership with interests in multiple disciplines; our view of fisheries science has become more interdisciplinary and more complex. So, who are we now?

In my March column, I described the intelligent association as an organization that sustains and uses knowledge to guide decisions and to adapt to changes; actions of intelligent associations are strategically guided and are focused on achieving a set of desired outcomes. Those desired outcomes can be articulated once the core values and purpose of the association have been clearly defined. Knowing who we are and what we value is an essential step in this journey. How do we begin to address this question? I believe we have information that can help us initiate this critical dialogue.

One source of this information is the recent AFS membership survey. A thorough and detailed report on the results of this survey will be delivered to the AFS Governing Board at the 2008 AFS Annual Meeting in Ottawa. Here, I simply wish to highlight my preliminary impressions of the responses we received. The membership survey was distributed electronically to a random sample of AFS members, and to our pleasant surprise, over 55% of the recipients responded.

As I considered the tabulated responses, I came away with a strong impression of who we are. Allow me to explain. The membership survey included questions concerning AFS products and services (such as publications, mentoring, outreach, and advocacy), as well as questions concerning AFS governance, recruitment and retention, and future priorities for the Society. Although almost all respondents supported the development of new products and services (e.g., special publications and mentoring programs for young professionals), products and services with wide support were not necessarily high priorities for members. This indicates that although many good suggestions for new activities exist, these are not necessarily activities that require attention in the next five years or so. Directed questions concerning priorities revealed the need to provide opportunities for scientific interactions—between students and professionals and among professionals—and to accommodate the desire to be regarded as a national and global leader in the conservation of marine and aquatic resources. Priority was also highly placed on the need to increase appreciation of our profession among members of the public. We want to be viewed as relevant to ongoing discussions of environmental issues, and we want to contribute to the global dialogue on the future of world fisheries. It is clear that AFS members place high value on our chosen profession and we desire increased awareness of the potential contribution of fisheries professionals to deliberations on environmental matters—matters that have increasingly become the focus of media attention. We view ourselves as contributors of reasoned scientific information, but we are concerned that our collective knowledge is rarely tapped, unless the environmental issue specifically involves fisheries (e.g., endangered salmonids, or overfishing of large pelagic species). I suggest that improving the visibility and appreciation of fisheries science among the public is a major focus area of the next AFS strategic plan.

Another way to obtain information concerning our contemporary identity and core values is from focus groups. Focus groups are commonly used in marketing research to gauge reaction of consumers to new products; however, non-profit organizations like AFS have successfully used focus groups to uncover the opinions, beliefs, and attitudes of members. On a basic level, feedback from focus groups helps to reveal critical areas of service or important products that may have been overlooked. Depending on how questions are crafted and posed, focus group interactions can also uncover needs and desires of the membership. Recognizing this, AFS is currently pursuing the use of focus groups to help us understand the needs of our members and disclose new activities that require consideration and perhaps, future development. Discoveries from such focus group interactions are rich grounds for new ideas and initiatives. I invite you to share your thoughts on who we are and what we value with me, the AFS officers, members of the AFS Governing Board, and the AFS Executive Director. We look forward to continuing this dialogue.

NEWS: FISHERIES

JOAO PAULO KRAJEWSK

Anglers' Legacy reaches 50,000 pledges

The Anglers' Legacy program has surpassed the 50,000 pledge milestone, the Recreational Boating and Fishing Foundation (RBFF) announced as the initiative approaches its two-year anniversary mark. The program, which asks avid anglers to pledge to introduce newcomers to boating and fishing, continues to develop new partnerships with fishing clubs and membership organizations, sports media, outdoor retailers and manufacturers, state fish and wildlife agencies, industry leaders, and outdoor enthusiasts nationwide. RBFF President and CEO Frank Peterson said the goal for this year is to sign up an additional 85,000 new anglers to the program.

According to a 2007 survey of pledged ambassadors, most take more than 4 people a year fishing and also generate an initial $120 in fishing tackle and equipment sales, buy $166 in boating supplies and accessories, and purchase 3.2 fishing licenses. "At 50,000 pledges, this means the program may have already generated $12 million for the boating and fishing industries and 88,000 new fishing licenses for states," said Peterson.

Didymo found in Maryland

The Maryland Department of Natural Resources announced that didymo, an invasive, non-native algae, was found in Maryland for the first time by anglers at Gunpowder Falls in Baltimore County. Didymo mats, also called "rock snot," look slimy, but feel like wet cotton or wool, and can be white, yellow, or brown. Once didymo is established, it can cover and suffocate a stream bottom, and movement of a single cell can contaminate a new waterway. Didymo is an algal diatom that forms long stalks which combine to form heavy, thick mats. The stalks can persist for two or more months after the diatoms die, causing habitat damage for an extended period of time. Originally found in Scotland and extreme northern Europe and Asia, didymo has been transported worldwide. Recently, the species has been found in the northeast and mid-Atlantic regions of the United States. In many cases, anglers have unknowingly transported the diatom on their fishing gear. Felt bottom boots and waders commonly used by anglers are considered among the worst culprits in the spread of this aquatic invader. Anglers are strongly encouraged to replace these boots with non-porous materials. New boots made of a sticky rubber material are easier to clean and disinfect.

Fish diet to avoid fights

Some fish voluntarily go on diets, according to researchers from the ARC Centre of Excellence for Coral Reef Studies and James Cook University in Australia, and described in the journal *Current Biology.* The scientists discovered subordinate coral gobies deliberately go on a diet to avoid posing a challenge to their larger rivals.

"In studying gobies we noticed that only the largest two individuals, a male and female, had mating rights within the group," explained Marian Wong. "All other group members are non-breeding females, each being consistently 5–10% smaller than its next largest rival. We wanted to find out how they maintain this precise size separation."

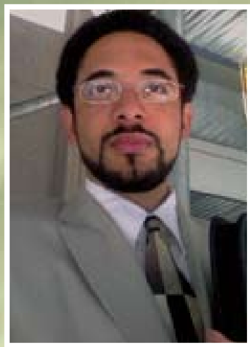
Once a subordinate fish grows to within 5–10% of the size of its larger rival, its size provokes a fight which usually ends in the smaller goby being expelled from the group—and the safety of the coral it occupies. More often than not, the evicted fish is then eaten by a predator. It appeared that the smaller gobies were keeping themselves small in order to avoid provoking larger gobies. Whether they did so because of stress caused by the bullying of larger fish or voluntarily by restraining how much they ate was not clear. The team decided to try to fatten up some of the subordinate gobies to see what happened. To their surprise, the gobies simply refused the extra tidbits they were offered, apparently preferring to remain small and avoid fights.

NFHAP names "Waters to Watch"

The National Fish Habitat Action Plan issued its 2008 "10 Waters to Watch" list at the National Casting Call event on the Potomac River in April. Assembled by leading authorities on aquatic conservation, the list is a collection of rivers, streams, and shores that soon will be cleaner and healthier habitats for many fish and wildlife species. Due to the combined actions of concerned community groups, non-profit organizations, local watershed groups, Native American tribes, and state and federal agencies, these waters are being improved by planting streamside vegetation, removing structures blocking fish from habitat, and protecting bodies of water from the effects of industrial processes, agriculture, and livestock. The 10 waters include Big Spring Branch, Wisconsin; Lake Oconee Island, between Atlanta and Augusta, Georgia; Little Susitna River, near Wasilla and Anchorage, Alaska; O'Dell Spring Creek, near Bozeman and Ennis, Montana; South Fork Chalk Creek, near Coalville, Utah; Stinky Creek, near Alpine, Arizona;Tampa Bay shoreline at MacDill Air Force Base, Florida; Trout Run, Filmore County, Minnesota; Williams Run, northeastern Pennsylvania; and Aaron Run, Frostburg, Maryland.

For more information on these projects, see http://fishhabitat.org.

UPDATE: LEGISLATION AND POLICY



Elden Hawkes, Jr.

AFS Policy Coordinator Hawkes can be contacted at ehawkes@fisheries.org.

MANAGEMENT AND ENFORCEMENT OF INTERNATIONAL FISHERIES

On 3 April 2008 the Senate Commerce, Science, and Transportation Committee conducted a hearing on the management and enforcement of international fisheries. The hearing started with John Negroponte, Deputy Secretary of State, stating that there are many nations that question the intention of U.S. international fishing policies as it has not yet joined the Law of the Sea convention. He explained to the committee that U.S. fishermen already adhere to the rules and regulations of the convention.

John Balsiger, acting assistant administrator, NOAA National Marine Fisheries Service, stated that management strategies require multilateral regional approaches, and that regional fisheries management organizations are vital in managing illegal, unregulated, and unreported (IUU) fishing. He further elaborated that steps have been taken to reduce the bycatch of sea birds and sea turtles and then concluded by declaring a need to provide funding for other countries to collect data on fishing.

David Balton, Assistant Secretary Oceans and Fisheries, Bureau of Oceans, Environment, and Science for the U.S. Department of State, explained that three-fourths of the world's commercially exploited fish stocks are at least overfished and over-capacity. He urged that the United States join the Law of The Sea convention. Balton also expressed need for the creation of a global record of fishing vessels and called for greater assistance to be given to developing countries. Rear Admiral Brooks, District 17 commander of the U.S. Coast Guard, explained that many coastal nations are not capable of handling fisheries management, which in turn leads to resource exploitation and economic collapse. He concluded by endorsing the implementation of an integrated deep water system for the U.S. Coast Guard, which would further aid in the combat of IUU fishing.

David Benton, executive director of the Marine Conservation Alliance, stated that the United States must urge its Arctic neighbors to support similar fishery policies within their own countries. He also implored that controls need to be put in place before the continued retreat of Arctic ice allows for full-blown commercial fishing in the Arctic.

James Cook, vice president of the Pacific Ocean Producers, LLC, focused mainly on fisheries management in the southwestern Pacific. He explained that fisheries scientists have recommended a 25% reduction in fishing to better conserve those fish stocks. However, countries give fishermen permission to fish in their EEZs, thus making conservation nearly impossible. He observed that the Western Pacific Management Council (which manages fisheries policy in the region) has enacted an effective and aggressive policy, and that the U.S. Coast Guard needs more funding and assets to effectively monitor U.S. economic zones in the southwest Pacific.

Lisa Speer from the Water and Oceans program of the Natural Resources Defense Council explained that the United States, Korea, Japan, and Russia have entered into an initial agreement for a regional fisheries management organization for the northwest Pacific. Currently in the draft treaty, Japan falls short of what U.S. fishermen adhere to under the Magnuson-Stevenson Act. If this does not change, then she recommends for the United States to withdraw from the negotiations.

CLEAN WATER RESTORATION ACT

On 16 April 2008, the Committee on Transportation and Infrastructure received testimony on the Clean Water Restoration Act of 2007. The hearing consisted of five panels of witnesses. Committee chairman Rep. James Oberstar (D-MN) began the hearing by stating that for 30 years the Clean Water Act (CWA) has doubled the number of waters that are safe for drinking, swimming, and fishing across the United States, and has been universally praised by industry, environmentalists, Democrats, and Republicans alike. He indicated that parties from across the spectrum have expressed concern over the mess and delay that recent court decisions have caused. He went on to state that the Clean Water Act should be restored with the protections that were taken away by the Supreme Court decisions.

Rep. Mica (R-FL) expressed his dissatisfaction over the language of the legislation as it has been written. He stated that the legislation is far from a restoration of the previous CWA, but is a representative of an agenda item being pushed through. He further stated that this agenda item

Continued on page 249

Pike not picky eaters

While northern pike are a familiar and desirable fish in many parts of North America, they are neither welcome nor native in the Pacific Northwest. Some states even offer a bounty for their capture, since pike are suspected of eating native salmon and trout, including some endangered and threatened species. So how many trout and salmon can a northern pike eat? In a recent paper in the *North American Journal of Fisheries Management*, a group of researchers from the U.S. Geological Survey, the University of Idaho, and Montana Fish, Wildlife and Parks used bioenergetics modeling to determine how many other fish the pike are consuming. First, the scientists needed to determine how many northern pike were living in a stretch of the Flathead River in Montana. Then they collected hundreds of pike stomachs from anglers and analyzed the contents. Finally, a bioenergetics computer model was used to estimate the quantity of fish that the Flathead River pike would need to consume in order to survive. The estimated 1,200 northern pike in the study area annually consumed 8 metric tons (8.8 imperial tons) of fish flesh. While 82% of their diet was made up of other species such as sunfish and whitefish, the pike still ate an estimated 13,000 westslope cutthroat trout and nearly 3,500 threatened bull trout. The authors suggest that northern pike are contributing to the decreasing numbers of native salmon and trout. **Using Bioenergetics Modeling to Estimate Consumption of Native Juvenile Salmonids by Nonnative Northern Pike in the Upper Flathead River System, Montana,** by *Clint C. Muhlfield, David H. Bennett, R. Kirk Steinhorst, Brian Marotz, and Matthew Boyer.* ***North American Journal of Fisheries Management*** 28:636-648. Muhlfield can be contacted at cmuhlfield@usgs.gov.

Can toadfish whistle?

The lowly toadfish may have a face only a mother could love but its loquacious tendencies may help open up a whole new world of eavesdropping on fish through "passive acoustics." Passive acoustics involves lowering hydrophones from boats or towing hydrophone arrays through the water in order to detect fish species through the noises they make naturally. In a recent paper in *Transactions of the American Fisheries Society*, Michael Fine of Virginia Commonwealth University and Robert Thorson outline how the relatively sedentary but noisy toadfish can be used to solve passive acoustic puzzles like recognition of individual fish, sound pressure level, directionality, and interactions of fish through sound. Studies of toadfish recordings made from the 1970s until 2002 reveal how the species uses sound throughout the day and in different seasons. Like many sound-producing fish, toadfish produce sound through rapid contraction of "sonic muscles" around the swim bladder. Male toadfish guard their nests for several weeks, while using a boatwhistle "boop" call in competition with other males or to attract females. Both males and females also grunt. Boatwhistles often provoke grunts or "tags" from other males in accordance to a dominance hierarchy. The authors demonstrate the acoustic recordings can provide a rich source of information even about unseen fish, and research on toadfish can pave the way for application of acoustic techniques to other species. **Use of Passive Acoustics for Assessing Behavioral Interactions in Individual Toadfish,** by *Michael L. Fine and Robert F. Thorson.* ***Transactions of the American Fisheries Society*** 137:627-637. Fine can be contacted at mfine@vcu.edu.

Catch and release trends for bass

More and more anglers are heeding the call to voluntarily release the largemouth bass they catch. This catch-and-release conservation ethic has been promoted by the media, fishing organizations, and even some fisheries agencies. Since most bass do survive being hooked, caught, and released, this practice can affect bass fishing quality. In a recent paper on the *North American Journal of Fisheries Management*, scientists from the Texas Parks and Wildlife Department, the University of Florida, and the Florida Fish and Wildlife Commission evaluated the changes in the voluntary release rate at four Texas reservoirs and two Florida lakes from 1975–2006. The voluntary release rate only refers to legally harvestable fish released completely voluntarily and not in order to comply with bag limits or other regulations. Using data from annual creel surveys, the researchers determined that the voluntary release rate had dramatically increased over time, reaching a peak of 90% at the two Texas reservoirs in the early 2000s. The voluntary release rate varied seasonally, by year, and among the different lakes and reservoirs studied. Although the reduced fishing mortality rates benefit the overall numbers of largemouth bass, it can prove problematic for fisheries managers attempting to develop trophy fisheries through slot-limits intended to reduce competition and allow some fish to grow larger. Therefore, the authors suggest that managers attempting to use harvest regulations to change the size structure of a bass population will need to consider local angler attitudes towards harvest. **Temporal Trends in Voluntary Release of Largemouth Bass,** by *Randall Myers, John Taylor, Michael Allen, and Timothy F. Bonvechio.* ***North American Journal of Fisheries Management*** 28:428-433. Myers can be contacted at randy.myers@tpwd.state.tx.us.

JOURNAL HIGHLIGHTS: TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY

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SPECIAL SECTION: PASSIVE ACOUSTICS

FEATURE:
FISHERIES RESEARCH


Oak Grove Fork study site 3 at baseflow

Demonstration Flow Assessment: Judgment and Visual Observation in Instream Flow Studies

ABSTRACT: The Demonstration Flow Assessment (DFA) method evaluates instream flow benefits using expert judgment and direct observation of habitat during several flows. Early DFA applications were low-effort, qualitative, and vulnerable to well-known biases. We describe a higher-effort, more quantitative DFA (or expert habitat mapping) approach that uses techniques from the judgment-based decision analysis literature to increase objectivity and reproducibility. Specific metrics—habitat types to be quantified visually during flow observations—are designed from appropriate conceptual models of how flow affects target resources. During field observations, patches of each habitat type are delineated by consensus and marked on maps for digital analysis. A case study illustrates these procedures applied to instream flows for salmon spawning and rearing.

Evaluación de Regímenes de Caudales: juicio y observación visual en Estudios de Caudal Ecológico.

RESUMEN: El método de Evaluación de Regímenes de Caudales (ERC) examina los beneficios del caudal ecológico a través del juicio experto y observación directa del hábitat durante diferentes regímenes de caudal. Aplicaciones previas del ERC se caracterizaban por ser poco precisas, cualitativas y vulnerables a sesgos diversos. Con el fin de incrementar la objetividad y reproductibilidad de dichas evaluaciones, aquí se describe una ERC que implica un mayor esfuerzo que la anterior y enfoques de carácter más cuantitativo (Mapeo Experto de Hábitat) obtenidos de literatura sobre técnicas de análisis de decisión basados en juicio. Se diseñaron medidas específicas—tipos de hábitat a ser cuantificados visualmente durante la observación de los caudales—a partir de modelos conceptuales que describen cómo los caudales afectan las especies objetivo. Durante las observaciones en campo y por medio de un consenso, se delinean los parches de cada tipo de hábitat y se trasladan a un mapa para su análisis digital. Un caso de estudio ilustra la aplicación de estos procedimientos al caudal ecológico para el desove y cultivo del salmón.

Steven F. Railsback and John Kadvany
Railsback is an environmental scientist with Lang, Railsback and Associates, Arcata, California. He can be reached at Steve@Langrailsback.com. John Kadvany is a principal at Policy and Decision Science, Menlo Park, California.

INTRODUCTION

Two recent reviews of instream flow methods (EPRI 2000; Annear et al. 2004) noted the increasing use of assessments conducted by observing the stream during several alternative flows, then recommending flows using professional judgment as the primary basis. The Instream Flow Council (Annear et al. 2004) referred to this approach as the "Demonstration Flow Assessment" (DFA) method. Unofficially, the method has


Oak Grove Fork study site 3 at 35 cfs


Oak Grove Fork study site 3 at 80 cfs


Oak Grove Fork study site 3 at 150 cfs


Oak Grove Fork study site 3 at 200 cfs


Oak Grove Fork study site 3 at 300 cfs

also been called BOGSAR—"bunch of guys standing along the river"—a name reflecting the method's reputation for subjectivity. The limitations of DFA noted by EPRI (2000; five DFA studies between 1995 and 2000 reviewed) and Annear et al. (2004) arise from its potential subjectivity: because DFA relies more on judgment and less on quantitative tools such as models and data analysis, it can appear unscientific, irreproducible, and susceptible to bias.

