The Role of Fish Biologists in Helping Society Build Ecological Sustainability

Evaluating Localized vs. Large-scale Management: The Example of Tautog in Virginia
A Responsible Approach

A half century ago, efforts to supplement marine fish stocks in the United States were abandoned for lack of evidence of their success. Since then, worldwide declines in coastal fisheries have sparked a resurgence in hatchery-based marine stock enhancement. New aquaculture and tagging technologies, along with demands for accountability in fisheries management, have resulted in a quantitative approach to marine stock enhancement.

For example, Dr. Ken Leber at Mote Marine Laboratory (www.mote.org) in Florida conducts research that addresses critical uncertainties about stock enhancement of important coastal commercial and recreational species. In a recent publication, Dr. Leber used Coded Wire Tags to estimate the postrelease mortality of striped mullet *Mugil cephalus* released at different sizes. He found that size-dependent postrelease mortality had a significant impact on the cost-effectiveness of stocking strategies. Dr. Leber has also used Coded Wire Tags in his research evaluating the effectiveness of stocking snook, Pacific threadfin, and red snapper.

This research, and many other programs examining marine stock enhancement around the world rely on Coded Wire Tags to identify and track hatchery reared fish and crustaceans after release. Please contact us if we can help with your program.

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The Role of Fish Biologists in Helping Society Build Ecological Sustainability

Unsustainable use of ecosystems causes pervasive loss of aquatic biodiversity and ecosystem services. Fish biologists can help build ecological sustainability by investing more in conservation education.

Paul Angermeier

Evaluating Localized vs. Large-scale Management: The Example of Tautog in Virginia

Simple models used for localized assessments can have advantages over sophisticated models applied to an entire stock complex when multiple stocks exist.

Troy Tuckey, Noëlle Yochum, John Hoenig, Jon Lucy, and Joseph Cimino

A Perspective on the Decision to Establish an AFS Marine Journal

Constitutional protocol was not followed in making the decision to create another AFS journal.

Dennis R. DeVries, Gary G. Grossman, David H. Wahl, Jennifer A. Stone, Fred M. Utter, Cecil A. Jennings, and Deirdre M. Kimball

Sharing the Table and the Source

The formation of the Mexico Chapter illustrates the increasingly international focus of AFS.

Jennifer L. Nielsen

Developing the New Marine and Coastal Fisheries Journal

Despite some early miscommunications, the new marine and coastal fisheries journal should be a major step forward for the Society.

Gus Rassam

Effective conservation education involves not only the presentation of objective facts, but also the inculcation of a land/water ethic that is largely absent in modern culture.

CREDIT: Michelle Adcock

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 2007 are $76 in North America ($88 elsewhere) for regular members; $38 in North America ($44 elsewhere) for student and retired members. Fees include $19 for Fisheries subscription. Nonmember and library subscription rates are $112 ($134). 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 ©copyright 2007. 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. Republication or systematic or multiple reproduction of material in this publication is permitted only under consent or license from the American Fisheries Society. Postmaster: Send address changes to Fisheries, American Fisheries Society, 5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814-2199.
One activity that has changed significantly over the last four years during my tenure as an officer of AFS is our international involvement. We have established a new, affordable dues structure for international members outside Canada and the United States. We sponsored the 4th World Fisheries Congress in Vancouver, British Columbia, and are actively participating in the October 2008 5th World Congress in Yokohama, Japan. Starting this month, all Fisheries abstracts will be published in Spanish as well as English. AFS has joined and plays a leading role in the new World Council of Fisheries Societies, along with a dozen other international fisheries organizations from around the world. The Japanese Society of Fisheries Science (JSFB) and the Fisheries Society of the British Isles both have active exchange programs with AFS. JSFB is holding a joint symposium at our 2007 Annual Meeting in San Francisco on “Conservation and Bioremediation of Coastal Ecosystems and Restoration of Fisheries Resources.” AFS is collaborating with the Australian Society for Fish Biology and the New Zealand Marine Sciences Society to produce the “International Symposium of Tagging and Marking Technologies for Fisheries Management and Research” in Auckland, New Zealand, 24–28 February 2008.

One successful international AFS activity was the development of the Mexico Chapter of the American Fisheries Society. This new unit has spread the AFS banner across the southern U.S. border to add to our ranks as fisheries professionals a truly North American fisheries focus. As an introduction to activities sponsored by AFS in Mexico, I am dedicating this President’s Hook to an overview of that country and their fisheries organizations.

Mexico has some 11,500 km of Pacific, Gulf of Mexico, and Caribbean coastline, and its inland waters cover more than 2.9 million hectares (U.S. Library of Congress). During the past decade, fishery science in Mexico has been confronted by regional imperatives to achieve rational and integrated exploitation of present and potential marine resources within the framework of responsible and sustainable fisheries. The entire country of Mexico is within the geographic boundaries of the Western Division of the American Fisheries Society but, until recently, there had been relatively minor AFS activity in Mexico. Over the years, several strategic meetings have indicated a strong interest by Mexican fisheries professionals in increasing their opportunities by participating within and through collaboration with AFS.

Our goal was to create a unique partnership where those interested in Mexican fisheries can come together to exchange ideas and approaches to fisheries research and management, discuss current conditions of Mexican freshwater and marine resources, and collaborate on future action plans. Through AFS, fisheries professionals have been able to bridge political, cultural, scientific, and social gaps to make fisheries science and management more effective for the benefit of all stakeholders.

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Investigating downstream passage of adult, silver-phase American eels

Over the last two decades, scientists have found the abundance of American eel (Anguilla rostrata) in the northwest Atlantic to be in serious decline, so much so that the eels are presently under consideration for listing under the Endangered Species Act. A multitude of factors appear to contribute to the decline, but to what degree?

Until recently, information about eel behavior passing downstream through dams has been limited. In 2002 and 2003 Leah Brown, then a masters student at the University of Massachusetts, used acoustic telemetry to investigate their behavior along the Connecticut River, at one of the numerous north-eastern hydroelectric facilities.

Fifty eels were surgically implanted with HTI's Model 796 Acoustic Tags, and their movement was monitored in 3D in the forebay (the first 100 m of area located directly upstream of the dam). The study helped shed light on how the eels chose to pass the dam. The acoustic tags were remotely tracked using HTI's Model 290 Acoustic Tag Receiver with eight hydrophones. Each eel's 3D location was calculated every 3 seconds, and resulting tag positions were plotted in 3D, revealing the fine scale movement of each tracked eel. From those data, Leah and her client found that the eels occupied a variety of depths throughout the forebay, but most of their time was spent near the bottom. However, immediately upstream of the trash racks (first 5 m upstream of the dam), the eels occupied the middle and upper water column more frequently and displayed an increase in turning movement (the average 3D turning angle increased from 56° to 98°).

The increase in surface orientation and elevated turning angle was the result of the eel's vertical and horizontal searching behavior in this area. Additional behavioral trends were observed. Most frequent upstream movements after eels encountered the trash racks, vertical and horizontal changes in position at or near the trash racks, and circular movements that often covered the entire forebay as well as small areas directly upstream of the trash racks. Eels appeared to be volitionally choosing the turbines as their preferred downstream passage route based on the turbines' dominant flow.

According to Dr. Alex Haro, Ms. Brown's major professor at the University of Massachusetts, “This study enabled us to obtain detailed, previously unknown behavioral responses of eels to forebay conditions.”

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FISHERIES NEWS

Update on Reregistration and Use of Piscicides Rotenone and Antimycin

ROTenone Reregistration

In April 2006, U.S. Environmental Protection Agency (EPA) indicated that the reregistration of rotenone would be completed in May 2006. The AFS Fish Management Chemicals Subcommittee (FMCS) has been working with the registrants (called the Rotenone Task Force) and EPA in addressing the data needs. Due to changing priorities with other pesticides, the reregistration of rotenone has been delayed. EPA completed its tolerance in September 2006 following agreement by all registrants that terrestrial (i.e., garden and agricultural) uses would be canceled. EPA will have additional technical conversations with the registrants and FMCS shortly on mitigation measures necessary to protect applicators, and these will factor in the development of the draft Registration Eligibility Decision (RED). EPA hopes to have a draft RED in the next two to three months, but it could be up to six months depending on priorities. The risks of concern center on applicator safety, primarily associated with the powdered formulations. The liquid formulations of rotenone are not affected. The registrants and FMCS have indicated that the required safety gear worn by fisheries professionals and recent advancements in powder application technology mitigate these concerns.

FMCS also worked with EPA in gaining federal registration of an alternative rotenone liquid formulation, CFT Legumine®. CFT Legumine® does not use the conventional petroleum hydrocarbon solvent system, is believed to be more environmentally friendly, and is in use throughout Europe. CFT Legumine® is available through Prentiss Incorporated. A review of the toxicity data for this formulation indicates that the respirator requirement will likely be dropped for handling the concentrated liquid.

Antimycin Reregistration

EPA officials have indicated that the schedule for reregistration of antimycin is sometime in 2007. There are a number of remaining data gaps, and EPA is ready to publish the public health and environmental risk assessments within the next month. The assessments will speak to the uncertainties in the data. A Standard Operations Procedure (SOP) manual that will be a condition of reregistration is in progress and should be available within the next few months. The SOP manual is based on the one developed for lampricide applications in the Great Lakes and the stream and lake monographs developed by FMCS. The U.S. National Park Service is working on its own manual that may be appended to the registrant’s SOP manual. EPA understands that the commercial catfish use in aquaculture will likely be included in the same document for lake and stream use. The existing data may be adequate for reregistration under a limited use scenario defined as a lack of human exposure in dietary drinking water or recreational activities and the lack of hazard to the environment. Because most use by public agencies occurs in remote areas where there is little potential human contact with antimycin, public agency use may fall within the definition for a lack of human exposure. EPA waived a number of environmental and other data requirements based on this limited use (see Fisheries 27[6]:10-18).