In practice, all decision models and analyses depend on professional judgment. Model-based approaches, for example, require judgment in selecting the processes or variables to include in the model, where to place study sites, what parameter values to use, and how to interpret results. Instead of describing alternative instream flow methods as subjective versus quantitative, it is more useful to see them as having different balances between the effort they require and the amount of useful information they provide. Good methods could provide either a modest amount of useful information at low effort, or more information (or more useful kinds of information) for greater effort. Whether low- or high-effort methods are best depends both on how much effort can be expended on a study (what resources—time, expertise, flow, etc.—are available) and on how much more useful information the high-effort methods provide. Early DFA applications tended to be at the low-effort, low information extreme of this balance, with observers using unstructured and holistic judgment to simply rank several alternative flows. Sometimes the choice of low effort appeared motivated not only by a lack of resources but by lack of confidence that higher-effort methods would provide more useful information (EPRI 2000).

The goal of this article is to improve the effort–usefulness balance for DFA studies by recommending procedures that improve credibility and reproducibility. DFA is a "grass roots" method largely lacking in published procedures. Professional judgment and visual observation have long been used for instream flow assessment (e.g., Tennant 1976; Tharme 2003), and several instream flow methods explicitly incorporate judgment (e.g., King and Louw 1998; Failing et al. 2004). There is extensive literature on judgment-based environmental decision-making (e.g., Keeney and von Winterfeldt 1989; Morgan and Henrion 1990; Kadvany 1995), and balancing effort against usefulness is covered extensively in the judgment and decision-making literature (e.g., Payne et al. 1993). However, little from this literature has previously been applied explicitly to DFA.

Our approach is motivated by two basic principles of human judgment and decision-making. First is "bounded rationality" (Watson and Buede 1987; Payne et al. 1993), meaning that practical decision-making processes are subject to resource limitations; hence, estimation methods useful when resources are high are not necessarily useful when resources are low, and vice versa. Second is that judgments of complex quantities—the population of a large city, gross national product (GNP), etc.—can be improved by disaggregating the quantity into "smaller" or simpler quantities—population by neighborhoods, economic production by region and season—and then aggregating results. One application of this principle is the use of influence diagrams (Merkhofer 1990; Clemen 1996) or other conceptual models when using data and professional judgment to identify a small set of important variables or metrics to evaluate in the field. This kind of articulation and structuring of complex professional judgments also benefits communication by defining the problem more clearly and helps make more efficient use of resources (Merkhofer 1990; Morgan and Henrion 1990).

Judgment of quantities and probabilities is subject to several well-known kinds of bias because we often use a set of common heuristics to make mental estimates. For example, when making unconstrained judgments people tend to assume that an event results from a process when the event represents (i.e., fits a preconceived notion of) the process, to assume events are more likely when examples of them are easily brought to mind, and to estimate values by starting with a known value and adjusting from it, often inadequately (known as "anchoring"; Kahneman and Tversky 1982). No procedures guarantee the elimination of bias (Lichtenstein et al. 1982; Morgan and Henrion 1990), but our approach acknowledges and attempts to avoid these and several other types of error in expert judgment. Biases due to preconceived notions (e.g., the belief that more flow equates to more fish) or stakeholder preferences (e.g., water users benefit from lower instream flows) are reduced by using field evaluation of several specific metrics developed by consensus from specific conceptual models rather than estimating a single holistic variable such as "overall suitability." Anchoring bias in estimating habitat area is reduced by delineating habitat patches on detailed maps instead of mentally estimating patch area. Susceptibility to group-think motivated by a shared set of desired outcomes (Budnitz et al. 1998) is reduced by including diverse stakeholders in the assessment. Other potential biases we consider include a tendency to underestimate uncertainty in subjective measurements (Morgan and Henrion 1990) and failure to eliminate incorrect observation "habits" developed early in field assessment.

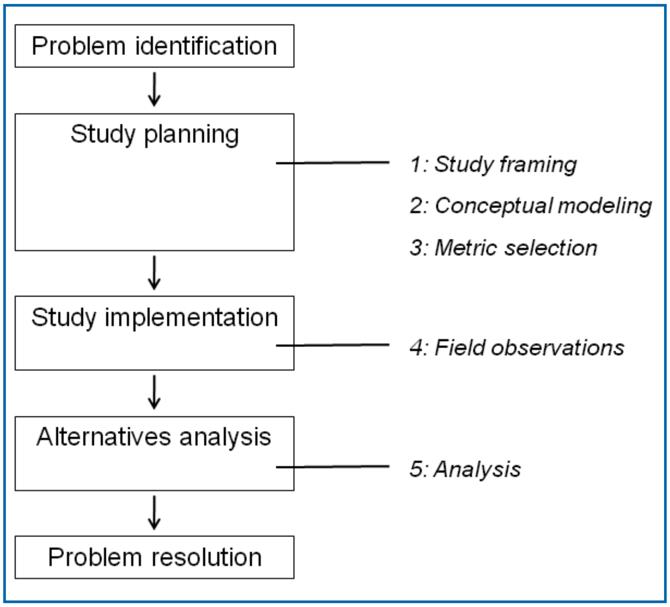
Here we focus on DFA studies in which observers use judgment to visually estimate the area of specific habitat types at several alternative flows. This kind of DFA (sometimes referred to as expert habitat mapping) requires more effort than the earliest DFA studies, but produces results that are more quantitative, reproducible, and therefore useful.

We limit our discussion to assessing instream flow releases for fish. Instream flow decisions typically require assessment of other resources such as recreation, aesthetics, channel maintenance, water quality, riparian vegetation and groundwater, etc. (Annear et al. 2004). DFA is potentially adaptable to some of these resources, but often other tools are required. Similarly, instream flows for fish often vary seasonally; separate DFA studies can be made to evaluate flow needs for different seasons, or other approaches can be used.

DEMONSTRATION FLOW ASSESSMENT PROCEDURES

Like many other instream flow methods, DFA has the purpose of providing decision-makers with information on how aquatic ecological benefits vary with flow. The key difference between DFA as we describe it here and other popular methods is that DFA does not use mathematical models but it does provide quantitative information on how fish benefits change incrementally with flow. This information is gathered by directly observing and delineating usable habitat during several flows. We describe DFA as five steps that can fit within the Instream Flow Incremental Methodology (IFIM) decision-making process as described by Stalnaker et al. (1995; Figure 1).

Figure 1. The IFIM is described by Stalnaker et al. (1995) as having five phases (left column). Our five DFA steps (right column) fit within the IFIM's study planning, study implementation, and alternatives analysis phases.



For each step we describe its objectives, discuss key procedures and uncertainties, and illustrate the step through a case study. (EPRI 2004 provides additional detail.) The case study was conducted below a hydroelectric diversion on Oak Grove Fork of the Clackamas River, Oregon (CIFGS 2003). The Oak Grove Fork study preceded and was independent of our work on DFA procedures, but it illustrates many of our points.

Step 1: Study Framing

"Framing" defines a study's basic goals and resources and methods available to achieve them. This step settles issues such as:

1. Who participates in the study and what are their roles?
2. What resources are targeted, and what are their management objectives and priorities?
3. What study sites are to be used, and how will results from each be integrated?
4. Will different flows be recommended for different seasons, for wet versus dry years, etc.?
5. What range of flows are feasible, for either physical or legal and institution reasons? How many flows can be observed during the study (so how precisely must their effects be distinguished?)?

Fundamentally, this framing step should identify the larger decision-making context for the study, and the role of the study in that context (as in Figure 1).

Key procedures and uncertainties

Selecting how many and which flows to observe is a particularly critical framing issue for DFA. This decision is a judgment that strongly affects study cost and uncertainty, and subsequent study design decisions. Observing more flows increases the definition in the observed relation between habitat and flow (illustrated at Step 5, below) but increases costs for field observations, analysis, and released water. It may be efficient to select flows adaptively, by first observing only a few flows over a wide range, possibly using coarse and less costly metrics (see Step 3), and then observing additional flows in the most promising range.

The baseline flow

The flow existing before new flow requirements are instituted should be included in the observations, even if it is unlikely to be a preferred alternative. Habitat quantity at the baseline flow provides a basis for comparison. For example, three alternative flows might be determined by the study to provide 2,000, 2,200, and 2,500 m^2 of habitat. If the baseline flow provided 1,800 m^2, these numbers would indicate that there is a steady but not spectacular increase in habitat with flow, but if the baseline flow provided 500 m^2 the interpretation would be that any of the new flows provides a major habitat increase.

Case study

In the study framing step of the Oak Grove Fork case study, the assessment team identified representatives of the company operating the diversion, fisheries management agencies, and non-governmental conservation organizations. A consulting firm (McBain and Trush, Inc., Arcata, California) was chosen to facilitate the study. The site supports spawning and juvenile rearing of coho salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*), and the clear objective of fisheries agencies was for instream flows to enhance the production of these anadromous species. The affected stream reach is 7,300 m long, bounded at the upper end by an impassible waterfall and at the lower end by the confluence with the mainstem Clackamas River. Gradient decreases as the mainstem is approached. The assessment team selected two study sites to represent higher and lower gradients. The lower and upper sites were 340 and 500 m in length, totalling 11% of the affected reach.

The range of feasible instream flow releases was established as 0 to 9.2 m^3/s. The current release of 0 was the baseline; at 0 release, tributary and groundwater inflows produce 0.3-0.6 m^3/s at the study sites. The upper limit of 9.2 m^3/s was chosen because it approaches the range of flows that would exist with no diversion at all (the pre-dam median summer base flow is estimated to be 10.2 m^3/s in average runoff years and 7.7 in dry years), and because observers could not wade safely at higher flows. The study team decided to observe seven flows over this range, including the baseline. This investment reflects a desire to avoid the uncertainties that result when only a few flows are observed and the flow–habitat area relationship is only coarsely defined. One consequence of this decision is that study methods then must be precise enough to distinguish among the seven observed flows.

Step 2: Developing Conceptual Models of Flow Effects

This step establishes consensus on the most important ways that flow affects the target resources. Conceptual models can be thought of as shared assumptions and explanations for important processes, used to design assessment methods and interpret results.

Key procedures and uncertainties

For DFA, conceptual modeling is when biological knowledge is most directly applied, as participants discuss and document assumptions for how flow affects the target resources. Conceptual model development is a hypothesis-generating exercise, with participants discussing alternative models for how flow affects target resources and considering ways that these models can be quantified in the flow observations.

Many DFA studies depend mainly on the "habitat selection" conceptual model that is widely used in instream flow assessment (e.g., in the PHABSIM model; Bovee et al. 1998). Habitat selection analysis (a subset of "resource selection" analysis; Manly et al. 2002) identifies the kinds of habitat that fish select (or "prefer"), and assumes that alternatives providing more of the preferred habitat are better. The habitat selection concept has important limitations (EPRI 2000; Garshelis 2000; Manly et al. 2002; Railsback et al. 2003), but remains popular for instream flow assessment. Although its appropriateness remains debated, the conceptual model is simple to apply and habitat selection by fish is relatively easy to observe.

A strength of DFA is that studies can also use two other kinds of conceptual models. Mechanistic conceptual models explicitly consider ecological mechanisms by which flow affects fish, such as by scouring or drying redds or producing food. Theoretical conceptual models may be useful for complex resources and when mechanisms are too numerous or poorly understood. For example, if a study's target resource is a native warmwater community, the most useful conceptual model may be the theoretical assumption that biological diversity increases with habitat diversity (Schlosser 1982; Lobb and Orth 1991; Aadland 1993). (Example DFA methods for warmwater communities are in EPRI 2004.)

Each kind of conceptual model has limitations leading to uncertainty in assessment results. For habitat selection modeling, it may be only approximately correct (or even incorrect) that habitat types where fish are most often observed is high-value habitat or that population status varies directly with the area of selected habitat (Railsback et al. 2003). For mechanistic models, uncertainty is increased if key mechanisms are neglected or mischaracterized. For theoretical conceptual models, uncertainty arises from using a very coarse model of complicated aquatic communities.

Case study

The Oak Grove Fork assessment team used the following sequence of assumptions to define two conceptual models of how flow affects the management goal of enhancing coho salmon and steelhead production. Each assumption was debated and judged by consensus to be a useful approximation.

1. Production of adult salmon and steelhead is enhanced by producing more and bigger smolts.
2. One important way flow affects smolt production is by affecting availability of spawning habitat.
3. Availability of foraging habitat for fry is not an important way flow affects smolt production because fry habitat was assumed sufficient at all flows.
4. Availability of foraging habitat for age-1 coho salmon and age-2 steelhead ("juveniles") is an important way flow affects smolt production. Flows sufficient for age-2 steelhead are also sufficient for age-1 steelhead.
5. The habitat selection approach is useful for defining spawning and juvenile foraging habitat, as highly selected habitat

(habitat types where fish are observed in high densities) is assumed highly productive.

Consequently, the first conceptual model addressed juvenile foraging. This model is that smolt abundance and size increase with the area of highly selected habitat for juvenile foraging. The second conceptual model is that spawning success increases with the area of highly selected spawning habitat.

The team's second conceptual model considers mechanistic effects of flow on spawning. Instream flow was judged to affect the risk of a redd being scoured out by high flows during incubation. Spawning in the deepest parts of the channel places redds at higher risk of scouring during uncontrolled high flows, so spawning habitat is more valuable if it is not in the deepest part of the channel. This conceptual model was based on a mechanism plausible at this site where redds are likely to be created during base flows but then exposed to spill flows.

The case study illustrates several important points. First, the number of conceptual models strongly affects both the study's effort and its uncertainty. More conceptual models, and more realistic models, may seem important for accuracy, and uncertainty will be high if important processes are ignored or misunderstood. Yet too many conceptual models could be too expensive to evaluate and too hard to integrate into meaningful conclusions. Second, while habitat selection is used widely in instream flow assessment, other kinds of conceptual models (here, mechanisms driving redd survival) can be important and easily incorporated.

Step 3: Selecting Habitat Metrics

Now the specific metrics that will be quantified during the field observations of Step 4 are defined. Habitat metrics are the specific types of habitat that observers will quantify during the demonstration flows, and are defined from the conceptual models.

Key procedures and uncertainties

The habitat metrics are essentially models of ecological processes, so avoiding uncertainty requires consideration of three ecological modeling issues: reproducibility, spatial resolution, and biological resolution.

Reproducibility is essential for any scientific study and especially important for overcoming DFA's reputation for subjectivity. Reproducibility can be provided by:

- Documenting assumptions about factors affecting habitat selection, such as the size of fish being evaluated, their activity (e.g., daytime foraging, nighttime foraging, spawning, winter sheltering), and site conditions that affect habitat selection.
- Using enough habitat types to represent the conceptual models but not so many that it is difficult to classify observations. (Think about organizing music at a record shop. Using more categories gives customers more information about the music in each bin, but also makes it harder to decide which bin a particular recording should be in.) Hierarchical habitat classification schemes (e.g., Vadas and Orth 1998) may allow more types to be used with less difficulty categorizing habitat.
- Documenting the characteristics of each habitat type, whether those characteristics are based on judgment, data, or other information.
- Ensuring that habitat types can actually be distinguished during observations. Depth and substrate type, for example, might be useful for defining habitat types in clear, wadeable streams but unobservable in deep, turbid rivers. In large and turbid streams, metrics could be based on such variables as the size and relative frequency of habitat unit and cover types (Lobb and Orth 1991; Aadland 1993).
- Ensuring that metrics do not change during an assessment. "Creep" in the definition of habitat types is likely as observers gain experience. Practice using the habitat metrics (e.g., during observation of the existing base flow) is essential for avoiding creep; ambiguous metrics or protocols can be identified and changed.

In some DFA studies, observers used published PHABSIM habitat suitability criteria to supplement their judgment. While supplementing judgment with "hard data" is attractive, PHABSIM criteria should be used judiciously. The traditional PHABSIM "criteria curves" that assume effects of habitat variables (often, depth, velocity, and substrate type) are independent, range from 0.0 to 1.0, and are easy to use during DFA observations. However, this simplified approach to habitat criteria is outdated (Vadas and Orth 2001; Manly et al. 2002) and has been found less accurate than more sophisticated approaches (e.g., Ahmadi-Nedush et al. 2006). Experienced observers may have a more nuanced understanding of how habitat variables interact to affect fish. Because habitat preferences vary with factors including fish size, competition, temperature, and turbidity (Railsback et al. 2003), PHABSIM criteria should be avoided if they are not from clearly similar sites (or if it is not clear what kind of conditions they represent).

Spatial resolution is critical in any ecological study (e.g., Starfield and Bleloch 1986; Manly et al. 2002) because ecological relationships can change with scale. Using an inappropriate resolution or mixing resolutions is a common, major, yet poorly understood source of uncertainty in instream flow studies (Railsback 1999). Corsi et al. (2000) introduce scale issues in habitat modeling, Scott et al. (2002; Part 2) cover them extensively, and Railsback (1999) illustrates their relevance to instream flow assessment.

The spatial resolution of a habitat metric is the area over which habitat conditions are aggregated during observations. For territorial fish such as drift-feeding salmonids, the feeding territory size is an appropriate minimum observation area. Quantifying habitat at finer scales than a territory size is inappropriate because habitat value to the fish is determined by all the conditions throughout its territory, not just at any spot within the territory, and because a patch of otherwise good habitat is not useful if it is too small to support one fish. (An isolated 0.1 m^2 patch with perfect velocity and depth for adult trout feeding should not be counted as habitat because it is much smaller that a trout's territory.) Many warmwater fish use entire channel units (pools, riffles), so their habitat metrics should be at the channel unit scale (e.g., Vadas and Orth 1998). Spatial resolutions are often specified only approximately, and habitat can be quantified over areas greater than (but not less than) the chosen spatial resolution.

Biological resolution refers to how many metrics are used to represent how many resources. The Oak Grove team realized, as have others (e.g., Loar et al. 1985; Studley et al. 1996), that habitat-based methods cannot predict how different fish groups respond to flow when those groups use the same habitat. If, for example, adults of two trout species both use the same foraging habitat, doubling the area of this habitat will probably not double the abundance of both species; instead, new habitat may be dominated by one species. The inability to resolve between fish groups with similar habitat requirements means that an instream flow study has limited biological resolution. If habitat metrics for two groups of fish cannot be clearly distinguished, then the groups must be combined in the assessment.

Case study

The Oak Grove team arrived at three habitat metrics: (1) coho salmon and steelhead spawning habitat—the area of habitat judged to be high quality for spawning, (2) coho salmon foraging habitat—the area of habitat judged to be highly selected by age one and older coho salmon for foraging, and (3) steelhead foraging habitat—the area of habitat judged to be highly selected for foraging by age two and older steelhead. Reproducibility, spatial resolution, and biological resolution were considered explicitly.

Concerning reproducibility, the team decided that their metrics should not include separate delineation of "marginal" and "good" habitat, but instead to delineate only clearly good habitat. This decision reduces the number of judgments and the opportunities for subjectivity, keeps field observations from being overly complex, and avoids, in the analysis step, the difficult problem of comparing marginal habitat to good habitat. Further, the team agreed that habitat metrics should be based on relatively well-defined and observable variables. Therefore, judgment of spawning habitat should be based mainly on availability of appropriate depths, velocities, and gravel sizes; and judgment of foraging habitat should consider proximity to velocities that provide drift food, availability of velocity shelters to reduce swimming speeds, and proximity to hiding cover.

The assessment team explicitly discussed and selected a minimum size for delineated habitat areas, essentially the spatial resolution of field observations. They recognized that very small patches of habitat occur in complex habitats (e.g., small eddies in boulder gardens), but trying to identify such small patches would be impractical and uncertain, and very small patches are of less biological value (e.g., too small to support even one fish). Hence, they chose a minimum patch size of two square meters.

Concerning biological resolution, the team agreed that spawning habitat for coho salmon and steelhead could not be distinguished, so one spawning habitat metric applied to both species. However, they also agreed that coho salmon generally use lower velocities than steelhead, so separate foraging habitat metrics are needed.

Step 4: Designing and Conducting Field Observations

In Step 4 the habitat metrics are quantified at the different demonstration flows. Decisions include determining who participates in the observations, how to quantify the habitat metrics, and which types of uncertainty to address and how.