Training on Piscicides Offered

AFS, in conjunction with Utah State University at Logan, is offering a weeklong training course for planning and executing successful fish sampling/control/eradication projects using the fish management chemicals rotenone and antimycin. The course instructors have trained 60 biologists to date. The course is scheduled for 21–25 May 2007 in Logan, Utah. For more information contact Brian Finlayson (bfinlays@ospr.dfg.ca.gov) or Don Skaar (dskaar@mt.gov). Applications are available through Joseph Melvin (jmelvin@fisheries.org) at AFS (301/897-8616 x 207).

need for NPDES permits

On 20 November 2006, the EPA administrator signed a final rule on the lack of applicability of National Pollutant Discharge Elimination System (NPDES) permits for application of aquatic pesticides, including rotenone and antimycin. The rule revokes NPDES permit regulations and adds a paragraph to the list of discharges listed in 40 CFR 122.3. Specifically, application of pesticides to waters of the United States to control pests consistent with all relevant requirements under Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) are excluded from NPDES permit requirements. The EPA has concluded that pesticides like rotenone and antimycin applied under these circumstances are not pollutants and therefore are not subject to NPDES permitting requirements.

Piscicide Application in National Forests

Piscicides are integral to successful restoration of 13 species and subspecies of native trout populations on U.S. Forest Service (USFS) lands. However, piscicide use by state and federal agencies in national forests has become encumbered by redundant processes, uneven and irregular application of policies and regulations, and overlapping authorities. Central to the issue is whether piscicide applications by states require a permit from USFS; those that require a permit usually invoke a redundant, federal

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Congress approves Magnuson-Stevens reauthorization

Congress approved the reauthorization of the Magnuson-Stevens Sustainable Fisheries Act on 9 December 2006. The act, under development since early 2005, took until now to bring together all the different interests to reach a final bill. The act makes a number of significant changes to the fisheries management system in the United States.

The bill places limits on the creation of no-fishing zones, requiring that they be based on sound science and that a review process be set to determine when and if they are no longer needed. The bill also requires the federal fishery management councils to recognize the economic contributions of sport fishing when setting allocations. Important conservation measures include: a time frame to end overfishing, new requirements for reducing bycatch, and provisions for buyouts of overcapitalized commercial fleets. The bill also contains extensive provisions on individual fishing quotas for commercial fleets and strengthened enforcement to fight illegal international fishing.

This bill reauthorizes the Magnuson-Stevens Act (MSA) through 2013. The law retains the conservation improvements enacted by the 1996 Sustainable Fisheries Act, and makes some modest improvements to existing law. The bill excludes some provisions, however, that would have significantly advanced ocean fisheries management.

Key Improvements to Existing Law

- **Science and Statistical Committees (SSCs):** The bill requires SSCs to provide regional fishery management councils with scientific recommendations for fishing levels. SSC members are also required to disclose financial conflicts of interest.
- **Catch limits:** The bill requires the regional councils to develop annual catch limits for all fisheries that are based on scientific recommendations and at a level that prevents overfishing.
- **Overfishing:** Within two years of a stock being declared overfished, councils are required to development and implement a rebuilding plan that ends overfishing immediately.
- **Limited Access Privilege Programs:** The bill enacts new standards that include periodic reviews of the programs and a term limit of 10 years on quota shares.
- **Fisheries Conservation and Management Trust Fund:** The bill establishes a trust fund for, among other things, improving fishery data, broadening observer coverage on vessels to monitor for wasteful fishing practices, and providing financial assistance to fishermen to help them comply with the MSA.
- **Cooperative Research:** The bill requires the Secretary of Commerce to establish a nationwide, regionally-based cooperative research and monitoring program.

The 109th Congress reauthorized the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as one of its final actions. The MSA was originally passed in 1976 to establish the 200-mile Exclusive Economic Zone (EEZ) off the United States coast line. The MSA was publicly supported then as a means of preventing large foreign fishing vessels from pillaging U.S. fish stocks and to ensure mineral rights along the Continental Shelf. Over time, the MSA took on an increasing role in managing federal fisheries.

The MSA should be reauthorized every 5 years, but it happens on average every 10 years. The most recent reauthorization was the Sustainable Fisheries Act of 1996 which prohibited overfishing in United States fisheries. Another important addition with the reauthorization is the introduction of a national fishery trust. A fishery trust was originally proposed by the Pew Oceans Commission and the U.S. Commission on Ocean Policy. The trust would fund necessary fishery research, stock assessments, enforcement, management, and development of more selective and environmentally-friendly types of fishing gear.

While the reauthorization of MSA is welcomed as a step forward in fisheries management and conservation, a large portion of the bill was cut at the final stages. The bill does not include language pertaining to national health care for fishermen.
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ABSTRACT: Biodiversity and ecosystem functions are discounted in most environmental decisions and market transactions. The ongoing pervasive losses of aquatic biodiversity reflect unsustainable uses of the biosphere but society is profoundly ignorant and apathetic regarding this degradation. Conserving aquatic biodiversity will require fundamental changes in the human economy, which fish biologists can help catalyze by re-configuring their role in conservation. Biologists concerned about biodiversity loss could become more engaged in assessing sustainability, in understanding relations among biodiversity, ecosystem function, and sustainability, and in promoting sustainable uses of ecosystems. Fish biologists can most effectively help build ecological sustainability by educating policymakers and publics about how biodiversity loss diminishes the quality of human lives. Via education, fish biologists should seek to influence people's values and ecological behavior, especially consumption patterns. The societal literacy needed for sustainability includes understanding how humans affect biota, dispelling the misconception that quality-of-life depends on consumption, and recognizing how intact ecosystems contribute to aesthetic, emotional, intellectual, physical, social, and spiritual dimensions of human lives. I advocate a more proactive, interdisciplinary commitment to conservation that elevates conservation education to equal importance with scientific research in the collective activities of fish biologists. These shifts will be difficult and require serious dialogue to reach consensus regarding fish biologists' role in building ecological sustainability.

La Función Social del Biólogo Pesquero en el Uso Ecológico Sostenible de los Recursos Acuáticos

ABSTRACTO: La biodiversidad y las funciones de los ecosistemas son ignoradas en la mayoría de las decisiones de economía y mercadeo relacionadas con el ambiente. Las pérdidas persistentes de biodiversidad acuática reflejan la falta de utilización sostenible de la biosfera y la ignorancia y apatía de la sociedad en relación a esta degradación. La conservación de la biodiversidad acuática require cambios fundamentales de la economía y la participación de los biólogos pesqueros como agentes catalizadores en la conservación de estos recursos. Los biólogos preocupados con la conservación de la biodiversidad y alarmados por la pérdida acelerada de especies, se sentirán comprometidos durante el proceso de evaluación del uso sostenible de estos recursos especialmente, con el estudio de las relaciones entre la biodiversidad y su función en los ecosistemas. Estos elementos facilitarán la promoción del uso sostenible de estos recursos. Los biólogos pesqueros tienen la capacidad de fortalecer el uso sostenible de los recursos acuáticos; mediante la educación de legisladores y administradores de recursos naturales y del público en general acerca de cómo las pérdidas de biodiversidad disminuyen la calidad de vida de los seres humanos. A través de la educación del público los biólogos pesqueros podrían influenciar los valores de las personas en relación a patrones de consumo y su actitud de conservación ecológica. La educación social necesaria para el uso sostenible de los recursos acuáticos incluye el conocimiento del impacto que los seres humanos ejercen en la biota especialmente la idea de que la calidad de vida depende de los hábitos de consumo. Adicionalmente debemos reconocer que los ecosistemas vírgenes contribuyen en la vida de los humanos en aspectos físicos, espirituales, intelectuales y estéticos. La educación de conservación se eleva al mismo nivel de importancia que la investigación científica en las actividades desempeñadas por los biólogos pequeños. Esta serie de cambios serán difíciles de implementar y requerirán un diálogo profundo de todas las partes interesadas para alcanzar un acuerdo en el nuevo rol que los biólogos pequeños desempeñan en el uso ecológico sostenible de los recursos acuáticos.
INTRODUCTION

Sustainability is a timely topic for fish biologists (e.g., the 2005 Economic Growth Forum in Fisheries), ecologists (e.g., the February 2005 issue of Frontiers in Ecology and the Environment), and informed citizens (e.g., the September 2005 issue of Scientific American). Sustainability is also devilishly complex in terms of what it is, how society might pursue it, and which environmental conditions would prevail if we actually achieved it. Consequently, sustainability is like the weather in that there are many (sometimes contradictory) discussions but few effective actions, at least among scientists. Herein, I suggest what fish biologists should do to be most influential in society’s attempt to construct sustainability.

Sustainability discourse has three broad, interactive dimensions: ecological, economic, and social (Goodland 1995). Ecological sustainability, the dimension most familiar to fish biologists, addresses the maintenance of biodiversity and ecosystem functions in the face of a humanized biosphere (e.g., Chapin et al. 2000; Rosenzweig 2003). Economic sustainability focuses on maintaining the flow of wealth and desired goods and services to society, as controlled by households, markets, and governments (e.g., Hahn 2000; Daly and Farley 2004). Social sustainability is concerned with promoting human well-being and justice in the expanding human enterprise (Dobson 1998; Dasgupta 2001).