Key procedures and uncertainties

Delineating habitat metrics by marking patches of each type on a base map has been found (especially in the Oak Grove Fork study) to let field observers quantify the metrics rapidly and with a level of precision judged to be adequate, while avoiding anchoring biases associated with simply judging the size of each patch. Much of Step 4's effort and cost therefore is likely to be devoted to developing detailed and accurate base maps. Uncertainties and inaccuracies in field observations can be reduced by providing maps with an abundance of landmarks, e.g., boulders and trees.

Selecting the team of field observers is critical for both the study's scientific credibility and for its success as a decision-making process. Limiting observers to a few highly qualified scientists may cause some stakeholders to feel excluded and reduce their confidence in, and commitment to, the results. But including all stakeholders regardless of expertise could compromise the credibility of the results even if the team as a whole is well-qualified. Any stakeholders whose representatives in the overall decision process are not well-qualified for the field observations could choose to recruit field observers they believe to be both qualified and not biased against the stakeholder's values. Establishing expertise thresholds for observers early in the study (in Step 1, or early in Step 4) is recommended to reduce the potential for conflict over inclusion. Criteria for inclusion on the observer team should include familiarity with the target species and the biological processes of the conceptual models identified in Step 2, and field experience observing these species and processes. Finally, team members need to remember that they are collecting data, not making decisions.

During observations, it is desirable to encourage all members of the team to express their judgment instead of letting a single person or perspective dominate; a continual dialog provides checks and balances. One way to encourage participants to think independently is for each person to delineate an area's habitat on their own map, then develop a consensus delineation, all before moving on to the next area. When the group cannot arrive at a consensus in delineating a patch of habitat, separate delineations can be made for each opinion. If disagreements are few, they may have no significant effect on results. If disagreements are many and consistent, then it may be necessary to analyze separate delineations produced by different participants; causes of disagreement (e.g., consistent differences in judgment of what constitutes highly selected habitat) should be documented for consideration in the Step 5 analysis. If disagreement in habitat delineation leads to different analysis results (e.g., different trends in how habitat metrics vary with flow; differences in which flow produces the highest metrics), the analysis can treat the differences as a source of uncertainty that must be considered in the instream flow decision.

An observation team needs a leader to draw the group's habitat delineation onto the map, mediate disagreements, forge consensus, and keep the team moving. It is typically best to explicitly select a leader that the participants feel is fair and able to address challenges reliably, instead of leaving this role to be filled by the most forceful personality. Consensus formation will depend both on leadership and a team goal of developing the best possible analysis.

Concern about uncertainty in DFA usually focuses on the visual observations, because these are the key difference from model-based approaches. Several sources of uncertainty could affect the field observation step, though they may not be the most important uncertainties overall. (1) Observers can be biased by preconceived notions or desired outcomes, although the use of specific shared metrics should reduce this uncertainty. (2) Habitat metrics can be inconsistent, changing over time or varying among observers. (3) There is error and variability in habitat quantification, e.g., uncertainty in visual observations due to habitat varying too gradually to delineate habitat types sharply. (4) There can be error in measuring and controlling the flow rates during observations (a challenge at Oak Grove Fork because of groundwater inflows and a lack of good gaging sites).

Some DFA studies may choose to quantify uncertainty in the habitat area estimates. Whether and how to do so must be decided in advance of field observations because the decision affects how data are collected. There are several potential approaches. (1) Uncertainty in the area of each habitat patch can be quantified, e.g., by estimating the minimum and maximum extent of each patch. (2) Uncertainty in the entire study can be estimated by quantifying habitat several times. (3) Bias and uncertainty among observers can be evaluated by having each participant delineate habitat separately (which can also help calibrate individual or group judgments).

Case study

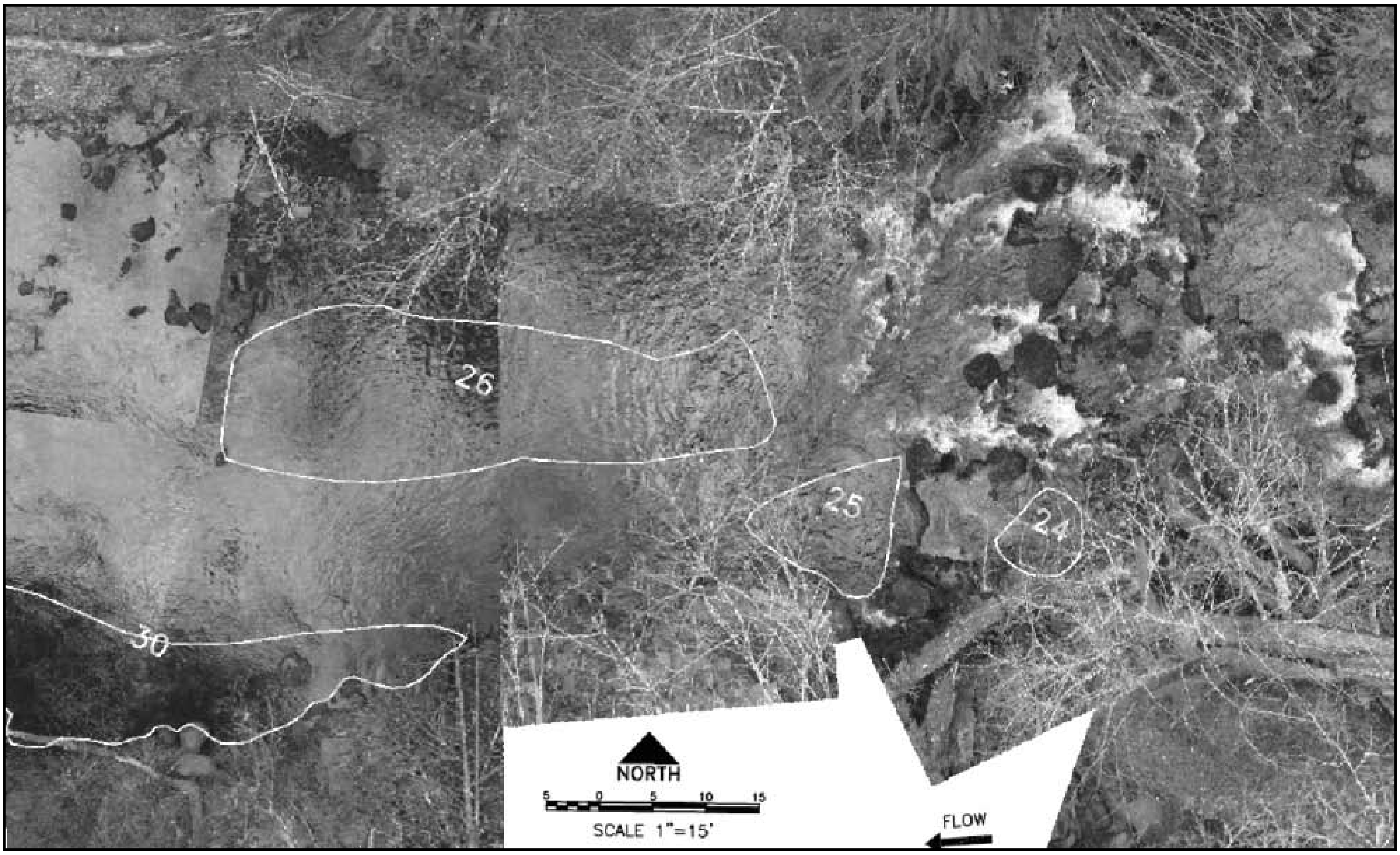
The case study delineated habitat metrics by drawing patch boundaries on highly detailed base maps. Available aerial photographs were unusable as base maps because overhanging trees obscured the channel. (Reflected sunlight is another common problem.) McBain and Trush, Inc. used a balloon-mounted photography system (Floatograph Technologies, Napa, California); three technicians photographed the study reach from an elevation of about 15 m, during a low flow. The photographs were digitally rectified and assembled into composites (Figure 2). Developing the maps required several person-weeks of research, field time, and computer processing, especially to rectify and combine approximately 200 photos.

The assessment team considered which among its members had sufficient experience observing the target fish to participate in the habitat delineation, and determined (using unreported criteria) that all members were qualified. The habitat delineations were carried out by separate teams for each site. Two demonstration flows could be evaluated each day (including the time for changing and measuring the dam release) and the seven flows were observed within four consecutive days. The group discussed each patch that contained habitat as defined by the three metrics, and the facilitator drew the patch on the base map after its boundaries were agreed upon. Field assistants measured depth and velocity as requested, allowing team members to re-calibrate their mental estimates of these variables and their judgments based on them.

Step 5: Analysis

The final step analyzes field data with the objective of producing the assessment results, a summary of how well each alternative instream flow meets aquatic resource management objectives identified in the study framing step. If field data on uncertainty in habitat quantification were collected, they are also analyzed at this point.

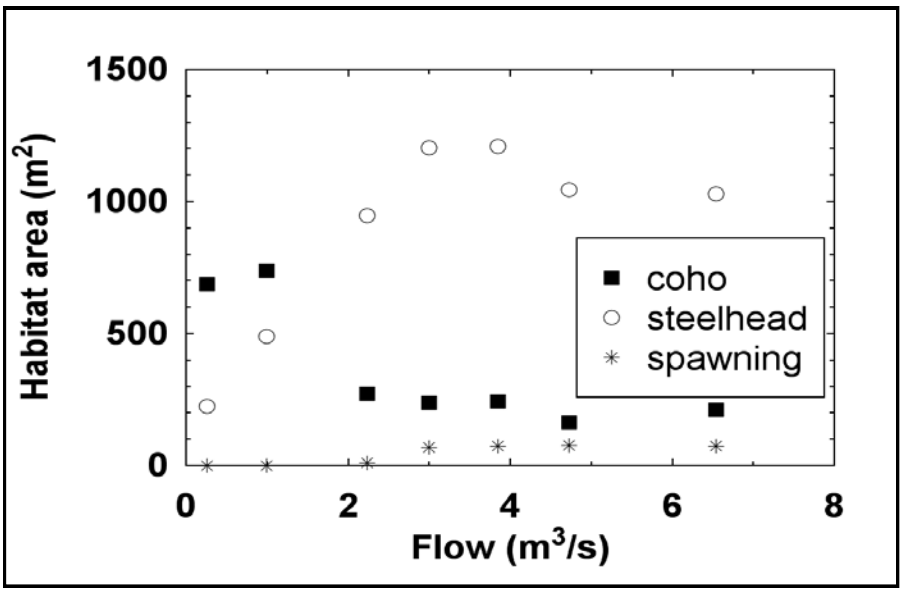
Figure 2. Example base map and field habitat delineation from the Oak Grove Fork study. The white curve is a digitization of patches of coho salmon foraging habitat delineated by observers at a demonstration flow of 2.3 m^3/s, in a small portion of the study site. (Figure reproduced from CIFGS 2003.)



Key procedures and uncertainties

The analysis of DFA results to recommend instream flows is much like analysis of PHABSIM results. Relations between flow and habitat may differ strongly among target species and life stages (e.g., between coho salmon and steelhead in the case study, below) and these differences must be resolved. In all habitat-based studies, the relation between habitat area and population response is a fundamental uncertainty. This approach cannot predict population responses so its use implies an assumption that trends in habitat area produce similar trends in population. The assessment team can use a mixture of quantitative analysis, qualitative judgment, and consensus formation to make final flow comparisons. The team's judgment should be guided by the conceptual models developed in Step 2 and thoroughly documented. Final instream flow recommendations, of course, consider all the resources affected by flow.

Figure 3. Example results of the Oak Grove Fork DFA study, for one study site. The graph shows the total area of habitat for the three metrics (foraging habitat for coho salmon and steelhead; spawning habitat) at each of the seven demonstration flows.



Case study

For analysis, McBain and Trush, Inc. digitized the habitat patches delineated in field observations so patch areas could be computed and summed. Then results from each study site (e.g., Figure 3) were weighted by the river length represented by the site, and combined into total metrics for entire reach.

The case study analysis found that some habitat metrics varied sharply and inconsistently as flow increased (Figure 3). For example, coho salmon habitat increased as flow increased from 0.3 to 1.0 m^3/s, then decreased sharply as flow further increased above 2 m^3/s, and then increased again between 4.7 and 6.5 m^3/s. Interpolating a "best" flow for each species and life stage would have been quite uncertain if fewer flows had been observed.

CONCLUSIONS

In deciding whether DFA is an appropriate method for an instream flow assessment, its following characteristics deserve consideration.

1. Because DFA does not require hydraulic simulation, assessment of habitat with complex hydraulics is more feasible. However, high depth, velocity, or turbidity can limit how observations are made (e.g., by limiting how much of a site can be waded, or how accurately habitat metrics can be estimated).
2. A DFA study can assess long reaches fairly quickly, whereas approaches requiring hydraulic modeling are often constrained to a small number of transects.
3. Being explicitly judgment-based, DFA can encourage open consideration and revision of the many assumptions and judgments that are involved in any instream flow study.
4. Uncertainty in field observations of habitat metrics is often of special interest in DFA studies. There are several ways this uncertainty can be quantified.
5. DFA facilitates use of mechanistic and theoretical conceptual models in addition to, or instead of, habitat selection.
6. A DFA study can quantify habitat at only a few discrete flows, so assessment of other flows requires interpolation between, or extrapolation from, results from the observed flows.
7. DFA requires extensive field time by a number of people, in addition to the effort of developing maps and analyzing results.
8. DFA could be difficult to apply where flows are not controlled by a dam.

Dependence on judgment in environmental decision support studies is unavoidable and does not necessarily reduce the quality of decisions; judgment is necessary because data and models are inherently uncertain and decisions inherently involve values (Gregory et al. 2006). The DFA procedure we describe is intended to control subjectivity and uncertainty by using established ecological and decision analysis frameworks. Biological knowledge and judgment are applied and documented, especially in the conceptual modeling and metric development steps. Explicitly defining, delineating, and quantifying habitat metrics helps make results quantitative and defensible.

Our case study was high-effort and produced extensive data and analysis. However, lower-effort (but carefully designed) DFA studies may be as appropriate as any other method for target resources so complex or poorly understood that higher effort produces little more useful information. If we lack reliable mathematical models of how instream flow affects a resource (e.g., the biodiversity of an unstudied warmwater community), then a low-resolution DFA—perhaps based on theoretical conceptual models—might be appropriate, especially if it frees resources for purposes such as monitoring and watershed restoration.

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FEATURE:
FISHERIES MANAGEMENT

Management Concerns about Known and Potential Impacts of Lead Use in Shooting and in Fishing Activities

ABSTRACT: We present a summary of the technical review, jointly requested by the American Fisheries Society and The Wildlife Society, addressing the hazards to wildlife resulting from lead objects or fragments introduced into aquatic and terrestrial environments from the use of ammunition and fishing tackle. Impacts from lead are well documented in humans, as well as in terrestrial and aquatic organisms. Concern about impacts from lead ammunition and fishing tackle has resulted in the development of non-lead alternatives, educational campaigns, and regulations to restrict their use. This article discusses the general biological impacts of lead exposure from fishing and shooting activities to fish, wildlife, and humans; summarizes existing and proposed regulations to reduce lead exposure to biota; reviews alternatives to lead materials that are currently available for fishing; and outlines options for further actions to reduce wildlife and human exposure to lead from fishing activities.

Chris I. Goddard, Nancy J. Leonard, Doug L. Stang, P. Jack Wingate, Barnett A. Rattner, J. Christian Franson, and Steven R. Sheffield

Goddard is the executive secretary of the Great Lakes Fishery Commission at the Great Lakes Fishery Commission, Ann Arbor, Michigan, and can be contacted at cgoddard@glfc.org. Leonard is an academic specialist at the Center for Systems Integration and Sustainability, Department of Fisheries and Wildlife, Michigan State University, East Lansing. Stang is assistant director at the Bureau of Fisheries, New York State Department of Environmental Conservation, Albany. Wingate is a fisheries research manager who is retired from the Minnesota Department of Natural Resources, St. Paul. Rattner is an ecotoxicologist at the Patuxent Wildlife Research Center, Beltsville Laboratory, U.S. Geological Survey, Beltsville, Maryland. Franson is a research wildlife biologist at the National Wildlife Health Center, U.S. Geological Survey, Madison, Wisconsin. Sheffield is a professor at the Department of Natural Sciences, Bowie State University, Bowie, Maryland and at the National Capital Region—Northern Virginia Center of the College of Natural Resources, Virginia Polytechnic Institute and State University, Falls Church.

Previsiones de Manejo Acerca de Impactos Conocidos y Potenciales del Uso de Plomo en Actividades de Caza y Pesca

RESUMEN: Presentamos un resumen de la opinión técnica solicitada por la Sociedad Americana de Pesquerías y la Sociedad para la Vida Silvestre con respecto a los peligros para la vida silvestre que resultan de la introducción de objetos o fragmentos de plomo a los ambientes acuáticos y terrestres, provenientes del uso de municiones y equipos de pesca. El efecto del plomo está bien documentado en humanos, así como también en organismos terrestres y acuáticos. La preocupación acerca de los efectos de la presencia de plomo proveniente de municiones y equipos de pesca ha resultado en el desarrollo de diseños alternativos libres de plomo, campañas educativas y regulaciones para restringir su uso. En este artículo se discuten los impactos biológicos generales en peces, vida silvestre y humanos de la exposición al plomo derivado de la caza y pesca; se hace un resumen de las regulaciones tendientes a reducir la exposición de la biota al plomo; se hace una revisión de los materiales alternativos al plomo disponibles para las actividades de pesca, y se proponen posteriores acciones tendientes a reducir la exposición humana y de la vida silvestre al plomo producido por las actividades de pesca.

INTRODUCTION

Lead (Pb), being one of the easiest metals to mine and smelt (Pattee and Pain 2003), has been extracted and used by societies for numerous purposes at least as far back in time as the Roman Empire (Hernberg 2000). Lead can be introduced into the environment from multiple sources including surface runoff; atmospheric deposition associated with the burning of coal, oil, and waste; release of contaminated tailings from mining and smelting activities; the application of products containing lead; and through the loss of lead objects, such as lead shot and fishing weights (IPCS 1989; Henny et al. 1994; Scheuhammer and Norris 1995).

Lead is a nonessential heavy metal with no known beneficial role in biological systems. The adverse effects of lead on human health have long been recognized. Exposure of humans to lead is known to adversely affect hematopoiesis, the central and peripheral nervous systems, the renal system, cardiovascular system, and can result in brain dysfunction, neuropathy, altered amino acid transport, anemia, impaired fetal development, and reduced survival (Nordic Council of Ministers 2003; Khan 2005). Some studies have associated elevated bone or blood lead levels with aggression, delinquent behavior (Needleman 2004), and attention deficit hyperactivity disorder (Braun et al. 2006). Although the adverse effects of lead on human health have long been recognized, the exposure of fish, wildlife, and humans to lead continues (Hernberg 2000).

In comparison to the long-standing recognition of the effects of lead poisoning in humans, the hazard of lead ammunition and fishing sinkers to wildlife has only recently been acknowledged (Pattee and Pain 2003). In this article we present a summary of the technical review that was jointly requested by the American Fisheries Society and The Wildlife Society (Rattner et al. 2008). Specifically, we review briefly the effects of lead introduced by fishing and shooting activities to living organisms, discuss regulations and alternatives to lead to reduce exposure, and suggest possible actions that may further minimize lead introductions into the environment from fishing.

DISSOLUTION OF LEAD FROM SPENT AMMUNITION AND FISHING TACKLE

Spent lead ammunition and lost lead fishing tackle are not readily dissolved in aquatic and terrestrial systems and, depending on environmental conditions, can be relatively stable and remain intact for decades to centuries (SAAMI 1996). Lead from spent ammunition and tackle can undergo weathering and lead salts can dissociate, form stable complexes (carbonates, hydrides, chlorides), precipitate (phosphates, sulfides, carbonates, hydroxides), become bound to soil and sediments, and thus exist in many forms with varying degrees of bioavailability. Uptake of lead by plants is relatively limited, although several studies have documented elevated lead concentrations in plants in the vicinity of shooting ranges (Rooney et al. 1999; Hui 2002; Cao et al. 2003; also reviewed in Rattner et al. 2008). Weathering and dissolution of elemental lead is influenced by water chemistry, mechanical disturbance (e.g., water flow rate), grain size of soils and sediments, gaseous aerobic conditions, and acidity and alkalinity. Under some conditions (e.g., soft acidic waters, mechanical disturbance), lead can be released from artifacts, although annual corrosion rates of lead are generally low (Jacks and Bystrom 1995). Due to the possible dissolution of lead ammunition and fishing tackle, we review briefly the findings from studies examining the effects of bioavailable lead on living organisms, including fish, amphibians, reptiles, birds, mammals, and humans.

In field and laboratory studies, lead is generally found to evoke its toxicity in multiple organ systems. Perhaps best known are inhibition of heme-synthesis enzymes, lead-induced anemia, central and peripheral neuropathy, nephrotoxicity, hypertension, and alteration to endocrine and reproductive function. Lead is also known to be a carcinogen for some animals (Needleman 2004). Numerous studies have examined the effects of lead on fish. It is well known that bioavailable lead principally accumulates in the gills, liver, kidney, and bone; can evoke morphological lesions (e.g., erosion of caudal fin, spinal deformities); alters physiological function (e.g., enzyme inhibition, anemia, decreased survival); and impairs avoidance behavior (IPCS 1989). The report compiled by International Programme on Chemical Safety (IPCS 1989) also summarized studies on effects of lead on amphibians, which include arrested development and delayed hatching. Similarly, while their review was not focused solely on lead sources linked directly to hunting and fishing activities, Patte and Pain (2003) considered the literature about lead in the environment and identified many existing studies pertinent to this focus on lead exposures. For example, studies in the Coeur d'Alene floodplain, which is heavily contaminated by heavy metals such as arsenic, lead, and zinc from mining and smelting activities, have also detected negative effects from the accidental ingestion of lead-contaminated food or the accidental ingestion of lead associated with sediments in osprey (*Pandion haliaetus*), raptors, songbirds, and tundra swan (*Cygnus columbianus*; Henny 2003). These negative effects included inhibition of delta-aminolevulinic acid dehydratase involved in heme synthesis, elevated lead levels in blood and tissues, and weight loss. In addition, waterfowl die-offs have been reported from this area since the early 1900s. Humans exposed to lead have experienced similar negative effects to those described for fish and wildlife.

Due to their intended scope, the aforementioned studies do not investigate the effects of bioavailable lead from spent ammunition or from lost fishing tackle. Lead objects can dissolve under certain conditions, thereby contaminating soil, sediment, and vegetation, and resulting in exposure of biota via ingestion of soil, sediment, food, and water. Nevertheless, for bioavailable lead arising from ammunition and fishing tackle to have significant effects on biota at the organism- or population-level, the quantity of shot or tackle lost within a given area would have to be substantial.

LEAD EXPOSURE RELATED TO SHOOTING ACTIVITIES

The effects of spent lead shot and bullets on American wildlife has been recognized since the 1870s (Sanderson and Bellrose 1986), but it wasn't until the 1959 publication by Bellrose, "Lead poisoning as a mortality factor in waterfowl populations," that the widespread hazard of spent lead shot was fully appreciated. The availability of spent lead in a terrestrial setting is a function of the depth these particulates are located in soil or sediment. Several investigations have demonstrated that shot accumulates in most sediment near the surface and, thus, the total number of shot available can increase in density and availability over time (Pain 1992). In an aquatic setting, spent lead shot availability is affected by water depth and the depth that the shot is buried within the sediment. With the popularity of sport shooting (target, trap, and skeet shooting) and firearms training in the United States and elsewhere, an estimated 72,600,000 kg per year of lead is deposited at 9,000 shooting ranges (USEPA 2001). The amount of lead shot deposited in waterfowl hunting areas has been estimated to range from 125,970 to 5,000,000 shot per hectare (Bellrose 1959; Pain 1992, respectively). It is generally accepted that shot density in a field or wetland is directly related to hunting or shooting intensity.

Documentation of fish ingesting spent lead bullets or shot was not found. Also, evidence was not found that ingestion of lead shot and lead bullets by amphibians or reptiles is a widespread problem, and there is limited information documenting the incidence of lead shot, bullets, fragments, or fishing sinkers in the digestive system of these vertebrates. Lance et al. (2006) reported reproductive failure in captive American alligator (*Alligator mississippiensis*) that was potentially associated with lead exposure. These alligators were fed wild nutria (*Myocastor coypus*) meat contaminated with lead shot, and the alligators' eggs' yolk had a high lead concentration (Lance et al. 2006). Ingestion of lead shot was also observed in other farmed American alligators (Camus et al. 1998) and Australian crocodiles (*Crocodylus porosus*; Hammerton et al. 2003). In general, studies with sites in close proximity to shooting ranges have found elevated concentrations of lead in the tissues of amphibians and reptiles, which is thought to be due to ingestion of lead with water and food items (Pattee and Pain 2003).

Birds can ingest spent bullets, shot, or their fragments. Ingestion most likely occurs due to the bird mistaking these lead artifacts for food or grit material (Sanderson and Bellrose 1986; Scheuhammer and Norris 1995). Waterfowl have been documented to die from ingesting lead shotgun pellets deposited on the bottom of lakes, in marshes, and in fields. Often cited reviews addressing the effects of ingested shot on waterfowl include Bellrose (1959) and Sanderson and Bellrose (1986). Waterfowl may succumb after ingesting one or more lead pellets, as their bodies waste away over a period of several weeks—losing from 30 to 50% of their normal weight. Less frequently, a large number of shot are ingested, resulting in an acute form of lead poisoning, and the bird dies even though it still has a normal weight. In addition, the risk of spent shot to other upland species, including dove and quail, has long been recognized (Kendall et al. 1996). Raptors and other avian predators, as well as scavengers, may be exposed to lead from the consumption of shot pellets and bullet fragments embedded in tissues of dead or wounded animals (Pattee and Pain 2003) or from tissues discarded in gut piles (Fisher et al. 2006). For instance, vultures and condors appear highly susceptible to toxicity from ingesting small quantities of lead shot or bullets, as they are unable to regurgitate pellets from their gastrointestinal tracts (Eisler 1988). The presence of lead in California condor (*Gymnogyps californianus*) habitats in California and Arizona, in conjunction with their extreme sensitivity to lead toxicity, has been suggested as the primary threat to the continued existence of the species (Pattee et al. 1990; Meretsky et al. 2000). Recent evidence indicates that lead ammunition embedded in carcasses of hunted game and mammalian predators (coyotes, *Canis latrans*) or gut piles are the main sources of the lead accumulated by California condors (Church et al. 2006).

Ingestion of lead shot and bullets by humans, or the associated dust when casting ammunition has received considerable attention (reviewed by CPSB 2002). There are numerous case reports of accidental or purposeful (pica) ingestion of lead shot by humans in the medical literature (Gustavsson and Gerhardsson 2005). Ingestion of lead shot and bullets can cause lead intoxication, and depending on number and mass of fragments, lead lodged in certain but not all tissues can result in toxicity (Khan 2005). Accidental ingestion of ammunition by children has been documented (Durback et al. 1989). Furthermore, many sportsmen reloading rifle and pistol ammunition cast their own lead bullets, an activity particularly popular with black powder shooters, which exposes them to lead (Anonymous 2006).

The hazard that ingestion of lead pellets and bullets might pose to higher vertebrates is acknowledged, and in some instances already vulnerable populations (e.g., California condor) may become further at risk.

FISHING ACTIVITIES AND LEAD

Lead in the form of fishing lures, sinkers, lead core fishing line, downrigger cannonballs, and weights on a wide variety of fishing traps and nets can be introduced into the aquatic environment when a commercial fisher or recreational angler loses fishing gear due to accidental or intentional breakage. The amount of lead fishing tackle lost in the aquatic environment through recreational and commercial fishing activity is not accurately known. In studies based on angler interviews and actual detection of lost tackle along shorelines, the reported amount of lead fishing tackle lost varies, depending on the intensity of fishing pressure, the location of angling activity such as distance from the shoreline or boat, the type of aquatic habitat that may increase gear breakage and loss, and angler skill. Based on interviews, Radomski et al. (2006) reported average loss rates of 0.0127 lures per hour, 0.0081 large sinkers per hour, 0.0057 split shot sinkers per hour, 0.0247 jigs per hour, and 0.0257 hooks per hour; while Duerr (1999), assessing the amount of lead fishing tackle lost and detected along shorelines, estimated that there was from 0.0 to 0.01 sinkers per square meter in areas of low angling pressure and 0.47 sinkers per square meter in areas of high angling pressure. Some reports suggest that loss of lead fishing tackle in the aquatic environment can be substantial (e.g., Scheuhammer and Norris 1995).

Fish most frequently ingest, partially or wholly, fishing tackle when hooked. Whether the fishing tackle remains in the fish depends on whether the angler successfully lands the fish and whether the hook is too deeply ingested to safely remove it from the fish. The abandonment of fish hooks and associated fishing tackle may arise due to an angler breaking the line with a fish on, or leaving deeply set hooks in the fish to reduce injury (Cooke et al. 2001). Most reported mortality associated with fishing tackle is not related to the fish being exposed to the lead material used in the fishing tackle, but rather due to the extent of injury, blood loss, exposure to air, and exhaustion during handling to remove the hook (Cooke et al. 2001). Studies that related lead exposure from ingested lead sinkers and jigs or other tackle to the mortality of fish were not found. Nevertheless, given that it is commonly accepted that hooks and leaded jigs embedded in the mouths of fish will work their way loose, the effects of the lead from embedded fishing hooks and jigs would be minimal, in comparison to the potential sub-lethal and lethal injuries that may occur from swallowed hooks.

Evidence was not found that ingestion of lead fishing tackle by amphibians or reptiles is a widespread problem. There are published and unpublished accounts, however, of turtles suffering from lead poisoning after ingesting lead fishing weights (Borkowski 1997).

Concern about lead poisoning in birds from anglers' lead weights emerged as a significant issue during the 1970s as mute swan (*Cygnus olor*) populations declined in Britain (Sears 1988). This eventually resulted in the banning of most lead fishing sinkers in the United Kingdom in 1986 (Pattee and Pain 2003). In North America, the hazard of fishing sinkers and tackle to common loons (*Gavia immer*) was subsequently reported (Franson and Cliplef 1992; Pokras and Chafel 1992; Stone and Okoniewski 2001). Necropsy of common loons examined in New England found that lead poisoning from ingested fishing sinkers accounted for about one-half of the mortality in dead and moribund adults found during the breeding season (Pokras and Chafel 1992; Sidor et al. 2003). Birds most frequently ingest fishing tackle that has been lost or abandoned by anglers along the banks or within water-bodies. In their review, Scheuhammer and Norris (1995) stated that birds generally ingest lead fishing weights that are less than 57 grams (2 ounces), although ingestion of larger sinkers has been documented in the common loon (Franson et al. 2003). Thus, the harm from fishing weights to waterbirds seems to primarily involve smaller lead fishing weights used by recreational anglers (Scheuhammer and Norris 1995) and not larger weights or downrigger cannonballs. Based on the recovery of fishing weights associated with other fishing tackle (i.e., swivels and hooks), some birds such as the common loon may be ingesting lead fishing weights as a byproduct of ingesting the bait attached to the fishing tackle (Franson and Cliplef 1992; Stone and Okoniewski 2001). Once ingested by a bird, the lead object, if retained within the gizzard, will be ground down and, combined with the effect of the acidic conditions in the digestive tract, result in the lead being released and absorbed into the bird's tissues (IPCS 1989; Scheuhammer and Norris 1995; Nordic Council of Ministers 2003). It has been reported that lead fishing sinkers and jigs have contributed to lead poisoning mortalities in a number of aquatic birds, particularly mute swans, whooper swans (*Cygnus cygnus*), Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), brown pelicans (*Pelecanus occidentalis*), and common loons (Franson and Cliplef 1992; Pokras and Chafel 1992; Scheuhammer and Norris 1995; Stone and Okoniewski 2001; Franson et al. 2003). If the bird has the lead object embedded subcutaneously or intramuscularly, lead poisoning should not occur as the pH conditions in these tissues do not dissolve lead objects (De Francisco et al. 2003). There is the risk, however, of secondary poisoning by lead fishing weights for waterfowl predators, but studies linking lead poisoning of predators due to ingestion of a lead fishing weight lodged in their prey were not found in the literature.

Ingestion of lead sinkers or the dust associated with their manufacturing has been known to cause harm in humans. In sinker ingestion, the occurrence of lead toxicity depends on the amount of time that the object is retained within the stomach (Fergusson et al. 1997). If the lead object is retained in the stomach long enough for the object to be dissolved by the stomach acid, the lead will be absorbed while it is in the small intestine (Fergusson et al. 1997). Once the lead object is out of the stomach and in the small intestine it poses less of a potential hazard for lead toxicity (Fergusson et al. 1997). The U.S. Environmental Protection Agency (USEPA 1994) estimated that approximately 0.8 to 1.6 million people manufacture lead fishing weights in their homes for either personal use or for sale, representing approximately

30 to 35% of lead sinkers produced in the United States. Scheuhammer and Norris (1995) speculated that there is likely a similar "cottage industry" in Canada. Thus, the cottage-industry of melting lead and producing lead fishing tackle such as lead sinkers and jigs is a potential source of lead poisoning in humans through lead inhalation (USEPA 2004).

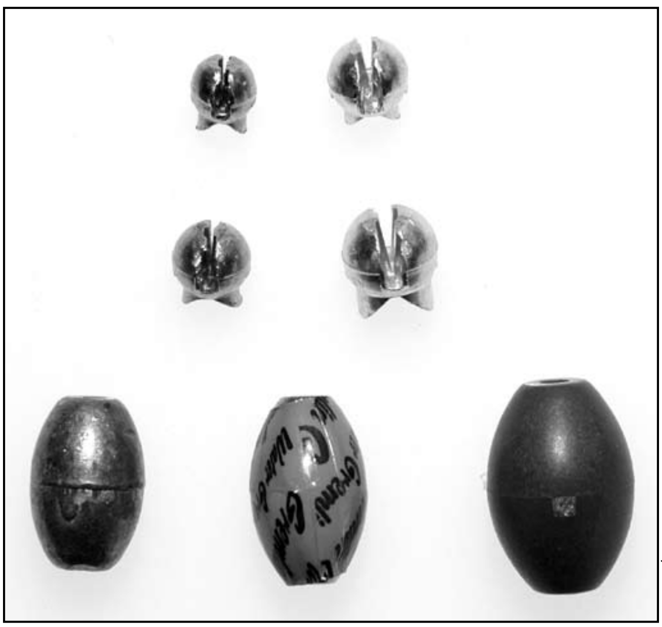
Lead fishing tackle, especially the smaller fishing weights and jigs that can be ingested, may be a source of lead poisoning for some species of waterbirds and can exert sub-lethal and lethal effects in the individual. Although of concern where waterbird populations are low or declining, the ingestion of lead sinkers has not been demonstrated to have wide-spread population-level effects. Nevertheless, the potential hazardous effect of lead on humans and aquatic ecosystem fauna lends support to an ongoing, general effort to reduce lead introduced into the environment by human activities.

ACTIONS TO REDUCE LEAD EXPOSURE

The desire to limit lead exposure in humans has resulted in several international conventions and treaties, as well as national restrictions to minimize environmental release of lead from anthropogenic activities including use of leaded gasoline, lead in paint, lead solder in tin cans for food storage, and lead shotgun pellets (Nordic Council of Ministers 2003). Scheuhammer and Norris (1995) provide a brief overview of restrictions placed by nations that are specific to the use of lead shot. These restrictions range from voluntary use of non-toxic shot for all wetland bird hunting in the United Kingdom, to nationwide restrictions on hunting migratory waterfowl species with lead shot in Canada and the United States, to an outright ban on the use of lead shot for all hunting and target shooting over water and agricultural lands in Denmark. A more recent example of this effort is the passing of the 2007 California Assembly Bill 821 "Ridley-Tree Condor Preservation Act" that requires the use of non-lead ammunition for hunting big game and coyotes in the range of the California condor in central and southern California (Center for Biological Diversity 2007).

The hazard of ingested lead fishing weights on aquatic and terrestrial fauna and humans has resulted in societal pressure to place restrictions on the sale and use of lead fishing weights. For instance, some nations, including Denmark, Canada, Great Britain, and the United States (partially summarized by Nordic Council of Ministers 2003), have begun to apply restrictions on the sale and use of lead fishing sinkers and jigs. In Canada the use of lead sinkers or jigs weighing less than 50 grams (1.76 ounces) in national parks and national wildlife areas is prohibited (Michael 2006). The use of lead tackle is also banned on some U.S. federal lands that have loon and swan populations (Michael 2006). In 1999, the U.S. Fish and Wildlife Service announced its intent to establish additional lead-free fishing areas by expanding the prohibition on certain fishing sinkers and jigs to more refuges used by loons (USFWS 1999); however, this has yet to be implemented. Some states, consisting of Maine, Massachusetts, New Hampshire, Vermont, and New York have, nonetheless, instituted restrictions on the use or sale of certain lead sinkers and jig heads (Michael 2006).

Figure 1. Relative sizes of sinkers manufactured from different materials.
Top row: 0.1 oz lead and tin split shot.
Middle row: 0.2 oz lead and tin split shot.
Bottom row: 0.8 oz lead, bismuth, and plastic-iron composite egg sinkers.
Sinkers courtesy of Water Gremlin.



T. Lawrence, GLFC

There are alternatives to lead bullets (e.g., copper; Barnes 2008) and to lead shot available to hunters. Alternatives to lead shot that have been approved for use in hunting waterfowl and coots and that are commercially available include shot made from steel, bismuth-tin, tungsten-bronze, tungsten-iron, tungsten-matrix, tungsten-nickel-iron, tungsten-polymer, tungsten-tin-bismuth, and tungsten-tin-iron-nickel. Substitutes for lead fishing tackle also have been available in retail stores in Canada, the United States, and European countries for several years (Scheuhammer and Norris 1995; Nordic Council of Ministers 2003). These include tungsten (both plastic composites and putty), stainless steel, carbon steel, tin, tin-bismuth, brass, ceramics, glass, and pewter (Scheuhammer and Norris 1995; Nordic Council of Ministers 2003; MOEA 2006). Sinkers made from alternative materials have been accepted to varying degrees, depending on their cost and how similar they are to lead tackle. Several of these alternatives such as ceramics and tin are not as dense as lead and, hence, need to be larger to produce the same weight (see Figure 1). Many anglers believe this increase in size is detrimental when inducing fish to bite. Other alternatives such as brass and steel, while somewhat larger in size, have been advertised as making more noise as they bump over the bottom, which is claimed to serve as an attractant to fish.