Adding to the complexity of sustainability issues is the fact that the currencies used to assess status and trends differ markedly among the three thematic dimensions. Ecological, economic, and social sustainability are typically assessed on the basis of so-called natural, manufactured, and human capital, respectively, where a policy or practice is sustainable if it does not deplete capital. A devil in this detail is that because the three forms of capital are somewhat interchangeable, everyone sees the balances differently. Those of us in modern capitalistic societies readily comprehend the monetary worth of manufactured capital (e.g., boats on a lake) but are less familiar with valuing natural capital (e.g., lake biota) and human capital (e.g., sense of community among lake users). Moreover, there probably are minimum thresholds of natural capital—for example, those needed to support life—below which other forms of capital collapse. Most of us lack explicit formulae for conversions between forms of capital, but it is precisely such formulae that are the basis for environmental decisions at personal, community, and national scales and for distinguishing sustainable from unsustainable practices. Although all three dimensions are interwoven in proposals for achieving sustainability, the relative values assigned

Aquatic biologists from Virginia’s natural resource agencies and Virginia Tech educate local stakeholders about the biota and value of a river ecosystem.
to the attendant forms of capital vary greatly among individuals. Much of the debate on sustainability issues stems from deep-seated disagreement on proper exchange rates among competing currencies (e.g., loss of a particular biotic community may be viewed by some as an unacceptable trade for a given gain in technological infrastructure). Fish biologists seem unlikely to develop a unifying currency for sustainability quandaries, but I believe we can influence how people negotiate their exchange rates among natural, manufactured, and human capitals and help people realize that natural capital is a prerequisite to other forms of capital.

I do not speak for all fish biologists but I assume their collective concern related to the sustainable management of ecosystems is founded more on the erosion of natural capital than on the erosion of manufactured or human capital. I suspect that most fish biologists see human economies as operating within ecosystems rather than vice versa. In striking contrast, the prevailing view of conventional or “neoclassical” economics is that nature is just another economic sector, like agriculture or industry (Daly and Townsend 1993). Further, I think our willingness to trade additional loss of natural capital for gains in manufactured or human capital is typically a decreasing function of how much natural capital remains. Moreover, we probably weight natural capital more, compared to other forms of capital, than society at large. If so, our perceived threshold for when erosion of natural capital becomes unsustainable (i.e., further trades are unacceptable) is higher than for most people. Thus, our vision for the future probably includes more intact biota and functional ecosystems than that shared by society at large. Many sociologists and biologists are concerned about the current global and regional depletion of natural capital (Jansson et al. 1994; Arrow et al. 2004; Daly 2005). The extent to which fish biologists recognize differences in perceived thresholds of sustainability, and the consequences for natural capital, as real and important largely determines how we define our professional role in building sustainability.

My purpose in this essay is to contribute to the dialogue among fish biologists regarding ecological sustainability. Herein, I use “fish biologist” to encompass any biologist involved in the study of fishes or the management of aquatic biota or ecosystems. Our dialogue should address questions such as “Is current use of aquatic ecosystems sustainable?”, “How important is biodiversity as an indicator of ecological sustainability?”, “Which factors govern sustainable use of aquatic ecosystems?”, and “What should fish biologists do to enhance sustainable use of aquatic ecosystems?” Addressing the last question requires us to articulate our collective vision of the future of aquatic biodiversity and fishery resources, which presumably guides our professional actions. My own position is that current uses of aquatic ecosystems are mostly unsustainable and that achieving an ecological sustainability that conserves aquatic biodiversity will require fundamental change in how the increasingly dominant human economy interacts with the economy of the biosphere. I want to see fish biologists and others move beyond spirited debate about sustainability and effect real change in how society writ large uses aquatic ecosystems. Further, I expect such change to be immensely challenging, given the complexities of socioeconomic policy-making.

Use of ecosystems is regulated primarily by governments and economic markets. Because biologists have relatively little political clout, we must interface with these social institutions to change sustainability policy. Furthermore, prevailing discourses on environmental management use a highly anthropocentric calculus to assess progress (Dryzek 2005). Biodiversity conservation and ecological sustainability are relevant to these discourses only to the extent that they contribute measurably to human quality of life – contributions that are largely overlooked in prevailing socioeconomic policy. Thus, one of fish biologists’ most important and challenging roles is to ensure that non-biologists at the environmental policy table, including economists, planners, and elected officials, care enough about aquatic biota and ecosystems to give conservation a significant voice. In part, this means educating policymakers about the primacy of natural capital and the trade-offs occurring between natural and other forms of capital.

These challenges are surmountable if we approach them collaboratively and strategically. Below, I advocate a particular strategy for building ecological sustainability, one that focuses on an appropriate, effective role for fish biologists. First, I point out key relations among the human enterprise, fish conservation, human quality of life, and ecological sustainability. Then, I discuss the professional role, especially as educators, that fish biologists play in changing society’s ecological behavior, thereby enhancing conservation effectiveness.

**FACING FACTS**

There is much we do not (and will never) understand about processes controlling the distribution and abundance of aquatic biota and how human actions figure into the mix. However, several undesirable aspects of the relation between humans and aquatic biota are well documented that they are practically indisputable. Below, I describe three of these harsh realities, which provide impetus for fish biologists to re-examine their role as conservationists.

**Harsh reality 1: Aquatic biota are in rapid decline worldwide.** The ledger for aquatic natural capital shows dismaying declines in the viability of biota and the functionality of ecosystems. For example, in North American freshwaters about 25% of the fishes, 33% of the crayfishes, and 50% of the mussels are threatened or endangered, including some taxa that were once widespread and abundant (Williams et al. 1989; Williams et al. 1993; Warren and Burr 1994; Taylor et al. 1996; Stein and Flack 1997). Worse still, <10% of the taxa under federal “protection” because of their tenuous status are recovering, and losers outnumber gainers nearly fourfold (USFWS 1994). Notably, some taxa (e.g., Pacific salmon) fail to recover despite large conservation investments (Lackey 2005). The oceans, thought by many to be too vast to suffer human impacts, are also ecologically stressed. Anthropogenic disturbances have dramatically altered the biological and physical structure of large areas, such as Georges Bank (Fogarty and Murawski 1998). Many (25-30%) major fish stocks are overfished or being harvested unsustainably (FAO 2000; Pew Oceans Commission 2003). This group includes 74% of the U.S. Caribbean reef stocks (U.S. Coral Reef Task Force 2002). Non-native species are widely established in...
(Fuller et al. 1999) and expanding their ranges in estuaries and freshwaters at the expense of native biota. Each summer, nutrient pollution kills an area the size of Massachusetts in the Gulf of Mexico. Although mechanisms of biotic decline and recovery are often cryptic, the net outcome of widespread decline is crystal clear.

**Harsh reality 2:** Humans are responsible for current declines in aquatic biota. A crucial point here is that ongoing declines in aquatic biota are not natural fluctuations, but reflect human economic activities in or near aquatic ecosystems (Richter et al. 1997; Czech et al. 2000; Sala et al. 2000). Worldwide, species extinction rates are now 100–1,000 times greater than during pre-human periods (Pimm et al. 1995; Riccardi and Rasmussen 1999). The trend for fish endangerment in the United States is tightly correlated with the trend for the gross domestic product, not coincidentally but because the economic activities encompassed by the gross domestic product imperil fishes (Reed and Czech 2005). Some studies suggest that the global human economy, including fishing, may have overshot its long-term ecological carrying capacity decades ago (Wackernagel et al. 2002). Human actions dominate many production pathways and hydrological processes. For example, most N-fixing is now induced by humans, most historical wetlands have been destroyed, most accessible freshwater is impounded or diverted, and most shallow-water coral reefs are severely degraded (Postel et al. 1996; Vitousek et al. 1997). More than 90% of the water in U.S. rivers is strongly affected by dams, diversions, or irrigation (Jackson et al. 2001), which adversely affect aquatic biota in myriad ways.

**Harsh reality 3:** Our current management of ecosystems is failing to protect aquatic biodiversity. The observed anthropogenic impacts on aquatic biota would not be so worrisome if they were new or if policies were not yet in place to reverse them. But in the United States for example, national and state policies enabled by laws such as the Clean Water Act of 1972, the Endangered Species Act of 1973 (ESA), and state versions of these have been operating for decades to conserve biological integrity and diversity in aquatic ecosystems. Implementation of these laws has evolved to enhance conservation effectiveness since the latter half of the twentieth century, although progress on that front has slowed recently (e.g., neither federal law has been reauthorized in more than 15 years). Much valuable work has been and is being done, but the billions of dollars spent on aquatic conservation cannot keep pace with the adverse impacts on biota, funded by many more billions of dollars, and I see no evidence that current implementation is improving that trend. In short, conservationists are “walking north on a fast southbound train” of human impacts (Orr 2003). Regardless of the policy causes, the deteriorating status of aquatic biota and ecosystems points to the reality that management regimes are not meeting conservation goals.

The upshot of our reality check is that biotic decline and ineffective conservation will persist into the foreseeable future. As troublesome as the situation seems now, the inertia of expanding human numbers and resource consumption (i.e., economic growth) is certain to make it worse. Although the growth rate of the human population is falling (Cohen 2005), there is no sign that human domination of the biosphere or loss of biodiversity is slowing. In fact, nearly all the serious environmental problems identified at the United Nations Earth Summit in 1992, such as water shortage, land degradation, deforestation, overfishing, biodiversity loss, and chemical pollution, are steadily worsening, in part due to globalization of the economy (Brown 2000). Economic globalization also interferes with conservation by obscuring the global environmental costs of local consumption (Berlik et al. 2002). Tragically, over a billion people still lack safe drinking water and 2.8 billion still lack basic sanitation (Jackson et al. 2001). Developing technology-intensive means to provide these services has priority over biological conservation and could further tax the resilience of ecosystems. As relatively natural ecosystems are transformed into increasingly humanized ecosystems, fewer resources remain to support nonhuman biota (Czech et al. 2000), ensuring further biotic decline. Hope for more conservation-minded policy is further dimmed by a society that is becoming increasingly urban, electronic, and detached from actual ecosystems, and less supportive of strong environmental regulations.