It needs to be stated, however, that a transition to alternative materials for sinkers provides significant challenges to the tackle manufacturing industry in terms of increased cost, availability of raw materials, and increased manufacturing costs, as well as the increased cost to anglers. The high cost of alternative raw materials may make the transition to non-lead sinkers more problematic now than several years ago. For example, tin is perhaps the most viable alternative for split shot sinkers and the manufacturing costs are similar to lead. The December 2007 price differential for the raw materials, however, is approximately $7.42 per pound for tin versus $1.15 for lead (MetalPrices.com 2007). As the specific gravity of tin is 7.2 versus 11.3 for lead, more tin is required to provide the same weight. Tin, therefore, is not only more costly, but also has performance drawbacks. Bismuth and tungsten currently cost $15/lb and $20/lb respectively. Moreover, tungsten is becoming essentially unavailable and has a high manufacturing cost. Brass may prove to be a less desirable alternative, because brass contains approximately 9% lead, as well as some zinc which could be problematic. Sintered steel, an alternative for non-split shot sinkers, has a specific gravity of less than 7 and it tends to rust in the tackle box. Although a variety of alternatives to lead sinkers have been proposed and investigated by the manufacturers of fishing tackle, it is not clear which alternatives will provide reasonable performance at reasonable cost.

As part of the effort to reduce the use of lead in fishing activities, some U.S. states, Environment Canada, and some U.S. and Canadian organizations are offering small-scale programs that exchange non-lead tackle for an angler's lead tackle (MOEA 2006). Educational campaigns also introduce anglers to non-lead substitutes and alert anglers to the toxicity of lead in the aquatic environment, with the aim of increasing angler use of non-toxic alternatives.

SUMMARY

The effects of ingested lead shot and bullets used in hunting and shooting sports activities are well documented. Principally, these include lead toxicosis and mortality of waterfowl and their predators (Pattee and Pain 2003). These impacts have resulted in restrictions on the use of lead shot and bullets, and subsequently regulations mandating the use of various non-toxic shot for species with habitats that coincide with waterfowl and condors. Studies assessing sub-lethal and lethal effects from lead shot ingestion among other wildlife, such as upland birds, are being conducted and discussions regarding the implications of lead toxicosis are ongoing among managers and policy makers (e.g. Association of Fish and Wildlife Agencies' Non-toxic Ammunition Task Force and its Ad Hoc Mourning Dove and Lead Toxicosis Working Group).

Fishing tackle, especially weights that fall within the size usually ingested by fauna (e.g., less than 2.5 cm, 0.98 inches) and weighing less than 50 g (1.76 ounces; Scheuhammer and Norris 1995), can have lethal and sub-lethal effects on aquatic fauna and on humans when ingested. Downrigger weights (cannonballs), lead core fishing line, and the weights used on a variety of commercial traps and nets are much larger than fishing sinkers and smaller jigs that have been ingested by fauna in aquatic ecosystem and by humans. Therefore, one would predict that the effect normally associated with ingestion of lead fishing tackle is minimal for downrigger cannonballs, lead core fishing line, and the weights affixed to commercial fishing gear. Some studies have examined the dissolution of lead from fishing tackle, although these are few and not conclusive. More research needs to be conducted to determine the potential effect on fauna of the dissolution of all types of lead fishing tackle in low and high deposition densities and varying water chemistry conditions.

RECOMMENDATIONS

As stewards of North America's aquatic ecosystems, fisheries management agencies, anglers, angling clubs, and commercial fishers, as well as manufacturers and retailers of fishing tackle, work actively and often collectively for the protection and conservation of North America's aquatic ecosystems. A tenet of this stewardship is minimizing the introduction of toxic materials, such as lead, to levels that have been shown to be non-hazardous, while recognizing that complete elimination may be neither feasible nor necessary. Detrimental effects at the population level of bird species that ingest lead sinkers have not been documented in North America, but impacts at the population level should not be a prerequisite for corrective action. Current knowledge indicates that small lead (and other toxic) sinkers (< 2.5 cm), in particular, are most likely to be ingested by waterbirds. Several options exist for the American Fisheries Society (AFS), perhaps through a small task group, to develop a position statement (white paper) based on the scientific data on the hazard and risk of lead from lost commercial and recreational fishing tackle.

1. The AFS could work with the provincial, state, and federal fisheries management agencies, in addition to the angling clubs, tackle manufacturers, and tackle retailers to educate anglers and commercial fishers about the availability and utility of non-toxic alternatives to lead weights and the environmental benefits of using these alternatives. AFS could also work with the U.S. National Institute of Health and Health Canada to educate anglers about the potential health hazards of casting and manufacturing their own lead sinkers and jigs.
2. The AFS Fisheries Management and Fisheries Administration Sections could collaborate to develop a specific Aquatic Resources Conservation Electronic Library (ARCeL) module for use as part of a lead-free education/outreach project, perhaps funded by the Fisheries Conservation Foundation. All of the requisite educational materials could be made available for production and distribution by all management agencies, fishing tackle manufacturers, and retailers.
3. AFS could partner with and encourage fisheries management agencies to develop lead tackle exchange programs and, in conjunction with this tackle exchange effort, participate in safe collection and disposal programs for lead fishing tackle.
4. AFS could work closely with the Association of Fish and Wildlife Agencies (AFWA), fishing tackle manufacturers, the American Sportfishing Association (ASA), and the Canadian Sportfishing Industry Association (CSIA) to encourage and facilitate a transition from the manufacture, distribution, and sale of small lead fishing weights to fishing weights made of non-toxic alternative materials. The development of schedules would facilitate this transition. It is recognized that a number of the recreational and commercial fishing tackle manufacturers have already taken the initiative by entering into the lead-free tackle market, and are well into this transition; however, the shelf space and volume of alternate material weights remains a small percentage of the overall inventory and sale of these small fishing weights
5. Consistent with the above negotiated transition schedule for the manufacture and sale of alternatives to lead, the AFS could work with the AFWA, ASA, and CSIA to develop a framework for future phased-in regulations on the sale, use, and possession of lead fishing sinkers while fishing. This framework would provide for requisite consistency in the rules, regulations, and their implementation; would help deliver a strong message to anglers; and would allow manufacturers to more easily develop and market non-lead products.
6. The AFS may consider local bans on the use of lead fishing sinkers as an appropriate management tactic in geographical areas of high annual mortality of waterbirds associated with lead poisoning and in heavily protected pristine areas such as national parks and national wildlife refuges.

In conclusion, AFS interacts with many natural resource management agencies, angling organizations, and the fishing tackle industry. AFS, therefore, is in a position to both foster education on the hazards of lead to wildlife and to develop a position statement with the aim of reducing to an absolute minimum the introduction of lead into the aquatic environment from fishing activities.

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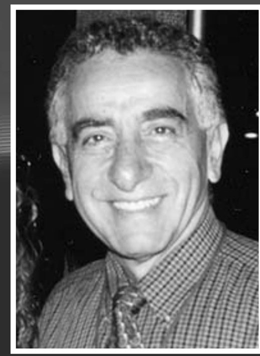
COLUMN: DIRECTOR'S LINE

Gus Rassam
AFS Executive Director
Rassam can be contacted
at grassam@fisheries.org.



Climate, Fisheries and Wildlife

The North American Wildlife and Natural Resources Conference in Phoenix this year devoted a special workshop to the topic of climate change and wildlife. Many papers at the meetings of both the Northeastern and the Western Divisions of AFS also addressed various aspects of the effects of major changes in the climate on fisheries resources. The U.S. Geological Survey's Biological Resources Discipline has been funded by Congress to begin working on a National Global Warming and Wildlife Science Center. A workshop is planned to jumpstart that effort.

What with Al Gore, the polar bear, and YouTube, climate change is now part of the general discourse in the United States among scientists certainly, but also in broad segments of the popular culture. Some candidates for political office in fact are using it to define their candidacy in a broader sense than the usual concentration on the economy and security. It is no longer an esoteric topic that the elites use to show that they know things better.

A recent survey of anglers and hunters commissioned by the National Wildlife Federation revealed that climate change and global warming are already on the minds of outdoors enthusiasts of all political persuasions. To highlight some of the data from that survey: more than 60% believe that global warming is already happening, more than 70% agree that the United States should be a world leader in addressing that issue, and a large majority believe that we should immediately invest in renewable energy technologies.

In fact, a general consensus is developing that: (a) significant warming is taking place and (b) a significant contribution to that trend is due to human activity. What is still contentious and unclear is what to do about climate change and the pace of action required to slow down the trend, if not reverse it.

The day-long workshop at the North American included many excellent presentations from scientists and managers working on the fish and wildlife resources of this country. The discussion that took place afterwards highlighted the state of knowledge, or lack of it, relative to fish and wildlife management in a warming globe. The concern was there and, more importantly, the commitment was there to learn more about the complex ways that species react to rising temperatures and sea levels, and adapt to their new environment.

Mitigating the adverse effects of global warming is a huge task that will require a lot more cooperation among the different entities (local, federal, international) that have jurisdictional oversight over public lands and waters. It will require increased public awareness, understanding, and participation.

AFS, in its traditional role of provider of science-validated information and as a forum for informed dialog, will act in concert with many other players to help in this process. In 2001, AFS took the lead (in cooperation with Sea Grant) in organizing a major symposium on "Fisheries in a Changing Climate." The proceedings of that symposium (http://afsbooks.org/x54032xm.html) remain as an important record of what we know and what we don't know about this overarching new paradigm for biology. Recent AFS Annual Meetings have continued to feature symposia on climate change, and this year's meeting in Ottawa is no exception. The planned symposia "Sensitivity of Fish and Fisheries to Climate Change—Response and Adaptation" and "Effects of Climate-Related Drying and Surface Water Loss on Aquatic Ecosystems in Extreme Environments" hopefully will shed further light on these critical topics.

Tom Gengerke, left, celebrates his final day on the job with the Iowa Department of Natural Resources with Jim Riis at the joint Iowa and Dakota Chapter meeting.

Dakota Chapter President Todd St. Sauver, left, bestows the Distinguished Professional Service Award to Ron Koth.

Steve Chipps, left, congratulates his student, Steve Ranney, winner of the Best Student Paper Award.

Dakota Chapter
Holds joint meeting with Iowa Chapter

The Dakota and Iowa Chapters met jointly on 19–21 February. Over 150 participants mingled at the socials, attended the plenary and concurrent sessions, participated in their respective Chapter's business meetings, and recognized their respective award recipients. Student recognition dominated the awards given by the Dakota Chapter.

Steve Ranney, a student in the Department of Wildlife and Fisheries at South Dakota State University, won the Best Student Paper award. His award-winning presentation was titled the "The influence of feeding level on the metabolic rate of largemouth bass: evidence of a compensatory response." Steve Chipps guided Casey on his research project.

Brian Spindler, another South Dakota State student, won the Best Student Poster award. He was helped with his poster, "Distribution and habitat use by juvenile pallid sturgeon in the Fort Randall reach of the Missouri River," by Steve Chipps and Rob Klumb.

Ryan Schmaltz from South Dakota State University was the winner of the Schmulbach Memorial Scholarship. Named after James C. Schmulbach, this competitive scholarship is awarded by the Chapter to an eligible junior or senior undergraduate studying fisheries in either

Ryan Schmaltz, left, receives the Schmulbach Memorial Scholarship from Dakota Chapter President Todd St. Sauver.

South Dakota State University students Mark Fincel, left, and Bethany Galster gleefully transact business during the student raffle.

Wayne Nelson-Stastny, left, congratulates Kris Edwards on winning the fictitious "I'm So Glad *You* Are Doing the Night-Sampling" award.

Incoming Vice President Scott Gangl

Incoming Secretary Treasurer Russell Kinzler

Sauger Scholarship winners display their awards. Pictured are Bethany Galster, Jonah Dagel, Jeff Grote, Nathan Kuntz, and Subunit President Andy Jansen. All are at South Dakota State University.

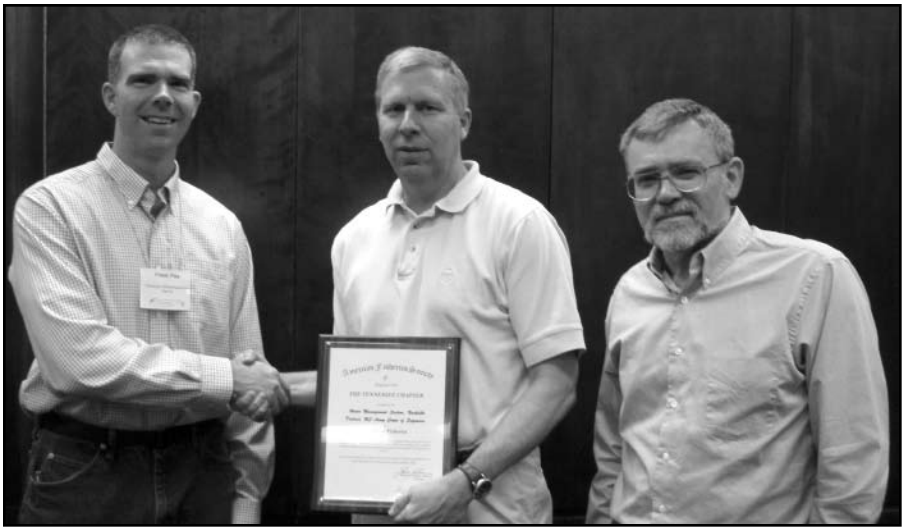
North or South Dakota. Sauger scholarships (travel awards) went to South Dakota State University students Bethany Gulster, Jeff Grote, Jonah Dagel, and Nathan Kuntz. Jonathan Tofteland from Valley City University and Jeff Grote from South Dakota State University received Kriel scholarships. Named after long-time Dakota Chapter member Al Kriel and funded by his family, the award pays for full membership in the American Fisheries Society.

Ron Koth and Mark Drobisch received Distinguished Professional Service awards, and the Aquatic Resource Conservation Award was given to the Barnes County (North Dakota) Water Conservation District.

New Chapter officers were elected at the meeting. Russell Kinzler (secretary-treasurer), Scott Gangl (vice president), and Mike Barnes (president elect), join incoming president Randy Hiltner.

—Mike Barnes

Tennessee Chapter Recognizes several members with awards



Frank Fiss presents the Friends of Fisheries Award to the Water Management Section of the Nashville District Corps of Engineers. Bob Sneed and Richard Tippit accepted the award for their section.

The Tennessee Chapter of AFS recognized several members at Fall Creek Falls State Park in March 2008. **Chip Walton**, Tennessee Technological University, presented the Best Student Paper. **Ed Scott**, a recent retiree from the Tennessee Valley Authority and life-long champion of snail darters, received a Lifetime Achievement Award. **John Riddle** and **Danny Scott** of the Tennessee Wildlife Resources Agency were also awarded Lifetime Achievement Awards for decades of service to fisheries in Tennessee. The **Water Management Section of the Nashville District U.S. Army Corps of Engineers** was awarded the Friends of Fisheries Award for their adaptive management of water and communication efforts during the exceptional drought of 2007.

—Frank Fiss

Frank Fiss presents the Best Student Paper Award to Chip Walton.

AFS CONSTITUTION AND RULES: PROPOSED AMENDMENTS

The following AFS Constitution and Rules Amendments were approved for publication in *Fisheries* by the Governing Board on 8 March 2008. They will be voted on by the membership at the AFS Business Meeting in Ottawa on Tuesday, 18 August 2008.

Joint Student Subunits

The Governing Board recommends revision of Article V.3 in the AFS Constitution as follows:

Background: Discussions with The Wildlife Society and other resource-related societies indicate that a few student subunits are experiencing difficult redundancies in joint affiliation with AFS. These subunits request that the Governing Board recommend approval of the following amendment to the AFS Constitution and adopt changes to the Procedures to avoid unnecessary duplication of officers while retaining effective connections to AFS.

Process: This proposed constitutional amendment must be published in *Fisheries* and posted to the AFS website for Society review at least 30 days ahead of a vote by Active Members at the Society Business Meeting in Ottawa on 19 August 2008. Associated revisions to the Procedures were adopted by a simple majority vote of the Governing Board on 8 March 2008, pending changes to the Constitution.

Recommended Amendments:

AFS CONSTITUTION Article V.3. Units of the Society
Only Active Members of the Society may hold a unit office, chair a unit committee, or vote on unit affairs. Among its elected officers, a unit must have at least a president, a president-elect or vice-president, and a secretary-treasurer or secretary and treasurer, whose duties must be defined in the unit's bylaws. **In the case of a Student Subunit that has joint affiliation with the Society and at least one other professional society, either the President or Vice President must be an Active Member of the Society.**

RULES
[No changes needed.]

PROCEDURES
[Not required to be published but available for review at www.fisheries.org/test/aboutus/proposedconstitution.pdf]

Resolution Approval Process

At the request of the Resolutions Committee, the Governing Board recommends **amending Rule 2** in the AFS Rules as follows:

Background: Updates several aspects of the resolution approval process and requires at least 60 days advanced notice to the committee chair for external resolutions.

Process: An amendment to the AFS Rules does not have to be published in advance for member review. However, by providing this explanation in *Fisheries* and on the website, active members may be better prepared to vote at the Society Business Meeting in Ottawa on 19 August 2008.

Recommended Amendments:

RULE 2. Resolutions
Resolutions shall be introduced at an annual or special Society business meeting by the Chair of the Resolutions Committee or a designated representative. General resolutions of broad national or international interest to be considered by the Society, including any that units may have approved and wish to nominate for Society action, must be submitted in writing to the Resolutions Committee Chair at least ~~30~~ **60** days before the annual meeting. Internal resolutions that concern the Society may be submitted to the Chair at any time **and need not be approved by the Governing Board prior to presentation to the membership.** All resolutions must be determined to be relevant and appropriate by the Governing Board in accordance with Article IX, 17 of the Constitution before presentation to the membership for **review or** a vote.

EDITORIAL: FISHERIES FORUM

Steven J. Cooke
Cooke is the chair of the AFS Publications Overview Committee and is also an assistant professor of environmental science and biology at Carleton University, Ottawa, Canada. He can be contacted at Steven_Cooke@carleton.ca.

Truth, Faith, and Transparency in Peer Review—Perspectives on the AFS Peer Review Process

A recent editorial (see Amos 2008; Fisheries 33:197-198) drew attention to the apparent increased publication of "faith-based science" (Hilborn 2007) through a series of personal anecdotes. The author summarized his concerns about a paper that appeared recently in the journal *Science* as well as his service as a referee for AFS. Beyond simply identifying problems, he went further and proposed several revisions to the AFS peer review model. Here, I address the ideas proposed by Amos wearing my hat as chair of the AFS Publications Overview Committee (POC) and as a fellow AFS member and scientist interested in ensuring that AFS journals maintain the highest reasonable standards and remain a credible outlet for fisheries research.

There are many different models for peer review and these vary extensively among "fishy" journals. The current model used in the AFS family of journals involves an editorial hierarchy. Each paper is initially assigned by AFS publications staff to one of the journal co-editors (equivalent to an "editor-in-chief") and an associate editor (AE). The editor is selected on the basis of subject expertise while the AE is selected on the basis of expertise and workload (how many articles they are currently handling). The AE evaluates the work to ensure that it is worthy of review. For each journal, there are approximately 10 to 20 AEs with a broad range of expertise in relevant topical areas. New AEs are recruited when warranted by increased levels of submission in a topical area or by the "retirement" of another AE. The AE is generally an expert in some aspect of a submitted paper.

The AEs identify a number of possible reviewers and attempt to encourage them to provide a critical appraisal of the submission. A minimum of two reviews is required, but it is not uncommon to receive comments from four referees. Not all reviewers will be experts in all aspects of a paper. Indeed, AFS strives for a mix of referees that cover relevant disciplines, institutional perspectives (e.g., academic, government), and regions (local knowledge versus a global perspective). AFS also seeks a mix of seniority and expertise and routinely involves advanced graduate students in the peer review process (usually identified because of their repeated submissions to AFS journals; see Jolley and Graeb 2007 for a summary of the many benefits of involving graduate students in the peer review process). After the reviews have been received, the AE collates and evaluates these comments and conducts their own assessment. They then pass along their recommendation to the editor. The editor also evaluates all of the material and forwards their decision to the author. At a minimum, each paper is reviewed by the editor, AE, and two referees.