Fortunately, our future reality need not be so harsh because fish biologists can help make conservation more effective. The economic activities that influence aquatic biota reflect behavioral choices, which in turn reflect human value systems. For biologists to foster a more biologically conserving, ecologically sustainable society, we must catalyze fundamental change in modern value systems, or at least in how those values manifest in ecological behavior. Herein, I define “ecological behavior” broadly. In modern urban society, where the vast majority of goods and services consumed are purchased rather than produced personally, one’s ecological impact is largely determined by one’s purchases (i.e., economic behavior). Thus, ecological behavior encompasses not only one’s personal interactions with ecosystems (e.g., commuting habits, lawn management, number of children, outdoor recreation), but also the full suite of ecological consequences of all one’s purchases. Similarly, “consumption” refers not only to personal use of goods (e.g., water, cars), but also to any activities, including purchases, associated with conversion of natural ecosystems (e.g., wetlands, forests) into humanized ecosystems (e.g., housing developments, cattle pastures). One way to effect change in ecological behavior is to realign the way people relate resource consumption, which largely drives economic activity, to human quality of life.

**RESOURCE CONSUMPTION VERSUS QUALITY OF LIFE**

Most people support the continued humanization of the biosphere because they believe it improves their lives. Much of the ecological change we impose, such as extracting potable water, controlling insect-borne diseases, and creating food-producing landscapes, clearly does improve human lives. But in a crowded, finite world where the human economy impinges on the biosphere’s operation, more economic growth yields a shrinking (and sometimes negative) return on our quality of life. In the United States, where consumerism is a cultural centerpiece, we are told since birth that our quality of
life is directly and positively related to resource consumption. This axiom of insatiability—that people are always happier consuming more—is a basic assumption of neoclassical economics (Costanza et al. 2002; Daly 2005), but may be invalid under many circumstances (Figure 1). For example, although people in wealthy nations are more satisfied with their lives than those in poor nations, changes in real per capita income (and its attendant consumption) in wealthy nations typically show no relation to changes in perceived well-being (Easterlin 1995). In fact, psychologists increasingly recognize that pre-occupation with consumption and acquisition of material goods (i.e., personal manufactured capital) seriously undermines one’s feelings of well-being (i.e., personal human capital), including inter-personal relationships and perceptions of self-worth (Kasser 2002). Thus, absolute consumption generally enhances quality of life only to the point where basic needs are met, which occurs at low affluence (Costanza et al. 2002; Daly 2005). Quality of life is limited by non-market factors at moderate and high affluence. The overall quality of life for most citizens of wealthy nations probably would not be diminished measurably by markedly reducing their consumption of goods and services.

The quality of one’s life cannot be assessed precisely and specific contributing factors vary greatly among individuals. Nevertheless, many environmental scientists, including ecologists and economists, are seeking to identify the major determinants of human well-being and how it is linked to ecosystem operation (e.g., Alcamo et al. 2003). Understanding the determinants of quality of life is useful in a conservation context because they provide a much broader basis for valuing biota than do conventional, narrowly-defined measures of economic worth. Some sociologists recognize six major dimensions of quality of life: aesthetic, emotional, intellectual, physical, social, and spiritual (Costanza et al. 2002). Intuitively, it seems likely that physical health and comfort are strongly related to resource consumption, whereas emotional, intellectual, and spiritual needs seem less likely to be met via consumption. In any case, intact ecosystems and biota contribute substantially to each dimension. The roles that aquatic biota play in enhancing the quality of human lives are a crucial nexus for conservation between the natural and social sciences, and warrant more attention from fish biologists interested in promoting ecological sustainability.

If not to enhance quality of life appreciably, why does the United States consume resources so unsustainably? There are many cultural, social, and emotional reasons but an especially relevant reason is that we collectively do not understand the long-term consequences of consumption and economic growth. This poor understanding is rooted in ecological illiteracy and reflected in public attitudes. U.S. residents are profoundly ignorant of how ecosystems and economies operate and interact. For example, 75% of U.S. residents do not know the source of their tap water (NEETF 1999) and 72% do not know that surface runoff is the most common source of water pollution (Coyle 2005).

Ecological ignorance fosters apathy and enables complacency. The lack of concern in the United States for environmental issues is striking and increasing. Less than 2% of U.S. residents belong to an environmental group (Wilson 2002). Less than 1% of U.S. residents rank environmental problems, including biodiversity loss, can be solved without reducing economic growth or resource consumption (Kempton et al. 1995; Ladd and Bowman 1995; Czech and Krausman 1999).

If not to enhance quality of life appreciably, why does the United States consume resources so unsustainably? There are many cultural, social, and emotional reasons but an especially relevant reason is that we collectively do not understand the long-term consequences of consumption and economic growth. This poor understanding is rooted in ecological illiteracy and reflected in public attitudes. U.S. residents are profoundly ignorant of how ecosystems and economies operate and interact. For example, 75% of U.S. residents do not know the source of their tap water (NEETF 1999) and 72% do not know that surface runoff is the most common source of water pollution (Coyle 2005).

About 90% do not know that polluted water is the leading cause of childhood death worldwide or that abandoned fishing line is the main cause of wildlife entanglement (Coyle 2005). Over two-thirds have not heard of biodiversity loss (The Biodiversity Project 2002). Most U.S. residents think that endangered species can be preserved simply by not killing them, thereby failing to recognize the importance of habitat conservation (Kempton et al. 1995). Barely half (53%) of the residents of the Chesapeake Bay watershed realize that their actions contribute to water pollution (McClafferty 1999). Moreover, most U.S. residents believe that environmental problems, including biodiversity loss, can be solved without reducing economic growth or resource consumption (Kempton et al. 1995). The proportion of U.S. residents who think that environmental regulations “do not go far enough” has declined substantially since the early 1990s (Coyle 2005); only 39% now think protection of endangered species is inadequate. Gallup’s 2004 Earth Day poll found that a record-low proportion of U.S. residents believe that environmental protection should take precedence over economic growth when the two conflict (The Nature Conservancy 2004). U.S. residents commonly overestimate government protection of public health and safety (Coyle 2005). Coincidentally, the environment has been a non-issue in the last three U.S. presidential elections; voters have tacitly approved the current environmental policies that aggressively undermine conservation. This is consistent with most U.S. residents’ unwillingness to reduce their standard of living (i.e., resource consumption) or spend additional money or time to

**Figure 1.** Relations between human quality of life and consumption of ecological resources (Costanza et al. 2002). (Loss of Natural Capital)
support environmental causes (Ladd and Bowman 1995). Two-thirds of U.S. residents believe scientists and engineers will find technological solutions to environmental problems (Coyle 2005), thereby absolving themselves of personal obligations to change behavior or restrain consumption.

Americans’ lack of environmental concern is also enigmatic and difficult to describe definitively, at least through the lens of questionnaires. Despite their lack of environmental engagement, most U.S. residents consider themselves “environmentalists,” think that environmental protection is inadequate, want to maintain a strong ESA, and believe that maintaining biodiversity is important to their personal lives (Kempton et al. 1995; Ladd and Bowman 1995; The Biodiversity Project 2002). These contradictions can be explained by the fact that although U.S. residents view environmental issues as serious, other more urgent concerns (e.g., terrorism, crime, inflation, and financial security) commonly divert our attention and support (Ladd and Bowman 1995; Coyle 2005).

DEFINING A ROLE FOR FISH BIOLOGISTS

Public attitudes toward resource consumption, economic growth, quality of human life, and biological conservation represent major challenges and opportunities for fish biologists. Without fundamental changes in attitudes, conservation will remain ineffective and aquatic biota will continue to decline rapidly. Fortunately, attitudes and behavior of most people are malleable—to a degree. Outcome assessments of environmental education consistently show that environmentally knowledgeable people are more likely to behave in pro-environmental ways, such as conserving water and recycling (Coyle 2005). Considering the state of Americans’ knowledge and attitudes germane to conservation, there is much ground to be gained if biologists collectively ply their educational skills to show people how their lives are improved more by sharing resources with aquatic biota than by consuming those resources. To that end, I propose that we develop a more proactive, comprehensive strategy to focus our professional efforts on helping society use aquatic ecosystems sustainably.

Conservation is a central charge of fish biologists. Our commitment to conservation has many sources, including personal convictions, the informal contract between scientists and society (Lubchenco 1998), and the missions of particular disciplines. For example, members of the American Fisheries Society (AFS) profess their concern for conservation in the first objective of the first article of the AFS Constitution, where we pledge to “promote the conservation, development, and wise use of the fishes.” Although each of us makes personal choices regarding how to promote conservation, substantive dialogue within the AFS can help galvanize our thinking on how our commitment to conservation is translated into our daily work.

Traditionally, fish biologists have promoted conservation primarily by generating new scientific knowledge and applying it to conservation objectives such as preservation, mitigation, regulation, and restoration. These activities include collection, analysis, and interpretation of data; dissemination of findings; and service on advisory panels and editorial boards, and the like. Promoting conservation as educators per se, wherein we seek to influence how non-experts such as policymakers and the public think and behave (and purchase) in relation to aquatic biota and ecosystems, has been secondary. Although we vary individually in how we divide our time and energy among these actions, we collectively have invested far less in education than in scientific study and application.

Professional scientific societies, including the AFS, can do much more to promote conservation by fully embracing their educational missions. The conventional research-heavy distribution of professional activity is unlikely to contribute much to constructing a conservation-minded, ecologically sustainable society. Stakeholder intention and motivation, not scientific knowledge, typically constrains effectiveness of conservation policy (Anderson 1996; Shellenberger and Nordhaus 2005). For example, although non-native species are widely recognized as major causes of aquatic species imperilment (Richter et al. 1997; Clavero and Garcia-Berthou 2005), little policy has been implemented to protect native biota from further non-native introductions. If fish biologists truly seek to shift the attitudes and behaviors of an apathetic, complacent public toward conservation, we must re-prioritize our professional efforts and redouble our participation in education. A central theme of our professional activity should be to disseminate scientific knowledge—old and new—that will effect changes in how individual people and society at large behave ecologically. In particular, we need to persistently show people how aquatic biota and functional ecosystems enrich human lives. For example, people displaced by Hurricane Katrina are probably keenly interested in scientific knowledge about relations between intact wetlands and flood amelioration.