Although I am hesitant to revert to personal anecdotes, I can think of many cases where my opinion diverged from those of the other referees—sometimes with me being more critical and sometimes being less critical. This is why it is important that we involve multiple referees with diverse expertise. Several recent scientific studies have evaluated the role of different review procedures in preserving rigor in the peer review process. One of the most relevant was published in *BioScience* and was authored by two active AFS members (Brian Neff and Julian Olden; Neff and Olden 2006). Their analysis revealed that the most reliable approach to ensure the integrity of scientific publications in journals was to use an editor or editorial board to prescreen and remove manuscripts of low suitability (AFS does this) and to use a three-of-three or four-of-four decision rule when making decisions. As noted above, although AFS rarely uses four "referees," at least four individuals (editors and reviewers) review each AFS paper before they appear in print. Amos suggested that he was "outvoted," although rarely is the process that pragmatic. The AE and editor take into account all comments and weigh them based on their own expertise to determine the fate of submitted papers. Unlike at AFS, many journals do not share the final decision and associated correspondence with referees. Personally, I value this service—it helps me to understand the basis for a decision and to see other perspectives on the same paper—and it is one of the reasons why I am usually keen to review AFS papers.

The AFS POC provides direction to AFS regarding our journals such that they best serve our members and the broader scientific community. In doing so, we conduct and interpret surveys, evaluate practices of other journals, respond to timely issues (such as this), and try to understand what can be done to enhance the delivery and quality of AFS publications. Several recent initiatives are worthy of sharing. The POC is active in evaluating emerging trends with respect to peer review. For example, in the last year we have discussed changes to the peer review process that would involve a double-blind format (neither the authors nor the reviewers are identified during the review process). Indeed, this approach has been shown to increase the diversity of contributions (in terms of gender) that successfully make it through the peer review process in a leading ecology journal (i.e., *Behavioral Ecology*; Budden et al. 2008). We have also considered completely open reviews (reviewers, editors, and authors all disclosed). To date, we have not recommended any changes to the existing family of AFS journals and will continue to monitor and debate trends related to the peer review process and other relevant publication issues.

We also have a unique opportunity to evaluate alternative review models as we launch our new online, open-access journal titled *Marine and Coastal Fisheries* (see Fabrizio 2008). This is the first new journal for AFS since 1989, when the *Journal of Aquatic Animal Health* was launched. Beyond providing authors with an appropriate venue for papers on this topic, the journal also serves as a means of trying new approaches to peer review. We are interested in trying to be more responsive (rapid) with the review process while maintaining the high quality that we have come to expect from AFS journals, so we have adopted a different peer review model for this journal. Instead of AEs, we have selected a diverse group of exceptional scientists that will be termed "subject editors." These individuals (approximately 20 to start) will personally select referees and will make final decisions on manuscript submission independent of the editor-in-chief (Donald Noakes). The editor in chief will provide input or address conflict when necessary but his real focus will be on refinement of editorial policy, recruiting subject editors, encouraging high quality submissions, and in making strategic decisions regarding topical areas that should be pursued by the journal. Authors will have the opportunity to identify the subject editor that they feel is most appropriate for their paper. The subject editor will have their name associated with a given paper, where it will state at the end that they had the editorial responsibility for the paper. This transparency is new to AFS journals, yet is common in other outlets such as *Diseases of Aquatic Organisms, Marine Ecology Progress Series, Endangered Species Research,* and *Ecology Letters.* We did discuss including an open referee approach as well (where referee identities are revealed to the authors). However, we have serious concerns regarding our ability to be able to attract referees in the face of a general trend toward diminishing time and increasing referee declines to review papers. We will continue to monitor developments in peer review in relevant journals and revisit this topic in the future.

The other comment suggested by Amos was a mechanism by which referees (or others) could provide comment on a paper which would accompany the paper in its published form. The idea of generating rationale debate and discussion associated with research output is critical for advancing science and policy. At present, there are exceedingly few "comments" in AFS journals (perhaps one or two a year). For the new journal, we have opted to include a dynamic section called the "Forum," which will have its own special editor (James Cowan). This section will serve as a vehicle for enabling and stimulating open and insightful debate regarding material published in the new journal and other outlets. Indeed, such a venue would be perfect for Amos and others to discuss and debate the recent string of papers on sea lice in a structured, moderated, and timely manner.

In the coming years we will monitor and evaluate what works and, where appropriate, consider extending these changes to other AFS journals. We appreciate Amos (2008) drawing the attention of these issues to the AFS community. Rest assured that the AFS POC, journal editors, staff, and the AFS Governing Board are all committed to disseminating the best science in a manner that is accessible to the fisheries community and other stakeholders. In closing, I also want to remind the AFS community that all of our editors, associate editors, referees (probably including you!), and members of the POC are volunteers and we owe all of them a great deal of gratitude for their service to the fisheries profession. We welcome comments on the AFS peer review policies and are open to considering other models for peer review. I'm not sure that this will yield the "truth" sought by Kevin Amos, but we do hope that it will help to increase his "faith" (play on Hilborn 2006) in the AFS peer review system.

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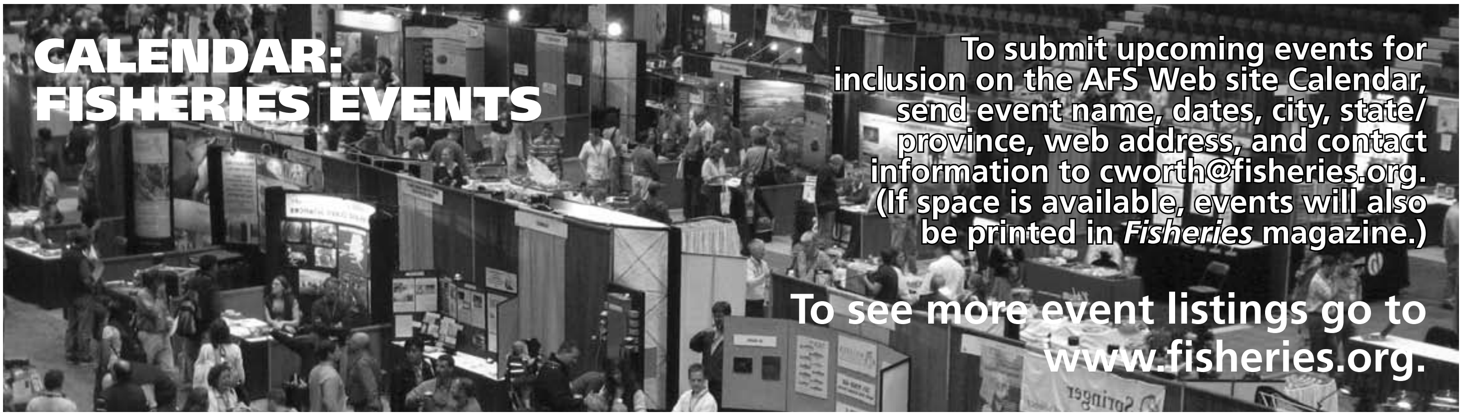
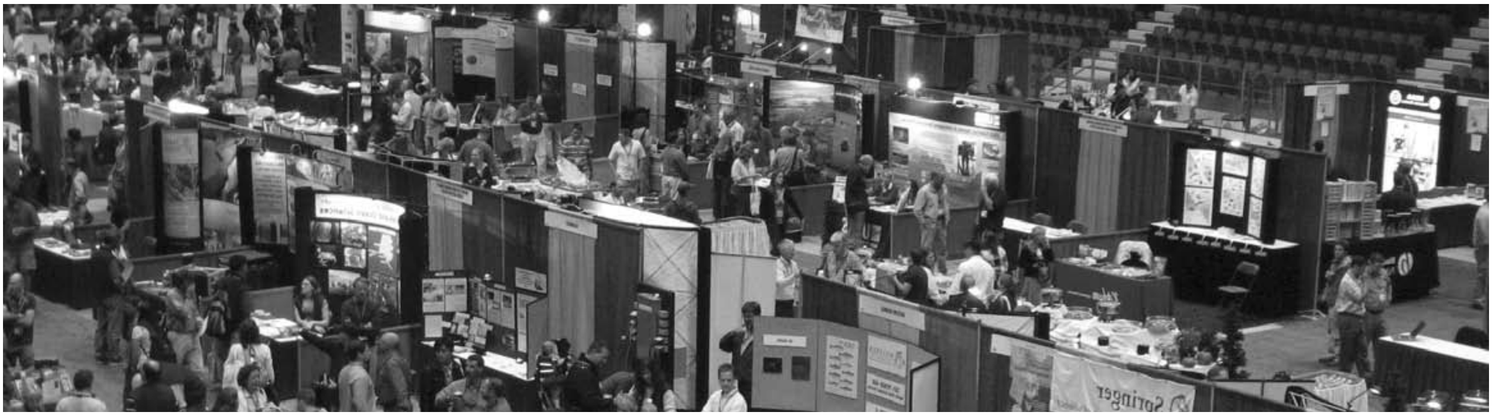


CALENDAR: FISHERIES EVENTS

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

To see more event listings go to www.fisheries.org.

DATE	EVENT NAME CITY, STATE	FOR MORE INFORMATION
Jun 2-13	**Diseases of Warmwater Fish,** Ruskin and St. Augustine, Florida	http://conference.ifas.ufl.edu/ame/wwf/index.html
Jun 3-4	**53rd Annual Meeting of the Great Lakes Fishery Commission,** Cleveland, Ohio	www.glf.org, 734/622-3209 x28
Jun 18-20	**Channel Migratiion Zone Delineation Workshop,** Zillah, Washington	www.nwetc.org/hyd-404_06-08
Jun 28-30	**Shanghai International Fisheries and Seafood Expo** Shanghai, P. R. China	www.gehuaexpo.com
Jul 7-11	**11th International Coral Reef Symposium** Fort Lauderdale, Florida	www.nova.edu/ncri/11icrs
Jul 9-12	**Annual Meeting AFS Fish Health Section** Charlottetown, Prince Edward Island, Canada	www.kupei.ca/FHS-AFS2008
Jul 13-17	**Conference for Society for Conservation Biologists** Chattanooga, Tennessee	www.utc.edu/Academic/ConferenceforSocietyofConservationBiologists
Jul 14-18	**HydroVision 2008** Sacramento, California	www.hcipub.com/hydrovision/abstracts.asp, techpapers@hcipub.com
Jul 20-25	**Eighth International Wetland Conference,** Cuiaba, Brazil,	www.cppantanal.org.br/intecol
Jul 21-25	**Fisheries Society of the British Isles Annual International Symposium** Cardiff, United Kingdom	www.Fsbi.org.uk/2008
Jul 22-25	**Asian Wetland Symposium 2008** Hanoi, Viet Nam	www.aws2008.net
Jul 23-28	**American Society of Ichthyologists and Herpetologists Conference** Montreal, Canada	www.asih.org/annualmeetings
Jul 25-27	**Seventh International Conference on Recirculating Aquaculture** Roanoke, Virginia	www.cpe.vt.edu/aquaculture/ Terry Rakestraw, aqua@vt.edu/aquaculture/, 540/231-6805
Jul 28-Aug 1	**Eighth International Congress on the Biology of Fish** Portland, Oregon	http://fishbiologycongress8.usgs.gov/
Aug 17-21	**American Fisheries Society 138th Annual Meeting** Ottawa, Ontario, Canada	www.fisheries.org
Aug 25-29	**Fourth International Symposium on FISH-GIS/Spatial Analysis** Rio de Janeiro, Brazil	www.esl.co.jp/Sympo/4th/index.htm
Sep 15-18	**2008 Conference: Australian Society for Fish Biology:** **Assessing Recreational Fisheries: Current and Future Challenges** Bondi Beach, Sydney, Australia	www.asfb.org.au
Sep 15-18	**Aquaculture Europe 2008** Krakow, Poland	www.easonline.org
Sep 22-26	**ICES 2008 Annual Science Conference** Halifax, Nova Scotia, Canada	www.ices.dk/iceswork/asc/2008/index.asp



Sep 28-Oct 2	**Pathways to Success 2008 Conference: Integrating Human Dimensions into Fisheries and Wildlife Management Increasing Human Capacity for Global Human-Wildlife Coexistence** Estes Park, Colorado	www.warnercnr.colostate.edu/nrt/hdfw/partners.html eduke@warnercnr.colostate.edu
Oct 11-15	**Fourth National Conference on Coastal and Estuarine Habitat Restoration** Providence, Rhode Island	www.estuaries.org/?id=4
Oct 12-15	**62nd Annual Southeastern Association of Fish and Wildlife Agencies Conference** Corpus Christi, Texas	http://seafwa2008.org
Oct 19-22	**Women Evolving Biological Sciences** Seattle, Washington	www.webs.washington.edu
Oct 19-24	**International Aquarium Congress 2008** Shanghai, China	www.iac2008.cn
Oct 20-24	**Fifth World Fisheries Congress 2008** Pacifico Yokohama, Japan	www.5thwfc2008.com, wfc2008@ics-inc.co.jp, +81-3-3219-3541
Oct 28-29	**Coastal Research Symposium** Biloxi, Mississippi,	http://masgc.orgbaysandbayous
Nov 10-13	**Fifth World Recreational Fishing Conference** Dania Beach, Florida	www.igfa.org, 954/927-2628.
Nov 11-14	**North American Lake Management Society Symposium** Lake Louise, Alberta, Canada	www.nalms.org
Nov 14-16	**Third International Bonefish and Tarpon Symposium: Research and Conservation for the Future** Dania Beach and Islamorada, Florida	aadams@mote.org
Nov 23-25	**International Symposium on the Bearing-Aleutian Salmon International Surveys: Climate Change, Production Trends, and Carrying Capacity of Pacific Salmon in the Bering Sea and Adjacent Waters** Seattle, Washington	www.napafc.org
Dec 3-4	**11th Flatfish Biology Conference** Westbrook, Connecticut,	http://mi.nefsc.noaa.gov/flatfishbiologyworkshop, rmercald@clam.mi.nmfs.gov, 203/882-6549

2009

Jan 13-14	**Lake Mead Science Symposium** Las Vegas, Nevada	www.lakemeadsymposium.org
Jan 15-18	**Spring Meeting of the Southern Division and Louisiana Chapter of the AFS** New Orleans, Louisiana	www.sdafs.org/meetings
May 25-29	**8th Indo-Pacific Fish Conference** Fremantle, Western Australia	
Jun 23-26	**International Paleolimnology Symposium** Guadalajara, Jalisco, Mexico	www.paleolim.org
Aug 30-Sep 3	**American Fisheries Society 139th Annual Meeting** Nashville, Tennessee	www.fisheries.org
Aug 14-17	**Aquaculture Europe 2009** Trondheim, Norway	www.easonline.org

COLUMN: STUDENTS' ANGLE

Steven H. Ranney
Steven Ranney is an M.S. student in Wildlife and Fisheries Sciences at South Dakota State University, Brookings, and serves as the secretary-treasurer of the AFS Student Subsection of the Education Section. Ranney can be contacted at Steven.Ranney@sdstate.edu.

Student Peer Reviewer: Benefits for the Profession and the Student

Peer review is the process of certifying new science (Berkenkotter 1995). Certifying research by other professionals allows a discipline to maintain high standards of research quality and credibility to peers and the public. Few scientists can imagine progress without the peer-review process (Laine and Mulrow 2003). At the recent student colloquium at the American Fisheries Society (AFS) Annual Meeting in San Francisco, the guest presentations and discussion focused on writing and publishing. As a part of this discussion, it became apparent that many students were not aware that they could be involved in the review process. While students have always been welcome as peer reviewers, student participation has waned in recent years. Indeed, as the future of the fisheries profession (Kohler 2005), students have a professional obligation to be involved in the peer-review process. Additionally, all three presenters at the colloquium indicated that student involvement in the peer-review process enhances a student's critical reviewing and writing skills and would be a benefit to the profession. This article is meant to describe the elements of a good critical review. More importantly, this discussion will hopefully serve as a catalyst for getting more students involved in the peer-review process.

WHAT ARE THE ELEMENTS OF A GOOD CRITICAL REVIEW?

Peer reviewers are the quality control of scientific journals (Berkenkotter 1995). The qualities of a good review are common to most disciplines, but there are no universally accepted standards for high-quality peer review (Frank 1996). The primary focus of any peer review should be the content and science of a paper (Hoppin 2002). The AFS has published rubrics designed to assist reviewers, but most reviewers will necessarily find their own method for providing a review (Benos et al. 2003). Of course, the quality of the review is important, and the worst review an editor can get is the simple "it looks good." As a result, reviews should be of a quality that editors can decide whether or not to publish the submitted manuscript. While there are no standard guidelines for reviewing manuscripts, the "golden rule" taught in grade school should always apply: treat a manuscript you are reviewing the same way you would want your manuscript reviewed (Benos et al. 2003). As reviewers, the goal should be to provide a critique that is positive, critical yet objective and balanced, and returned promptly.

Because a reviewer is asked to give an informed opinion of the manuscript, the review needs to be well written. The editor should be able to accurately determine the reviewer's thoughts and weigh them along with those of other reviewers. Reviewers should comment only on aspects of the work where they have familiarity (Benos et al. 2003), but understanding the science and logic of the manuscript is the primary goal of the reviewer (Hoppin 2002). The reviewer should provide citations for justification of their arguments when they disagree with the author. While reading the manuscript, the reviewer should be asking themselves questions such as: has the author acknowledged other reasonable hypotheses? Have the authors discussed differences found in their work and the results of others? What critical aspects of the scientific method are missing from this research? This is the crux of a good manuscript review—looking intently at the data analysis and write-up, and evaluating the science.

Quality reviews are focused on the content and science of a manuscript rather than simply on proofreading and recitation of editorial comments. Grammar and editorial issues should have been addressed by the author prior to manuscript submission. This will allow the reviewer to focus on questions regarding the structure and timeliness of the paper in addition to the novelty of the idea. While commenting on poor grammar and "hasty" presentation should be secondary to evaluating the content of the paper, the negative consequences of not correcting such mistakes (e.g., harsh reviews as a result of poor grammar) during preparation are well deserved (Hoppin 2002).

Guidelines for reviewing original scientific articles are available (Hansen 2002; Hoppin 2002; Benow et al. 2003; Provenzale and Stanley 2006). The AFS also provides a reviewing rubric to those who have agreed to be peer reviewers. These guidelines give excellent methods for evaluating a manuscript's acceptability and should be followed. Eventually, the style of a reviewer will change with time and experience (Benos et al. 2003) and the AFS guidelines can be replaced with personal guidelines.

STUDENT REVIEWERS BENEFIT BOTH THE PROFESSION AND THE STUDENT

Student involvement in the review process is beneficial in several ways. The primary reason is that it helps establish students as fisheries professionals and allows them to contribute to science.

Being involved in the review process is not only a way to contribute to the profession, but for students, it is also a way to increase the quality of their own writing. The act of reviewing others' work facilitates better writing through honing one's reviewing skills. Reviewing manuscripts allows readers the opportunity to improve their own work by critically evaluating the logic of others. Reading scientific papers is an excellent way of learning how (or how not) to write. In fact, 65% of those students surveyed indicated that one of the ways through which they learned to write was reviewing the work of others (Jolley and Graeb 2007). While reviewing a paper does take substantial intellectual effort and represents a significant time investment, student participation in the peer-review process helps to fulfill our responsibility to past, current, and future fisheries professionals in making a meaningful contribution to the profession.