Energizing our educational efforts sufficiently to advance ecological sustainability will require fundamental change in the activities of individual fish biologists as well as their professional societies. This might mean that the AFS advocates for parity between education and all other conservation efforts combined (research and application), as measured across its membership (Angermeier 2005). Ecologists increasingly recognize that a central component of doing good science is informing the public about the importance of monitoring and protecting environmental quality (Bazzaz et al. 1998). More pronounced efforts to educate policymakers about sustainability might include developing policy positions, such as the AFS’s pending position on the conflict between economic growth and fish conservation (Mead et al. 2005). Before re-configuring the AFS mission, though, we need to initiate serious dialogue among fish biologists regarding our perceived role in building ecological sustainability so that we, as a profession, can craft credible messages for policymakers, the public, and other scientists.

FOCUS ON ECOSYSTEM SERVICES

Education about sustainability encompasses many biological and sociological aspects of ecosystems, but an especially compelling focal point is the goods and services provided to society by functional ecosystems (Daily 1997). People accrue a wide array of benefits from healthy waters, including highly tangible foods, medicines, and water for drinking and
bathing, as well as less tangible beauty, spirituality, and recreational pleasure. People also benefit from biota-mediated processes that detoxify wastes and cycle nutrients. The relative importance of various ecosystem services can be inferred from how frequently resource managers invoke them to justify management actions. For example, most river restoration efforts are initiated to improve water quality, fishery productivity, or availability of edible (non-toxic) biota (Wohl et al. 2005), thereby indicating the great importance of those services to the public. Because all ecosystem goods and services contribute to one or more of the quality-of-life dimensions described above, they are excellent springboards for developing educational cases for conservation. No particular ecosystem amenity will compel everyone to be a conservationist, but everyone should find at least one amenity to make her/him passionate about conserving freshwater biota.

Ecosystem amenity is the quality of human lives, which stems from billions of incremental human choices about ecological behavior. I submit that most people do not recognize these relations between ecosystem operation and human lives, a condition that enables unsustainable ecological and economic choices. Fish biologists have the educational tools to fill these knowledge gaps. Furthermore, we are obligated professionally to do what we can to establish, not merely proffer, that knowledge throughout society.

Given the immensity of the task at hand, we must work selectively to be effective at enhancing conservation. I suggest focusing first on those links between quality of life and healthy ecosystems with which we are most familiar. For example, we can use people's passion for aquatic foods as a basis for educating them about the ecological processes that produce wild foods and how certain human activities limit the availability of functional aquatic ecosystems. Of course, we also need to emphasize fishing responsibly, including taking care not to spread exotic species. Finally, people are often moved deeply by the beauty of natural places and wild creatures but, in my experience, are typically unfamiliar with their own regional aquatic biota. Biologists can help people connect with the aesthetic, novel, and spiritual aspects of local ecosystems. By collectively taking advantage of and creating opportunities to influence society's
attitudes toward aquatic biota, we can incrementally instill the will to forge more sustainable ecological behaviors and economies.

INVESTING IN ECOLOGICAL LITERACY

What are appropriate goals for fish biologists as educators? Can we really expect conservation education to effect the radical changes in social values and consumption patterns necessary to achieve ecological sustainability? On one hand, we have no choice: education is the primary social lever we biologists can reach; it is incumbent on us to pull it with all our resolve to advance our vision for the future. Not resolving to change society’s ecological behavior is tacit approval of a future with few intact biota and functional ecosystems. Surely our vision is an improvement! On the other hand, the efficacy of education has important constraints. The simplistic learning model of more factual knowledge (awareness) leading to adjustments in attitude, then to more responsible behavior is no longer accepted by environmental educators. Rather, we now know that ecological behavior is a complex outcome of the interactions of a broad array of personal factors, such as emotions, empowerment, goals, knowledge, morals, resources, and skills, as well as external factors, such as available technology, cultural context, laws and regulations, macroeconomic policy, market prices, and social norms (Kollmuss and Agyeman 2002; Schneider and Cheslock 2003). The complexity of human behavior makes goal-oriented education somewhat inefficient. Nevertheless, if conservation education is to really help build ecological sustainability, educators (including fish biologists) must go well beyond merely providing more ecological facts.

Education can be a powerful tool for manipulating the exchange rates people use to convert among natural, manufactured, and human capitals. Raising ecological awareness and connecting people emotionally with biota inflates their perceived value of natural capital. Environmental literacy, including historical perspectives, builds human capital and sense of place and provides common ground for landscape-level planning and conservation (Spirn 2005). Moreover, perceptions of natural and human capital figure prominently in personal economic choices. People do not typically make economic decisions based on straightforward, rational estimates of monetary costs and benefits (charitable donations are good examples of common economic choices for which non-monetary factors predominate). Rather, emotional (mostly irrational) underpinnings such as aesthetic sensibilities, ethical convictions, and religious beliefs strongly influence economic behavior. Helping people build non-monetary rationales for behaving sustainably will advance conservation of biodiversity.

Progress toward sustainability hinges on enhancing ecological and economic literacy among all resource consumers and policymakers. By clarifying the links among natural, manufactured, and human capitals, environmental education can promote ecological sustainability in at least three major ways. First, by familiarizing people with the ecosystems and ecological context in which they live, education can cast personal ecological and economic behavior in a more comprehensive light. Second, by demonstrating environmental connectedness among people, education can galvanize public demand for economic policies, including pricing mechanisms, that slow the rate of natural capital loss and efficiently allocate resources. Third, by raising awareness of ecological values, especially among children, education can cultivate a culture of respect and stewardship for native biota and natural heritage. Conversely, our current environmental crises, including declines in biodiversity and losses of ecosystem amenities, largely reflect prevailing educational approaches that emphasize technological domination of nature (Orr 1992). These crises have less to do with insufficient bodies of knowledge held by scientists than with inappropriate senses of ecological prudence, moral responsibility, and human purpose held by society at large. The unfortunate consequence, as described above, is that our citizenry neither knows nor cares very much about their ecological places in the world or the biota that share those places.

Fish biologists’ response to this pervasive apathy should be to use education to change people’s exchange rates among natural, manufactured, and human capitals so that perceived net benefits of behavior favor conservation. I believe that well-designed education efforts can influence how individual costs and benefits, as well as societal costs and benefits, are assessed. Over the short term, education can shift an individual’s economic behavior toward sustainability (e.g., reduce fossil-fuel emissions to enhance water quality). Over the long term, educated citizens can pressure their governments to implement sustainability-based market controls (e.g., tax and subsidy structures that promote development and use of non-fossil-fuel energy sources) so that ecological and social costs of consumption are internalized in market prices. Such long-term effects, although more difficult to achieve, probably have the greater potential to conserve biota because of their eventual consequences for the behavior of more people. Coupling the costs and benefits of individuals’ economic choices in aesthetic, ecological, ethical, and spiritual terms—the coinage of natural and human capital—may often be as compelling as focusing on monetary costs and benefits.

Conservation education encompasses a wide range of objectives (e.g., enhance awareness versus change behavior) and approaches (e.g., passively present information versus engage people in on-the-ground management). A key role of fish biologists is to convey existing ecological knowledge to policymakers and the public to reduce ecological ignorance. In the context of building sustainability, however, what we do to enhance people’s sense of obligation, compassion, and respect for aquatic biota is probably more important than the factual information we disseminate. If fish biologists are to educate in ways that promote conservation, as affirmed in the AFS Constitution, we must recognize that teaching (like teachers) and knowledge (like knowers) are not value-free or dispassionate. Effective conservation education involves not only the presentation of objective facts, but also the inculcation of a land/water ethic that is largely absent in modern America’s urban, consumeristic, technocratic culture. Central tenets of this ethic include the notions of aesthetic value, ecological connectivity, limits to growth, respect for nature, and even certain rights of nonhuman biota.

If an ecologically literate and sympathetic public is crucial to a sustainable
society—as I believe it is—fish biologists and other environmental scientists should commit to more fully engaging people along the aesthetic, emotional, intellectual, moral, and spiritual dimensions that drive human behavior. In part, this means that education needs to become more interdisciplinary than most of us have imagined it. Ecological literacy based on a land/water ethic draws knowledge from several disciplines, including natural history, ecology, geography, moral philosophy, economics, and behavioral psychology. An ecologically literate society would understand important ecological processes, as well as how those processes influence human lives and vice versa. An ecologically literate society could distinguish healthy from unhealthy ecosystems, and appreciate the dependence of human health on ecosystem health. An ecologically literate society would be familiar with how its consumption of goods and services is likely to influence other people’s quality of life. An ecologically literate society would recognize the links among human perceptions and attitudes, social institutions (e.g., economies, government bureaucracies), and its own ecological behavior. Finally, an ecologically literate society could distinguish sound science (reviewed in Sullivan et al. 2006), conducted in pursuit of better understanding, from pseudo-science, asserted to support a pre-conceived political agenda.

Fish biologists can enhance public literacy in all these ways regarding aquatic ecosystems, but they may need to partner with other experts to be most effective. For example, they might collaborate with economists to convey information about the benefits and costs of aquatic conservation, the strengths and weaknesses of the market as a conservation tool, and the conflicts between economic growth and conservation. Fish biologists might collaborate with trained educators to sharpen their messages based on pedagogical principles, behavioral psychology, and learning dynamics. And biologists might collaborate with religious leaders to develop compelling educational cases based on value systems, environmental justice, and spiritual growth. All these efforts would be more complicated and time-consuming than most of our current conservation education.

Ecological literacy is clearly not monolithic. My personal views of what ecosystem attributes should be conserved, what is ecologically sustainable, or even what ecological literacy is, may be rejected by many. Opinions about what is natural, ecologically healthy, and/or worth conserving vary greatly among both experts and non-experts because of differences in individual experience and value systems (Lele and Norgaard 1996; Angermeier 2000, 2001; Hull et al. 2001). As purveyors of ecological literacy, biologists should not so much impose their values on the educated as explicate the values and selected knowledge that underpins various positions, so that the educated become literate enough to understand their ecological place in the world, make informed decisions, and facilitate discourse on their own. This does not mean, however, that all worldviews of nature warrant equal time. Promoting conservation based on literacy in a Leopoldian land/water ethic presumes acceptance of certain scientific conceptions of ecosystem operation and certain moral imperatives, which are absent from the prevailing anthropocentric approaches to environmental management (reviewed in Dryzek 2005).
CONCLUSIONS

Sustainability is essentially about the balance that society chooses between long-term environmental quality and short-term material prosperity. Intact aquatic biota and ecosystems may or may not be part of that balance, depending on how people choose to live. Ongoing, pervasive declines in aquatic biodiversity and delivery of ecosystem amenities are attributable to domination of the biosphere by human economies, which reflect human goals, attitudes, and beliefs. The most crucial element of an ecologically sustainable society is a majority who care deeply about intact biota and functional ecosystems. Fish biologists can help create such a majority by catalyzing a transformation in the aesthetic, emotional, intellectual, moral, and spiritual determinants of human resource consumption. They can also contribute to a coherent national dialogue on the relations among ecological, economic, and social sustainability.

Accepting this immense challenge will require fish biologists to first redefine their role as conservation educators so that the profession’s efforts to show people how aquatic biota and ecosystems enrich human lives attain parity with all our other conservation actions combined. Then, we will need to retrain ourselves to become interdisciplinary teachers who can engage policymakers and the public in ways that effect more sustainable ecological and economic behaviors. Making sustainability a reality will require us to practice a more holistic, civic-minded, policy-engaged science that integrates the many social and biophysical dimensions of environmental management (Cotner 2000). In building ecological sustainability, the most urgent and important task of fish biologists is to connect people physically, economically, emotionally, and spiritually with ecosystems so that societal attitudes and policies embrace conservation. There are at least three major knowledge gaps that biologists can help bridge: (1) the gap between what biologists know about biota and ecosystems and what non-experts know, (2) the gap between the worth of ecosystem amenities in quality-of-life currencies and the price of ecosystem products in market currency, and (3) the gap between how ecosystems are managed under the prevailing goal of economic growth and how they would be managed pursuant to a sustainable or “steady state” economy. Bridging these gaps means establishing an ecologically literate public who (a) understands the interactive relations among ecosystem operation, human quality of life, and human resource consumption, (b) appreciates the dependence of human health on ecosystem health, and (c) recognizes the links between human attitudes and societal behavior.

This transformation in public attitudes and literacy will not occur without fundamental shifts in our professional time/energy priorities. In particular, we need to de-emphasize the development of new technical information for experts and re-emphasize the dissemination of ecological wisdom to non-experts. Notably, time is working against us: the human economy is growing irrevocably, largely oblivious to ecological consequences. Inaction is tantamount to accepting a biologically and ecologically impoverished future. Which vision will we help build?

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NEETF (National Environmental Education and Training Foundation). 1999. The national report card on safe drinking water knowledge, attitudes and behaviors towards Chesapeake Bay watershed water quality issues. Conservation Management Institute, Blacksburg, VA.


ABSTRACT: Choice of management spatial scale is a critical step of any stock assessment, but deciding on a conservative criterion is difficult because of risks associated with any choice. For example, if one large unit is selected when distinct sub-stocks exist, then some population components may disappear over time. Alternatively, choosing several small management units when one well-mixed stock exists may lead to costly and ineffective management. We consider the example of tautog ('Tautoga onitis'). Mortality estimated for a single stock using virtual population analysis has exceeded the target and resulted in mandated reductions in fishing. In Virginia, tag returns and catch curve analyses are consistent with a localized mortality rate that is less than the target. Therefore, reductions of fishing effort in Virginia may not alleviate overfishing elsewhere and might not be conservative. Thus, simple models used for localized assessment can have advantages over sophisticated models applied to an entire stock complex when multiple stocks exist.

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Evaluating Localized vs. Large-scale Management:
The Example of Tautog in Virginia

Evaluación Local vs. Manejo a Larga Escala:
El Caso de la especie ('Tautoga onitis') en Virginia

ABSTRACTO: La selección de la escala espacial es uno de los puntos críticos en toda evaluación de “stocks” pero la definición de criterios de conservación es mucho más difícil considerando los riesgos asociados con este tipo de decisión. Por ejemplo si elegimos una unidad de larga escala cuando distintos sub “stocks” existen, algunos de los componentes de una población podrían desaparecer a través del tiempo. Alternativamente si consideramos la selección de pequeñas unidades de manejo cuando solo existe un “stock” muy mezclado; esto puede conducirnos a un manejo costoso y poco efectivo. Nosotros examinamos el ejemplo de la especie ('Tautoga onitis') determinando que cuando la mortalidad estimada para un solo “stock” es aplicada a un análisis virtual de la población que ha excedido su quota de explotación esto resultaría en recomendaciones de medidas de regulación para reducir la pesca. En Virginia los resultados del marcado y las gráficas de capturas son consistentes con los análisis de que la mortalidad localizada es menor que la quota de captura. Consecuentemente reducciones en la pesca de esta especie en Virginia no serían una medida conservativa que aliviaria la sobre-pesca en otras localidades. En este caso los modelos simples de evaluación localizada podrían ser más efectivos que los modelos sofisticados que se aplican a un “stock” complejo formado de unidades múltiples.
**INTRODUCTION**

The choice of management spatial scale is a critical step of any stock assessment. That decision depends upon the biology and behavior of the species and the operational considerations of the management policy. There are advantages and disadvantages of any choice of management unit that are strongly affected by the movement patterns of the species. We begin by reviewing the tradeoffs associated with few, large management units (large-scale management) compared with a greater number of small management units (localized management). We then discuss a case history of the tautog (*Tautoga onitis*) resource in Virginia, showing the application of a localized management design that contrasts with the established large-scale management practice.

**TRADE-OFFS ASSOCIATED WITH LARGE-SCALE VS. LOCALIZED ASSESSMENT AND MANAGEMENT**

There can be clear advantages to assessing a stock on a large-scale basis, i.e., treating a stock complex as a single unit for assessment and management (Table 1). When there is no significant spatial variability in population characteristics due to the fact that the stock is well mixed, large-scale analysis is appropriate and possibly requires less work since data compilation and analysis only need to be done once. A single stock management unit, when appropriate, also enables data from subunits to be used for estimating parameters for the whole stock complex. For example, to tune a Virtual Population Analysis (VPA) to obtain fishing mortality ($F$), it is appropriate to use a survey index of abundance from a portion of the species’ range provided the index is representative of the entire stock complex. Additional advantages of defining a single stock unit arise from the aggregation of data from subunits within the management area that results in potentially lower costs to gather data and possibly more precise parameter estimates.

If the stock-complex is managed as a single unit, but is comprised of sub-stocks that have real biological differences in terms of population parameters, potential problems arise. The aggregation of data from the entire stock-complex results in estimated parameter values that represent averages spread across the spatial scale used in the analysis. If managers use the average obtained from a coast-wide assessment and apply it to all sub-stocks, then for some sub-stocks restrictions will be too stringent, while in others restrictions will not be sufficient to meet management goals. This results in a loss of yield in both cases. Also, management regulations lacking spatial detail can potentially lead to localized serial depletion, lower recruitment, and instability in the fishery.

One way to address the risks of large-scale, single-stock analysis is to partition the management area into smaller spatial scales that reflect biologically meaningful units or sub-stocks (local populations that experience different mortality rates, have spatial or temporal isolation of spawning groups, show microevolution of morphological or genetic characteristics, or have abundances that are affected by local processes; Waldman 2005). Stephenson (1999) argued that spatially distinct spawning groups should be treated as sub-stocks under a “precautionary approach” until there is information to demonstrate otherwise. While data requirements increase as stocks are separated into smaller spatial scales, the potential of localized serial depletion is reduced. Localized management may also result in stability of the fishery and help to maintain genetic diversity and productivity in sub-stocks. However, if the spatial scale is too small, external forces (immigration and emigration) may overwhelm any management effort. For example, if unlimited fishing of a highly mobile species were allowed in a small management area, immigration into the area may dominate over depletion due to fishing, resulting in a constant catch rate and leading to the incorrect conclusion that fishing has little effect on the population. An additional consideration is that parameter estimates from smaller spatial scales may have more variance and the reduction in data availability could make localized management unwarranted.

**A CASE STUDY OF LARGE-SCALE VS. LOCALIZED MANAGEMENT: TAUTOG IN VIRGINIA**

Tautog, a member of the wrasse family (Labridae), is found from Nova Scotia to Georgia, with the greatest abundance found between Cape Cod, Massachusetts, and the Chesapeake Bay, Virginia. Tautog is a long-lived species (up to 30 years; Cooper 1967) that tends to inhabit structure such as wrecks and reefs, making it susceptible to overfishing (Briggs 1977). Springtime spawning typically occurs at or in the mouths of estuaries and bays and in nearshore waters, and juveniles settle in shallow estuarine habitats (Sogard et al. 1992).

Beginning in the mid-1980s, the coast-wide tautog stock began to decrease due to fishing pressure. The majority of Virginia landings (greater than 90%) result from a recreational fishery (ASMFC 2002). To facilitate management of the coast-wide stock, the Atlantic States Marine Fisheries Commission (ASMFC) adopted a Fishery Management Plan (FMP) for tautog in 1996 to rebuild spawning stock biomass by reducing fishing mortality. The ASMFC split the

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**Table 1.** Advantages and disadvantages of different spatial scales for possible management units used in stock assessments.