Most good reviewers believe that maintaining the high standards of research is critical to the progress of science (Hoppin 2002). Further, many reviewers see the peer-review process as a responsibility to their field and find that reviewing helps them remain on the cutting edge of science (Laine and Mulrow 2003). Upon being asked to provide a review, students may be hesitant to give their expert opinion on a subject on which they may have little knowledge. For many students, the hesitation and nervousness they may have about providing a good review is often accompanied by an unusually high attention to detail during the peer-review process. This is especially why editors enjoy having student reviewers. As a result of their eagerness to be thorough, editors find student reviews to be detail oriented and are commonly more thorough than those from non-students (M. Quist, Iowa State University, pers. comm.). In addition, because students are engrossed in the primary literature, editors find student reviews more pointed. One of the reasons students are useful in the review process is that they bring with them new ideas—a fresh way of thinking—without being biased by years of practicing within one particular paradigm. In other words, students at all levels are open to new ideas and may bring to the table new ways of evaluating old problems.

HOW CAN STUDENTS GET INVOLVED?

Recently, the Student Subsection of the AFS sent an e-mail to the student listserv encouraging students to register on a student reviewer database. This student reviewer database is now accessible to AFS editors and associate editors. Those students who did not receive the e-mail can view the requirements on the Student Subsection webpage at www.fisheries.org/units/edustu/announcements.htm by clicking the link under the "Student Reviewers Needed" section. The nomadic nature of student life will require the database to be updated yearly. Usage of the student reviewer database will be left up to the editors of AFS journals. Students may or may not be called upon to be reviewers, but if asked, it is their responsibility to strongly consider providing a review (Hansen 2002).

Reviewing a scientific manuscript requires a significant intellectual investment, but the benefits of being a reviewer far outweigh the time commitments required. Beginning a professional journey is only one of the benefits gained by investing time in maintaining the high standards of published research. The improvement in critical thinking through acting as a reviewer will surely be reflected in the quality of future manuscripts. Editors of AFS journals will appreciate students' commitments to the field of fisheries and students will enjoy investing in the field in which they will work for years to come.

ACKNOWLEDGEMENTS

Michael Quist committed his time to discuss this topic and provided editorial comments on an earlier draft of this manuscript. Jeffrey Jolley and Melissa Wuellner also provided helpful comments.

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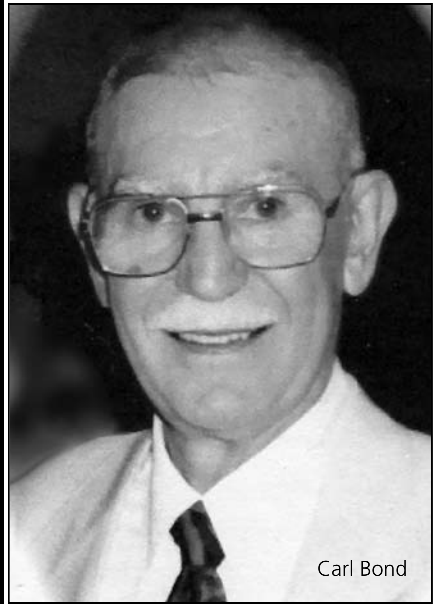
OBITUARIES: GEORGE RIDGWAY AND CARL ELDON BOND


Carl Bond

An era in the initial applications of genetic markers to identify and manage fish populations ended when **George Ridgway,** 85, passed away on 16 February 2007 in Augusta, Maine. With a Ph.D. in microbiology from the University of Washington, Ridgway initially joined the U.S. Fish and Wildlife Service at the Western Fish Nutrition Laboratory in Cook, Washington, in 1953. He transferred to the Bureau of Commercial Fisheries (BCF) Montlake Laboratory (then under the Fish and Wildlife Service) in Seattle in 1955. There he established an immunological research group intended to use heritable differences in blood groups and proteins to identify continental origins of salmon harvested in international waters under the International North Pacific Fisheries Commission. He transferred to the BCF Boothbay Harbor Laboratory in Maine in 1964 and ended his career at Woods Hole Laboratory. Ridgway initiated a continuity of management-related genetic research in the Pacific Northwest, where his initial visions were perpetuated and ultimately fulfilled. He will be remembered for this achievement and for being a true scholar and a gentleman.

—Fred Utter

Carl Eldon Bond, 87, passed away in Corvallis, Oregon, in November 2007. He was born in Culdesac, Idaho, the youngest of six children. His family moved to Monmouth when Carl was two years old. After graduating from high school, he attended Oregon Normal School in Monmouth and subsequently taught elementary school on the Oregon coast until the beginning of World War II.

Following the attack on Pearl Harbor, Bond worked as a civilian employee of the Army during construction of Camp Adair while he was waiting for his induction into the U.S. Navy. He married Lenora D. Jensen in Monmouth in June 1942. Carl served with the Naval Construction Battalion (Seabees) for more than three years in Sierra Leone, Africa; Honolulu, Hawaii; and Midway Island.

Bond received his bachelor's degree in 1947 and master's degree in 1948 in fisheries and wildlife from Oregon State College. In 1950, he joined the faculty of the Department of Fish and Game Management (later Fisheries and Wildlife) and remained with the department throughout his career. Teaching loads were heavy at first; he taught three courses each term and advised about 50 undergraduates. Bond studied at the University of Michigan in 1959–60 and was inducted into Phi Beta Kappa. He received his Ph.D. from Michigan in 1963. When he retired as professor emeritus in 1985, scientists came from many countries to wish him well. And he continued active research and writing for years after that.

Bond was an active member and fellow in many professional organizations, including the American Fisheries Society, American Society of Ichthyologists and Herpetologists, the Gilbert Ichthyological Society, and the American Institute of Fishery Research Biologists.

During his career, Bond taught and had projects in many countries, including India, Iran, Taiwan, Thailand, Japan, Hong Kong, and Chile. He was considered a world authority on sculpins. He was the author of an undergraduate textbook, *Biology of Fishes,* which is still in use today. For many years, Bond was on the "Names of Fishes" committee for the American Fisheries Society. He designed and taught one of the first U.S. university courses in aquaculture. He met with many dignitaries during his career; while in Japan, he was privileged to take tea with Japan's then crown prince Akihito [himself an ichthyologist], now emperor.

Among his awards, Bond was named "Oregon Scientist of the Year" in 1983 by the Oregon Academy of Science. He received the American Fisheries Society Award of Excellence in 1998 and its Distinguished Service Award in 2000. He was also honored by the Desert Fishes Council. Of all his accomplishments, Bond was most proud of his students. During his long career, he mentored 63 graduate students, 15 doctoral, and 48 masters. Many of these students went on to distinguished careers of their own.

Bond was interested in many things, particularly the sanctity of the living world. He treasured time spent with his family and "give and take" with friends and colleagues. He was an avid hunter and fisherman and an accomplished knife maker. His twinkling eyes, warm smile, and keen sense of humor will be greatly missed. Contributions in his memory can be made to the Carl and Lenora Bond Scholarship Fund, c/o OSU Foundation, 835 SW 35th Street, Corvallis, OR 97333.

—Jim Hall

Continued from page 214

could be disastrous to the economy, agriculture, personal land use rights, and the rights of states and localities to manage their own land.

John Paul Woodly, Jr., Assistant Secretary of the Army for Civil Works, stated that the U.S. Army Corps of Engineers remains fully committed to protecting U.S. waters as intended by Congress and expected by the American people. He further explained that although there are ongoing legal and policy challenges facing the Army's Regulatory Program, currently the program is operating robustly, protecting the environment, and supporting over $220 billion in economic development annually.

Chief Arlen Lancaster of the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service stated that in total, the USDA believes that NRCS authorities for wetlands compliance and restoration activities under the Farm Bill would not be affected by HR 2421 and that a change in definition would not impact the implementation of USDA's programs. He also stated that it is possible that enactment of HR 2421 would lead to more producers falling under the regulatory purview of the Clean Water Act, which in turn could lead to increased compliance costs for producers.

Benjamin Grumbles, assistant administrator of water for the U.S. Environmental Protection Agency (EPA), stated that the EPA is strongly committed to the protection of wetlands and believes that a good job is being done under the current statutory framework. He explained that proposed changes might be construed to expand the scope of CWA authorities in unintended ways and lead to protracted litigation. He asserted that the bill also seems likely to have implications for states and tribes, who work collaboratively with EPA and the Corps to achieve the act's water quality goals.

John Cruden, deputy assistant attorney general of the U.S. Department of Justice's Environmental and Natural Resources division, focused on an explaining the statutory and case law context of the Rapanos decision. As a result of this decision, he stated that the Department of Justice has filed more than 45 briefs in more than 30 federal court proceedings in which geographic jurisdiction under the CWA was a significant issue, including briefs in 9 of the 13 Courts of Appeal. He closed his testimony by stating the Department of Justice takes seriously its obligation to protect public health and the environment, and to enforce and defend the existing laws.

TRANSIT, BOATING, CLIMATE CHANGE, AND WATER RESOURCES LEGISLATION

On 15 May 2008, the House Committee on Transportation and Infrastructure approved HR 6052, the "Saving Energy Through Public Transportation Act of 2008." The legislation provides support to public transportation agencies and increases incentives for commuters to choose transit options. It also increases the federal share for clean fuel and alternative fuel transit bus, ferry, or locomotive-related equipment or facilities, which will reduce transportation-related emissions.

Also approved was HR 2452, the "Sewage Overflow Community Right-to-Know Act," which provides a uniform national standard for public notification of combined sewer overflows and sanitary sewer overflows. The committee also approved HR 5770, which requires the National Academy of Sciences to study the potential impacts of climate change on water resources and water quality.

In addition, the committee approved a bill to restore a decades-old exemption under the Clean Water Act for recreational boats. HR 5949, the "Clean Boating Act of 2008," reverses a recent California District Court decision that directed the EPA to impose fines on recreational boaters for discharges that are incidental to the normal operation of recreational boats.

2008 FARM BILL

On 14 May 2008, the House of Representatives passed the conference report on HR 2419, the Food, Conservation, and Energy Act of 2008. HR 2419 includes an increase of $7.9 billion in total spending for conservation programs. Some conservation programs affected include:

- Extending the popular Conservation Reserve Program, allowing 32 million more acres to be enrolled in the program from 2010-2012.
- Expanding the Wetlands Reserve Program by providing funds to reestablish a baseline of $1.3 billion and extending it through 2012.
- Strengthening the Environmental Quality Incentives Program by increasing funding by $3.4 billion.
- Extending the Conservation Security Program by providing $1.1 billion in new funding to enroll nearly 13 million acres per year.
- Providing new resources to protect and restore the Chesapeake Bay Region.
- Extending the Small Watershed Rehabilitation Program through 2012.
- Reauthorizing the Wildlife Habitat Incentives Program.
- Creating an Open Fields Program to provide incentives to state governments and Indian tribes to provide public access to private land for hunting and fishing.

PUBLICATIONS: NEW TITLES

NEW TITLES

Ecological Geography of the Sea. Second edition, By A. Longhurst. Academic Press, New York. 2007. 542 pp. $49.95 (paper); www.elsevier.com/wps/find/bookdescription.cws_home/708929/description#description. This is a much expanded new edition of the 1998 text which focused primarily on the planktonic ecosystem. The new book has 12 chapters which now include, in addition to general marine biogeography, explicit connections between benthic and pelagic processes. The last four chapters (and two-thirds of the length of the text) are devoted to detailed examination of biomes and provinces of the four major oceans.

Fisheries Management: Progress towards Sustainability. Edited by T. McClanahan, and J. C. Castilla. Blackwell Publishing, Oxford. 2007. 332 pp. $199.99 (cloth); www.blackwellpublishing.com/book.asp?ref=9781405139328&site=1. This volume is the result of discussions by members of the Pew Fellows in Marine Conservation. It begins with a summary of the status of the world's fisheries and is followed by 12 case studies which emphasize both setbacks and successes in the management process by authors who participated in the fisheries they describe. The book ends with a synthesis and a look forward written by the co-editors. The perspective is international, focusing on small-scale fisheries and innovative management approaches

Methods in Stream Ecology, 2nd edition. Edited by F.R. Hauer and G. A. Lamberti. Academic Press, Burlington, Massachusetts. 2006. 875 pp. $93.00 (cloth); www.elsevier.com/wps/find/bookdescription.cws_home/708163/description#description. This wide-ranging edited volume contains detailed chapters on physical processes, material transport uptake and storage, stream biota, community interactions, ecosystem processes, and ecosystem quality. Each of the 36 chapters is written by an expert in the field. Most chapters end with sections on specific methods, materials, and supplies. This synthetic and comprehensive book will appeal to a wide range of readers, from undergraduates to practitioners.

Salmon 2100: The Future of Wild Pacific Salmon. Edited by R.T. Lackey, D. H. Lach, S.L. Duncan. American Fisheries Society, Bethesda, Maryland. 2006. 629 pp. $39.00 (cloth); http://afsbooks.org/x55050xm.html. This volume is a sober look at the future of Pacific salmon. It addresses the important policy issues that surround salmon management and the likelihood that there will be salmon populations in western North America 100 years from now. The book contains 23 papers with 3 introductory and 2 concluding chapters. The book should broadly interest policy managers and scientists that produce information used by managers.

FOR YOUR INFORMATION

Alaska Crab Stock: Enhancement and Rehabilitation. Edited by B. G. Stevens. Alaska Sea Grant College Program, Kodiak. 2006. 94 pp., $10.00 (paper); seagrant.uaf.edu/bookstore/pubs/AK-SG-06-04.html.

Aquaculture Engineering. By O. Lekang. Blackwell Publishing, Ames, Iowa. 2007. 352 pp., $199.99 (cloth); www.wiley.com/WileyCDA/WileyTitle/productCd-1405126108.html.

Choosing a Conservation Vocation or a Bureaucratic Career: Personal Choices and the Environmental Consequences. By R. Kroger. Trafford Publishing, Victoria, British Columbia. 2005. 162 pp., $14.39 (paper); www.trafford.com/05-1920.

Effects of Urbanization on Stream Ecosystems. Edited by L. Brown, R. G. Gray, R. M. Hughes, and M. R. Meader. American Fisheries Society, Bethesda, Maryland. 2005. 423 pp., $69 (paper); www.afsbooks.org/x54047xm.html.

Fish Endocrinology. Volumes 1 and 2. Edited by M. Reinecke, G. Zaccone, and B. G. Kapoor. Science Publishers, Enfield, New Hampshire. 2006. 912 pp. $151.20 (cloth); www.scipub.net/fisheries/fish-endocrinology.html.

GIS for Environmental Management. By R. Scally. ESRI Press, Redlands, California. 2006. 202 pp., $24.95 (paper); http://gis.esri.com/esripress/display/index.cfm?fuseaction=display&websiteID=106.

Leviathan: The History of Whaling in America. By E. J. Dolin. W. W. Norton and Company, New York. 2007. 479 pp., $27.95 (cloth); $15.95 (paper); www.wwnorton.com/catalog/spring07/006057.htm.

Monitoring Stream and Watershed Restoration. Edited by P. Roni. American Fisheries Society, Bethesda, Maryland. 2005. 350 pp., $65 (paper); http://store.afsbooks.org/x55047xm.html.

Partnerships for a Common Purpose: Cooperative Fisheries Research and Management. Edited by A. N. Read, and T. W. Hartley. American Fisheries Society, Bethesda, Maryland. 2006. 270 pp., $60.00 (cloth); www.afsbooks.org/x54052xm.html.

Scallop Farming. By D. Hardy. Second edition. Blackwell Publishing, Ames, Iowa. 2006. 328 pp. $139.99 (cloth); www.wiley.com/WileyCDA/WileyTitle/productCd-1405113634.html.

Shrimp Culture: Economics, Market, and Trade. Edited by P. Leung, and C. Engle. Blackwell Publishing, Ames, Iowa. 2006. 335 pp., $179.99 (cloth); www.wiley.com/WileyCDA/WileyTitle/productCd-0813826551.html.

UPDATE:
ANNUAL MEETING PLENARY SESSION

Fisheries in Flux

American Fisheries Society • 138th Annual Meeting
August 17-21 2008 • Ottawa • Ontario

How Do We Ensure Our Sustainable Future?

The goal of the 2008 Plenary Session is to deliver a thought-provoking and engaging series of presentations about issues affecting fisheries and fisheries professionals in the workplace. We will examine the meeting theme, *Fisheries in Flux: How Do We Ensure Our Sustainable Future?*, by exploring the biological, political, and social constraints within which we work.

Fish communities and fisheries are not static properties of ecosystems—an observation that challenges our understanding of ecosystems and how we approach natural resource management. To better understand dynamic systems, we must study ecological conditions at multiple points in time, implying that we have much to learn from the past and that baselines are crucial to our understanding. **William Gilly** will illustrate this through his experience with the Sea of Cortez Expedition and Education Project that retraced the 1940 voyage undertaken by John Steinbeck and Ed Ricketts in the Sea of Cortez.

Although fisheries professionals may be armed with the latest data, the best scientific models, and the newest approaches, fisheries science advice may not carry the impact we desire. **Jake Rice** will challenge us to consider how discussions of economic incentives can promote fisheries goals and reduce ecosystem impacts. His examples from Canadian and European fisheries will shed new light on how we manage fisheries throughout the world.

Finally, the fisheries professionals who manage fisheries, conduct research, and set policy are critical to ensuring the sustainable future of our fisheries resources. **Sally Guynn** will help us understand our important role as leaders of change, and how professional communities and their culture can facilitate the realization of sustainable fisheries.

CHANGE IN THE GULF OF CALIFORNIA: WHAT IS THE FUTURE OF THE "AQUARIUM TO THE WORLD?"

William Gilly
Hopkins Marine Station, Stanford University

Mexico's Gulf of California, a UNESCO World Heritage Site, is a sea of exceptional productivity where "…almost all major oceanographic processes occurring in the planet's oceans are present…, giving it extraordinary importance for the study of marine and coastal processes" (http://whc.unesco.org/en/list/1182). It is home to 5,000 species of invertebrate macrofauna, nearly 1,000 species of fish, and 40% of the world's marine mammal species. Although the gulf has been studied by at least 500 scientific cruises since 1825, relatively few studies have taken a holistic view or explicitly addressed long-term changes in this storied body of water. Since 1935, a variety of human activities, ranging from damming the Colorado River to constructing Cabo San Lucas, have touched all parts of the gulf. The Steinbeck-Ricketts expedition of 1940 provides a unique baseline for comparison with more recent observations of intertidal, pelagic, and human communities. Although the gulf remains a stunningly beautiful and productive place, it indeed has changed and will continue to do so. Large fishes and snails have been replaced by smaller individuals of other species; Humboldt squid have replaced yellowfin tuna as a dominant pelagic predator; a mesopelagic hypoxic zone has greatly expanded; and vast agriculture, aquaculture, and tourism industries have arisen. "Far from being the remote fishing village of 20 years ago, Cabo San Lucas beckons to 400 cruise ships a year. Over one million annual visitors can't be wrong." (www.loscabosguide.com/cabosanlucas/index.html).

In 2004 Gilly led the Sea of Cortez Expedition and Education Project (www.seaofcortez.org) that retraced the legendary 1940 voyage of John Steinbeck and Ed Ricketts in an effort to discern long-term ecological changes and to consider them in light of human activities. He continues to study Humboldt squid in the Sea of Cortez and Pacific Ocean.

LINKING ECOLOGY TO ECONOMICS—ADVICE WITH IMPACT

Jake Rice
Department of Fisheries and Oceans, Canada

Science advice to policymakers has often been to reduce exploitation rates and allow stocks to rebuild, with the short-term sacrifice repaid through higher sustainable harvests from larger and more resilient stocks. Such advice often has ended up not being reflected in decision making, presumably to avoid the short-term costs. This apparent disconnect has been a major source of frustration to the science community. Scientists often blame short-term political considerations for outweighing sustainability and conservation, yet no decision maker wants to leave a legacy of ecological—and the consequent social and economic—disaster. Correspondingly, in the past decade at least four different pathways have been explored for breaking the disconnect between science advice and decision making: improved communication of science, adoption of rule-based decision-making, advocacy science, and linking ecological sciences to social and economic sciences.