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<tr>
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<th>Several Small (Localized)</th>
<th>Few Large (Large-scale)</th>
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<tr>
<td><strong>When Appropriate</strong></td>
<td><em>When there are real spatial differences</em></td>
<td><em>When there are few spatial differences</em></td>
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<tr>
<td><strong>Requirements</strong></td>
<td><em>Requires fine scale data</em></td>
<td><em>Requires only aggregate data</em></td>
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<td><strong>Advantages</strong></td>
<td><em>Will detect localized depletions, maintain reproduction in substocks (genetic diversity), promote stability of fishery (avoid serial depletion)</em></td>
<td><em>Potentially less work and expense to assess and enforce, may be able to &quot;borrow strength&quot; (obtain parameter values) from subunits</em></td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td><em>Possibly more work and expense to assess the stock, may be harder to enforce and identify location of catch, need information regarding recruitment and external factors (e.g., Immigration)</em></td>
<td><em>Gives spatially averaged results, perhaps biased (if the stock is not well-mixed)</em></td>
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<tr>
<td><strong>Risk if wrong management unit is chosen</strong></td>
<td><em>Additional, unnecessary expense; inappropriate scale may mask effects of management</em></td>
<td><em>Local depletion goes undetected, potential for loss of genetic diversity, potential loss of legitimate yield</em></td>
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management region into two zones: a northern zone (Massachusetts, Rhode Island, Connecticut, New York, and New Jersey) and a southern zone (Delaware, Maryland, Virginia, and North Carolina). Since 1996, three addenda have been added to the FMP to reduce fishing mortality and rebuing spawning stock biomass by creating minimum size and possession limits, gear restrictions, and closed seasons.

The ASMFC uses a VPA to examine tautog stocks on a coast-wide basis (Table 2). Fisheries dependent data from Massachusetts to Virginia (and fisheries independent data from Massachusetts to New Jersey only) are aggregated and the entire stock is assessed resulting in annual estimates of abundance and fishing mortality by age and in annual estimates of recruitment (ASMFC 2002). If tautog are well mixed throughout the range and if the assumption that natural mortality (M) is constant throughout the stock is warranted, then extending the results of the VPA to include the southern zone is appropriate. However, if sub-stocks exist, then VPA may mask real localized differences in population parameters. For example, VPA will average F across the entire stock and not appropriately allocate mortality rates among sub-stocks. The result would be an overestimate of F in one area and an underestimate in another area that could lead to ineffective management decisions and potentially to sub-stock collapse. The F calculated for the entire stock complex is a potentially biased estimate of the stock average because the estimate depends on which sub-stocks supply tuning indices and how those indices are weighted.

The VPA conducted in 2001 using catch-at-age data from 1981 to 2000 showed that the fishing mortality rate declined from 0.71/y to 0.41/y between 1993 and 2000. Despite the decrease, the estimated fishing mortality rate remained above the ASMFC target of F = 0.29/y (= F40%SSB) established by the Tautog Plan Review Team (ASMFC 2002). As a result, the ASMFC mandated a reduction in fishing effort for all states in 2003. However, the age composition data used in the analysis were from the northern zone and a lack of sufficient data from states south of New Jersey prevented a regional assessment based on VPA for this zone. In a subsequent VPA (2005), the estimated fishing mortality rate decreased to 0.30/y, but was still above the target value.

The Virginia Marine Resources Commission (VMRC) believed that tautog in Virginia experienced a lower fishing mortality rate compared with northern populations (White et al. 1997). Catch curves were constructed using samples collected primarily from the commercial fishery in Virginia to derive an age-length key that was applied to landings data obtained by the Marine Recreational Fisheries Statistics Survey (MRFSS) and the VMRC. The estimated total instantaneous mortality rate (Z) from the catch curves varied between 0.26 and 0.58/y from 1985 to 1996 and were lower than the coast-wide average of Z = 0.73/y at that time (Figure 1).

To examine the possibility of sub-stock structure in tautog, tagging studies conducted by the Virginia Saltwater Gamefish Tagging Program since 1995 were reviewed. These showed that 3 out of 1,410 tag returns (0.21%) from tautog tagged in Virginia were caught outside of the state of Virginia: one from Ocean City, Maryland, one from Delaware Bay, and the other from Oregon Inlet, North Carolina (Hoenig and Lucy Munroe 1993). The supporting evidence from the tagging data that Virginia tautog remain in Virginia waters or offshore of Virginia and show little along-shelf movement provides a mechanism to justify using localized fishing mortality rates and thus we have restricted our analysis to tautog landed in Virginia territorial waters and seaward to the outer edge of the Exclusive Economic Zone (324.2 km).

<table>
<thead>
<tr>
<th>Table 2. Comparison of virtual population analysis and cross-sectional catch curve analysis.</th>
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<tbody>
<tr>
<td><strong>VPA</strong></td>
</tr>
<tr>
<td><strong>Data Requirements</strong></td>
</tr>
<tr>
<td>* Catch at age matrix for more years than there are ages, tuning index, need to know (or assume) natural mortality (M)</td>
</tr>
<tr>
<td><strong>Output</strong></td>
</tr>
<tr>
<td>* Get a value for fishing mortality (F) and abundance by age and year, and recruitment by year</td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
</tr>
<tr>
<td>* M is known and is constant throughout the stock, stock is spatially well mixed, generally need some assumptions about catchability and possibly about a plus group</td>
</tr>
<tr>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>* F can be determined for each age class in each year</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>* Looks at the population from a historic perspective, the dependability of the results is poorest for most recent years; does not provide information on spatial variability</td>
</tr>
</tbody>
</table>
NON-EQUILIBRIUM CATCH CURVES

Opercle and otolith samples obtained primarily from the commercial fishery were examined to continue to monitor Virginia tautog mortality rates following the study by White et al. (1997). Additional samples were collected from recreational catches opportunistically. Ages were determined by Old Dominion University. The resulting aged samples were used to derive cross-sectional catch curves for each year from 1997 through 2004. Cross-sectional catch curve analysis was used because it provides an estimate of total instantaneous mortality rate and only requires information on relative abundance of cohorts from a single year (Table 2). Two assumptions of cross-sectional catch curves are: catchability of the cohorts is constant across age, and recruitment shows no trend over time for the cohorts being examined, but recruitment may fluctuate randomly about a stationary mean. Another possibility for examining localized mortality rates is the use of a longitudinal catch curve, which assumes that catchability of the fishing gear remains constant from year to year, that catchability of the cohort remains constant as the fish grow larger, and that the catch curve is based on known catch-per-unit-effort. Because longitudinal catch curves follow a single cohort through time, the analysis requires catch rates over multiple years. On the other hand, cross-sectional catch curves can be examined using a single year of catch composition data. An assumption of both longitudinal and cross-sectional catch curves is that the stock and fishery are at equilibrium. When there is equilibrium (no change in fishing or natural mortality rates and no trend in recruitment over time), the descending limb of the catch curve is a straight line whose slope reflects the total instantaneous mortality rate. However, for tautog, a stock undergoing rebuilding efforts, changing fishing mortality rates result in non-equilibrium conditions and departures from linearity (resulting in a bend in the catch curve). Interpretation of the non-equilibrium catch curve can provide insight into changes in stock dynamics, although additional years of data are required. If the bend in a cross-sectional catch curve always occurs at the same point every year, then either catchability changes with age or mortality changes with age, but distinguishing between the two is not possible (Figure 2). On the other hand, if the bend in the curve moves one time step to the right each subsequent year, then either there has been a change in mortality with time or a change in recruitment with time (Figures 3 and 4). A fixed percentage change in recruitment every year results in a series of catch curves over time that consists of two linear segments (Figure 4), whereas a one-time permanent change in recruitment results in a complicated pattern evolving in the catch curve over time (Figure 5). Distinguishing between the different explanations for bent catch curves is not possible without further information, but catch curves do provide a tool for examining non-equilibrium conditions using limited data.

CROSS-SECTIONAL CATCH CURVES FOR VIRGINIA TAUOTOG

Ordinary (equilibrium) cross-sectional catch curve analysis was used first for tautog in Virginia because available data included age composition of the catch. Results of the analyses suggest a slight reduction in total mortality in recent years relative to the 1980s and early 1990s (average Z estimate = 0.38/y from 1985 to 1996, average Z estimate = 0.30/y from 1997 and 1999 to 2004) with values that are below the target Z of 0.44/y established by the ASMFC (Figures 1 and 6). To check for the possibility that mortality may have changed over time, we then constructed non-equilibrium catch curves for 1997 and for 1999 to 2004. Total instantaneous mortality rate estimates for younger fish that only experienced the recent mortality rate ranged from 0.18/y in 2000 to 0.41/y in 2004, while the mortality rate for older fish that experienced both old and recent mortality rates ranged from 0.24/y in 2003 to 0.51/y in 1999 (Table 3; Figure 6). An important point is that the recent total mortality rate is below the ASMFC target Z = 0.44 (assuming M = 0.15). If the entire age range is used in the catch curve analysis (assuming there is no bend in the catch curve), then the estimated total instantaneous mortality rate for tautog ranged between 0.26/y in 2000 and 0.42/y in 1997 (Table 3; Figure 6). A possible criticism of catch curve analysis is that the age of full recruitment may not be the peak as used in this analysis, but may occur at an older age. If the age at full recruitment is assumed to be age 5 in all years based on the oldest observed peak (2001), then the estimated total instantaneous mortality rate for tautog changes, but still remains below the target value (Table 3). Thus, the conclusion that the mortality rate in Virginia is below the ASMFC target is robust to the interpretation of the shape of the catch curves and the age at full recruitment. In addition, the increase in MRFSS catch and effort estimates observed during 2003 and 2004...

Figure 1. Estimates of the total instantaneous mortality rate obtained using cross-sectional catch curves for Virginia tautog by White et al. (1997, columns 2 and 6 of Figure V.7) and this study.

Figure 2. Non-equilibrium cross-sectional catch curves for three years of data showing a consistent bend in the curve at age 8. Such a pattern is consistent with mortality increasing with age or catchability decreasing with age.
(Figure 7) correspond to a steepening of the catch curve at the extreme left of the descending limb, suggesting that the non-equilibrium catch curves may be tracking a recent change in the mortality rate (Figure 6, data for 2004). Additional years of data could verify this trend.