The talk will consider all four pathways; the first three briefly. Rice will argue that the potential for greatest progress in strengthening the impact of sound science advice can be made in linking the advice to actions for addressing perverse social and economic incentives that foster a political receptivity to short-sighted decision making. If the incentive structures in fisheries promote a longer-term view by the resource users, they naturally become allies with the ecologists in supporting politicians who show long-term vision in their decisions. The talk will review some major economic instruments for fisheries management from an ecological perspective, and highlight inherent affinities between the objectives of both the science advice and the social and economic instruments. The talk concludes with some optimistic words about the types of research partnerships that may really make a difference in achieving sustainable fisheries on healthy stocks, and in communities and ecosystems that are both resilient.

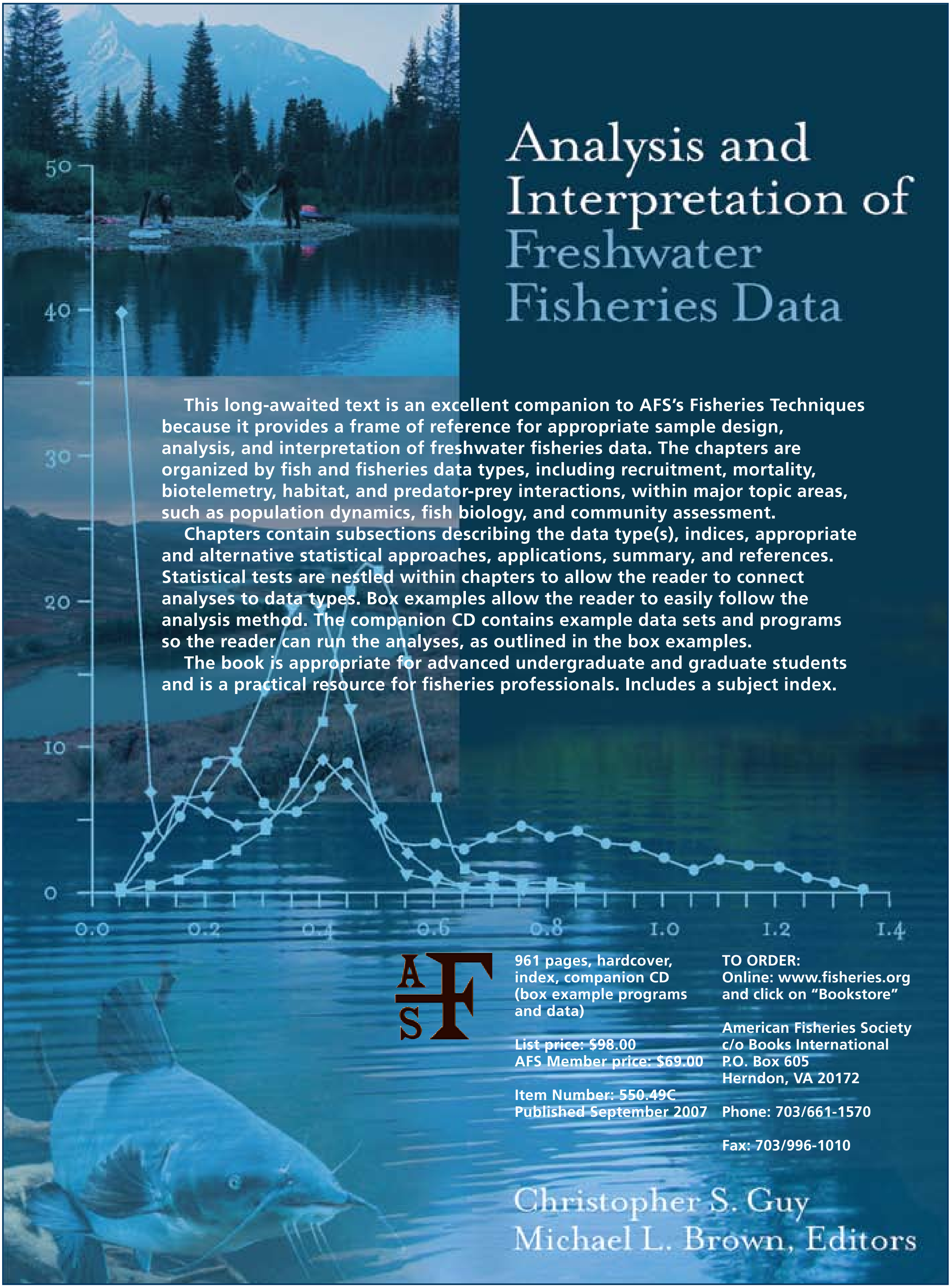
Rice has been increasingly interested in methods for increasing the impact of science advice on policy and management decision making, prompting current work on the interactions of social and economic incentives with biological advice, and he has served as science advisor to the Department of Fisheries and Oceans International Policy group.

TAKING THE LEAD

Sally Guynn
Association of Fish and Wildlife Agencies

The third critical factor in a virtual equation for ensuring the sustainable future of fisheries is the human factor. Fisheries are as great as the people who make them happen. But how do fisheries professionals effectively lead in a time of flux while facing the perfect storm? The importance of fisheries professionals as leaders of change, and the constraints and opportunities for leveraging our individual and corporate strength, will be explored.

Sally Angus Guynn is a senior organization development consultant with the Association of Fish and Wildlife Agencies Management Assistance Team (MAT). She also serves as the executive director of the National Conservation Leadership Institute.



Analysis and Interpretation of Freshwater Fisheries Data
This long-awaited text is an excellent companion to AFS's Fisheries Techniques because it provides a frame of reference for appropriate sample design, analysis, and interpretation of freshwater fisheries data. The chapters are organized by fish and fisheries data types, including recruitment, mortality, biotelemetry, habitat, and predator-prey interactions, within major topic areas, such as population dynamics, fish biology, and community assessment.
Chapters contain subsections describing the data type(s), indices, appropriate and alternative statistical approaches, applications, summary, and references. Statistical tests are nestled within chapters to allow the reader to connect analyses to data types. Box examples allow the reader to easily follow the analysis method. The companion CD contains example data sets and programs so the reader can run the analyses, as outlined in the box examples.
The book is appropriate for advanced undergraduate and graduate students and is a practical resource for fisheries professionals. Includes a subject index.
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ANNOUNCEMENTS: JOB CENTER

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.

To see more job listings go to www.fisheries.org and click Job Postings.

Postdoctoral Research Associate, School of Aquatic and Fishery Sciences, University of Washington.

Responsibilities: Work with an international team of scientists that is evaluating the ecological impacts that follow from the implementation of dedicated access privilege fisheries systems. For more project information see http://fish.washington.edu/research/dap/ and for more information about the position see at http://fish.washington.edu/research/dap/PostDocDescription.pdf.

Qualifications: Ph.D. in ecology, fisheries, biology or a related field, a sound foundation in statistics and quantitative analysis of complex data, and demonstrated ability to publish peer-reviewed papers.

Salary: $45,000–50,000 per year plus benefits, depending on applicant's experience. Full time effective immediately through September 2009, with prospects for extending the duration of the position.

Closing date: Until filled.

Contact: Send a CV and a brief statement of qualifications to Tim Essington, essing@u.washington.edu. For information phone 206/616-3698.

Postdoctoral Research Associate in Fish Nutrition, Hubbs-SeaWorld Research Institute, California.

Responsibilities: Develop and execute a fish nutrition research program to advance understanding of the nutritional requirements of specific life stages of marine finfish under culture with the goal improving stock health and survivorship.

Qualifications: Ph.D. granted within the past 5 years in a relevant field. Will also consider a DVM with demonstrated interest and experience in aquatic animal nutrition research.

Closing date: 1 June 2008.

Contact: mdrawbridge@hswri.org.

M.S. Graduate Research Assistantship, Fisheries and Illinois Aquaculture Center, Carbondale.

Responsibilities: Conduct research on otolith and fin ray microchemistry as indicators of fish environmental history.

Qualifications: B.S. in fisheries or a closely related field. Must meet admission requirements for the graduate school and Department of Zoology at SIUC (see http://www.science.siu.edu/zoology/programs-graduate.html).

Salary: $16,250/year plus full tuition waiver.

Closing date: 3 June 2008 or until filled.

Contact: Submit letter of interest, resume, contact information for three references, copies of transcripts and GRE scores to Greg Whitledge, Southern Illinois University, Fisheries and Illinois Aquaculture Center, Carbondale, Illinois 62901-6511; 618/453-6089; gwhit@siu.edu. See http://fisheries.siu.edu/.

Aquaculture Researcher II, Fisheries and Illinois Aquaculture Center, Carbondale.

Responsibilities: Assist with ongoing research projects in an aquaculture nutrition/physiology program, including general maintenance of aquaculture facilities and equipment, overseeing research trials, and involvement in data collection and dataset management. Other duties assigned as necessary to facilitate aquaculture-related research. Twelve-month term position with opportunity for renewal.

Qualifications: M.S. or B.S. equivalent experience in aquaculture or related discipline. Experience in aquatic animal husbandry and research project management desired, and ability to acquire and master new skills in a laboratory setting. Must have valid Illinois drivers license or be able to readily obtain one, be able to lift 50 lbs. safely, and be available to occasionally work after hours, weekends and/or holidays as project demands dictate.

Salary: Commensurate with experience.

Closing date: 30 June 2008 or until filled.

Contact: Submit letter of application, transcript and resume to Jesse Trushenski, Fisheries Illinois Aquaculture Center, Mailcode 6511, Southern Illinois University, Carbondale, Illinois 62901-6511; 618/536-7761.

Postdoctoral Position—Applied Conservation Science, Department of Biology, Tennessee Technical University.

Responsibilities: Plan and facilitate science advisory meetings (45%), make specialized presentations and provide other support as needed to develop Habitat Conservation Plans (15%). Conduct research pertinent to the HCPs and co-author two HCPs (40%).
Qualifications: Ph.D. in ecology, wildlife sciences, conservation biology or related field. Early-career scientist to develop applied conservation science skills.
Salary: $38,000 with full benefits and supplies/travel funds, renewable annually for 2–3 years based on performance and funding.
Closing date: 30 June 2008.
Contact: Hayden Mattingly, Department of Biology, Box 5063, Cookeville, Tennessee 38505; HMattingly@tntech.edu, 931/372-6410.

Field Research Assistant, University of Western Ontario, SE British Columbia.
Responsibilities: Travel to and from London, Ontario. Assist a graduate student with field research on the reproductive timing and behaviour of kokanee salmon.
Qualifications: B.S. in fisheries or wildlife experience. Perform field work in a remote location. Strong work ethic, attention to detail, ablility to live in close quarters with others.
Salary: $1,600–2,000 CND per month depending on experience. Work from 15 August–5 October 2008.
Closing date: 1 July 2008.
Contact: E-mail cover letter, contact information for 2 references, CV, and unofficial transcripts to Yolanda Morbey, ymorbey@uwo.ca. Early applications will be appreciated.

M.S. Research Assistantship in Stream Ecology, Department of Natural Resources and Environmental Sciences, University of Illinois.
Responsibilities: Evaluate the spatial variability of stream mussel assemblages.
Qualifications: Interests in stream ecology, be highly motivated self-organized, and able to work independently. Experience in mussel identifications and biostatistics will be assets. Minimum academic qualifications include a B.S. in ecology, zoology, or closely related field, 1100 on the GREs combined verbal and quantitative, and a 3.0 GPA. Additional graduate program information can be found at: www.nres.uiuc.edu.
Salary: $1,500 per month for 11-month plus tuition waiver and benefit.
Closing date: 30 July 2008.
Contact: Send a cover letter, resume, copies of transcripts, GRE scores, and the contact information of three references to Yong Cao, Illinois Natural History Survey 217 244-6847, yongcao@ uiuc.edu.

Data Analyst, Normandeau Associates, Inc., New Hampshire.
Responsibilities: Work closely with project scientists to analyze data and prepare tables and charts.
Qualifications: M.S. in applied statistics, biostatistics, or closely related field. Minimum of 3 years experience, including environmental data analysis and SAS programming. Knowledge of GIS, MATLAB, and R programming language a plus.
Salary: Depends on experience.
Closing date: 31 August 2008.
Contact: Send cover letter and resume to: Normandeau Associates, Inc., Attn: Robyn Chadwick, 25 Nashua Road, Bedford, New Hampshire 03110; rchadwick@normandeau.com; fax 603/471-0874

JIMAR PIFSC Fishery Scientist: ID#28115—RCUH Non-Civil Service, School of Ocean and Earth Science and Technology, Joint Institute for Marine and Atmospheric Research, National Marine Fisheries Service, Pacific Islands Fisheries Science Center, Honolulu, Hawaii.
Responsibilities: Analyze fishery statistics, data collected from biological and oceanographic surveys, and other information. Construct mathematical and statistical models, including computer simulation models of fish populations and fisheries to study dynamics and effects of natural and anthropogenic factors on fishery yields and other characteristics. Assist in establishing overfishing guidelines and reference points for determination of stock status is in compliance. Evaluate alternative fishery management strategies and policies with respect to their

yield characteristics and impact on fish stocks. Issue scientific reports and advisories to National Marine Fisheries Service managers and constituents. Publish research findings and present results at scientific conferences and public meetings.

Qualifications: M.S. in biology, zoology, oceanography, fisheries, or related field. 1–3 years experience in fisheries stock assessment research, population monitoring, and population modeling. Broad knowledge of fish population dynamics and stock assessment theory and methods. Working knowledge and experience in application of statistical methods to problems in fisheries, ecology, and wildlife science. Ability and experience in the development and application of computer simulation models. Ability to communicate effectively with scientists, managers, and the public. Must meet security requirements for working in a U.S. federal facility. Must be able to withstand uncomfortable living conditions at sea for up to 30 days at a time. Continuation of employment is dependent upon program and operational needs, satisfactory work performance, and availability of funds.

Salary: $3,620 per month, minimum.

Closing date: 31 July 2008.

Contact: Apply at www.rcuh.com For more information contact Nicole Wakazuru 808/956-9465.

North Pacific Groundfish Observer, Alaskan Observers, Inc., Seattle, Washington.

Responsibilities: Gather management data for the government. Live and work aboard U.S.-flagged commercial fishing vessels operating in the Bering Sea and North Pacific Oceans. Training in Anchorage, Alaska. Make 2 deployments of approximately 2 1/2 to 3 months each within 7 months of completion of training.
Qualifications: B.S. in fisheries biology, marine biology, general biology, zoology, or a related natural science.
Salary: $3,900–6,006 per month, depending on experience, plus room, board, and travel to and from job site. Subsequent deployment opportunities and salary advances available.
Closing date: 17 September 2008. Positions available year-round. Currently recruiting for trainings that will begin 2 May and 5 June 2008.
Contact: David Edick, Alaskan Observers, Inc., 130 Nickerson, Suite 206, Seattle, Washington 98109; 800/483-7310; aoistaff@alaskanobservers.com; www.alaskanobservers.com.

Natural Resources Biologist I, Maryland Department of Natural Resources, Fisheries Service, Annapolis.
Responsibilities: Provides technical and administrative support to Maryland's striped bass harvest monitoring program. Assist the current biologist in net inspections and certifications, tag distribution, and data management. Assist with the distribution and collection of harvest permit cards and declarations of intent.
Qualifications: B.S. from an accredited college or university in biology, natural science, natural resources management, botany, marine biology, fisheries management, zoology, or a natural resources management related field of study. Preference to candidates with up to one year experience working with Microsoft Access.
Salary: $31,461–40,441, contractual, no benefits.
Closing date: 26 October 2008.
Contact: www.dnr.state.md.us/hr/jobs.asp.

Fisheries Biologist I, Arkansas Game and Fish Commission, Fisheries Division, Mammoth Spring.
Responsibilities: Assist with all duties associated with a coldwater intensive culture trout hatchery including: spawning fish, monitoring development of eggs and fry, developing and implementing feeding schedules, administering chemical treatments for disease, monitoring water quality, maintaining hatchery production records, collecting and entering data and preparing reports on hatchery operations, assisting in the supervision of the hatchery staff, training workers in fish husbandry techniques, and assisting other personnel as needed with sampling and habitat improvement work.
Qualifications: B.S. in biology, zoology, botany, or a related field, or equivalent.
Salary: Grade 18, $26,415 per year. Salary above $26,415 requires exceptional qualifications as determined by the Office of Personnel Management.
Closing date: 26 October 2007.
Contact: See www.agfc.com/employment/. For additional information contact Melissa Jones, 877/625-7521.

Marine Stewardship Council Chain of Custody Auditor, MRAG Americas.
Responsibilities: Perform Chain of Custody Certifications on an as-needed, contractual basis and write audit reports for seafood processors, distributors, retailers, and restaurants against the MSC Standard. Travel required. Located throughout North America, with emphasis on the U.S., particularly the West Coast, and Canada.
Qualifications: B.S. or higher. QMS, ISO, HACCP, or similar experience. Fisheries experience preferred. MRAG will provide auditor training on the MSC Standard.
Salary: Paid an agreed upon daily rate consistent with qualifications and the location of the work. 10–20 days of work per year per auditor.
Closing date: 28 October 2008.
Contact: E-mail CV and cover letter to Jennie Harrington, jennie.harrington@mragamericas.com, www.mragamericas.com.

Flying Fish Make for Happier Fish

Project Location:
Wanapum Dam
Grant County, WA U.S.A.

Each year **progressive thinking** and **advanced technology** continue to help **Grant County PUD** evaluate fish behavior and improve dam operations.


Fish Transport Containers

Photos: Mark Timko


Wanapum Dam, Columbia River, WA

At Wanapum Dam (located on the Columbia River a few miles south of the I-90 Bridge at Vantage) the area is humming with activity. This spring, Grant County Public Utility District (PUD) contracted with HTI to track downstream migrating juvenile salmonids with acoustic tag 3D telemetry. The primary objectives are similar to past studies (e.g. estimation of fish survival, bypass effectiveness, and fine-scale 3D behavior). And this year, they will continue with an effective fish transport system that began a couple seasons ago - the technique of transporting fish by helicopter.

Each morning at 9:00 AM a helicopter transports and releases test and control juvenile steelhead at strategic points along the river. In fact, they expect that 120 helicopter flights will place approximately 2,400 acoustic tagged steelhead in the river on a nearly daily basis throughout May and June of this year. An additional 1,000 yearling Chinook were release for behavior studies. The process involves coordination between the helicopter pilot and ground crews as they work to place juvenile steelhead and Chinook in the Columbia River at several locations along the 90 km (56 mile) stretch between the tailraces of Rock Island and Priest Rapids dams.

But how does transporting fish by helicopter make for happier fish? The time it takes transporting fish prior to release is minimized and the ride for the fish is very smooth (vs. traveling via truck or boat), the fish are healthier when they are re-leased in the river. Also, helicopter transport makes it possible for HTI to use only one tagging and holding area, which saves time, money, and significantly minimizes the handling of fish.

Each year progressive thinking and advanced technology continue to help Grant County PUD evaluate fish behavior and improve dam operations. HTI is proud to assist the PUD with their research efforts. For more about the *Model 795 Acoustic Tags* or the techniques applied for this study, contact us at 206-633-3383 or learn more at HTIsonar.com.

715 NE Northlake Way   Seattle, WA 98105 USA   206.633.3383   support@HTIsonar.com   HTIsonar.com