In theory, another possible explanation for the bend in the catch curve is a violation of the assumption of no trend in recruitment. If recruitment continuously decreased at a constant percentage rate with time, the result would be to pull the left side of the catch curve downward and appear as a reduction in total mortality estimates for younger ages, i.e., for recent years (Figure 4). Observing a constant decrease in recruitment over time, such as 20% per year, is possible but not likely. Unfortunately, data for recruitment of Virginia tautog are not available and we are currently unable to definitively exclude this possibility. However, recruitment estimates from the VPA do not show any decreasing trend over time throughout the northern management area and actually show an increase in biomass and recruitment in recent years (ASMFC 2002). Inasmuch as recruitment is influenced by regional factors, such as climate (Myers et al. 1997), the results from the VPA concerning recruitment are consistent with the idea that recruitment in Virginia has not declined. Additionally, the MRFSS data showing lower fishing effort in recent years relative to the early 1990s (with a notable increase in only the last two years) support the conclusion that fishing mortality has decreased in recent years. Finally, the implementation of minimum size restrictions, closed seasons (commercial fishery), and possession limits (recreational fishery) for tautog in Virginia that began in 1997 would reduce fishing mortality of young tautog and tend to increase recruitment.

**DISCUSSION**

The management spatial scale that is chosen for a particular species may be based upon known biological criteria of the species or for convenience in terms of identifiable and enforceable management units. Because the true nature of the stock is unknowable, it is good practice to use a variety of assessment models, assess if the data are appropriate, and compare results. When model results vary the logical question to ask is “Why?” The argument for using a cross-sectional catch curve analysis does not negate the idea of using a VPA but, rather, suggests that different assessment tools may be complementary and show insight into stock dynamics that a single methodology may not reveal. For example, while VPA is superior in providing mortality rates and absolute abundance by age and year, it is inferior in that the parameters are averaged over the entire management unit. If substocks are not well-mixed, as appears to be the case for tautog, then mortality rates may not be accurate for any jurisdiction and management decisions may be less effective. Virginia’s fishing mortality rate may be below the value obtained using a VPA for the entire stock complex. If so, then cutting back fishing effort in Virginia results in unnecessary regulations and loss of yield. Furthermore, there must be higher values of F in another area (or areas) within the management unit that balances the below average value in Virginia. Therefore, the reduction in effort that is averaged across the management substocks may not be sufficient to decrease F to

![Figure 3. Non-equilibrium cross-sectional catch curve for three years of data showing a migration of the bend to the right. This is consistent with a decrease in mortality with time or a decreasing trend in recruitment. The slope of the line to the left of the bend shows the recent mortality rate if the mortality rate has changed.
](image)

![Figure 4. Non-equilibrium cross-sectional catch curve over a series of years showing a consistent 20% decrease in recruitment every year. Here total mortality (Z) is constant over all ages and all years and the departure from linearity is due to changing recruitment. The slope to the right of the bend reflects the true mortality rate. For clarity, each successive year’s catch curve is displaced below the previous years curve. In practice, the height of the curve is determined in part by sampling effort.
](image)

![Figure 5. Effect of a permanent decrease in recruitment from one constant level to another on a non-equilibrium cross-sectional catch curve starting in year two. For clarity, each successive year’s catch curve is displaced below the previous year’s curve. In practice, the height of the curve is determined by sampling effort.
](image)
Figure 6. Cross-sectional catch curves (left) and non-equilibrium cross-sectional catch curves (right) for 1997 and for 1999 through 2004. Operculum age was derived from tautog obtained primarily from commercial landings with some opportunistic data obtained from recreational catch. Ages represented by less than five fish were not used in the regression and only the descending limb is shown.
Table 3. Total instantaneous mortality estimates ($Z_{full}$) and non-equilibrium total instantaneous mortality estimates for recent years ($Z_{left}$) and earlier years ($Z_{right}$) for Virginia tautog from 1997 through 2004 (excluding 1998). Age of full recruitment is assumed equal to the highest observed catch-at-age (Peak) or the oldest observed peak for all years (Age 5). Bold faced values are above ASMFC target $Z=0.44$ ($f=0.29$ and assumed $M=0.15$). Note that estimates for 1998 are not shown because only 51 fish were aged. Effort is estimated from the Marine Recreational Fisheries Statistics Survey.
the case of tautog, where spatial scale appears to matter, the simple, yet spatially explicit model (catch curve analysis) provided details that were obscured by the more sophisticated model (VPA).

POSTSCRIPT

The latest assessment of the stock complex includes results of VPA, catch curve analysis and other methods because it was recognized that spatial scale may be important. For example, Rhode Island used a biomass dynamic model, Connecticut investigated trends using harvest values and survey indices, New York examined harvest trends, while New Jersey and Delaware conducted cross-sectional and longitudinal catch curve analyses (ASMFC 2006). The Tautog Review Panel encourages states to develop local stock assessments using appropriate models, with caution due to the lack of data in some cases, to complement the coast-wide assessment because of the potential for sub-stock structure in this species (ASMFC 2006).

ACKNOWLEDGEMENTS

We thank the Virginia Recreational Fishery Advisory Board for financial support and Robert O’Reilly (VMRC) for providing data and historical information. We also thank the Virginia Game Fish Tagging Program, an ongoing project jointly sponsored by VIMS and VMRC, the volunteer corps of trained anglers whose efforts contributed to the tagging database and Dan Hepworth for his work with this program. We thank the anonymous reviewers for insightful comments and helping to improve the manuscript. Also, a special thank you goes to the hundreds of anglers and commercial fishers reporting tagged tautog. This article is Contribution No. 2797 of the Virginia Institute of Marine Science, The College of William and Mary.

REFERENCES


As the Forum column in this issue of *Fisheries* indicates, the launch of a new journal in today’s environment is never free of controversy. With the multiple challenges of declining or steady-state library budgets, big investments in science publishing made by international commercial publishers, expanding open-access movements, and the general Internet/web emphasis on blogs and instantaneous information, it is no wonder that some scientific societies hesitate a lot before starting a new journal.

AFS in that sense is no exception. And again, the contribution published here expresses some of the hesitation and doubts. But the authors of that piece dwell at length on the “constitutionality” of the process that led to the unanimous decision by the AFS Governing Board to start the new journal.

To remind the reader of this process, a joint special committee of the Marine Fisheries and Estuaries Sections was formed by then President Kohler to examine the idea of publishing such a journal at AFS. That committee included representatives of the Publications Overview Committee (POC) in an effort to keep the POC informed of this work and gain their involvement in the discussions. This special committee contained participants from both Sections they felt were best qualified to judge: (1) the need for such a journal in those fields, (2) the new journal’s niche in the market, and (3) the possible mission, contents, and editorial policy of the journal.

Unfortunately, the communications between this special committee and the POC were less than ideal and these miscommunications persisted despite attempts by both chairs to reach a better understanding of each other.

Later, after that special committee reported to Governing Board mid-year meeting in March 2006, staff was directed by the Governing Board to provide the Board with different business plans and models for such a publication by the time of the 2006 Annual Meeting, in an effort to assess the financial and production implications for AFS from such development. These business plans were produced and then discussed at the Lake Placid meeting, where the Governing Board voted to launch this journal in the all-electronic, open-access mode of production.

During all of this, several members of the POC that time, including above all the chair, objected primarily on the grounds that the effort was led by a special committee, not by the POC. These objections culminated in the resignation of some POC members, including the chair, from POC membership. New members of the POC have been selected by President Nielsen. Several of those resigning after Lake Placid returned to continue their appointments and a fully functioning POC is currently chaired by Steven Cooke.

I am no constitutional authority nor am I a lawyer, nevertheless I believe that the process followed, while possibly novel for AFS, was not unusual in the sense that subject experts and experienced staff combined to present information to the highest authority in the Society, the Governing Board. The special committee’s recommendation was to launch such a journal, while the POC’s advice was to delay until the POC gave further consideration to the proposal. After both opinions were expressed, the Governing Board voted to take the advice of the first group. The ambiguities in such a course are many and if there were lapses in judgment along the path taken, the onus must fall on the executive director.

After all, the volunteers in any society, whether the presidential chain or committee members, are responsible only for performing their duties to the best of their ability and in the way they understand the requirements of office. The executive director, however, is responsible for making sure that communications among the various units and members involved in any given project are smooth and that consensus is achieved. In that I failed. I may have also over-interpreted the constitutional duties of the ED to launch new projects with the agreement of the ruling body elected by the membership (the Governing Board) to mean that while the advice of committees is useful and sometimes crucial, the Governing Board is the final arbiter for decisions made at AFS.

My excuse is that of enthusiasm for a project whose time has clearly come. Several other scientific societies are considering or have implemented new electronic journal opportunities, such as the American Institute of Fisheries Research Biologists, Ecological Society of America, and the American Institute of Biological Sciences, for example. The AFS has been in existence for 135 years and through most of that existence it has been known as a “freshwater fisheries” society, despite the fact that a substantial number of members work in the marine and coastal areas. To launch a new journal has some risks but these risks are minimal financially and the Society is healthy enough to take them on. And, in my opinion, it is time for scientific societies to take back some of the turf ceded to commercial publishers who have no members to care about or objectives beyond the need for profitability.

I feel confident that we will overcome the controversy and that those who authored the Forum piece will contribute their knowledge and expertise as the new journal takes shape with the guidance of the POC.
OPINION:
FISHERIES FORUM

A Perspective on the Decision to Establish an AFS Marine Journal

The scientific literature has seen a proliferation of peer-reviewed journals in the past few decades. The increased number of journals has provided more outlets for publication, but also has made it more difficult to keep up-to-date with the literature, and likely has diluted journal quality. In fact, in a search of the Web of Science, we found that papers including the word “fish” in the topic were published in 616 journals in 1984–1985 and in 2,355 journals in 2004–2005. In addition, a more restrictive search for the topic words “fish” and “marine” found such papers published in 38 journals in 1984–1985, but in 531 journals in 2004–2005. Given this abundance of existing journals, the initiation of any new American Fisheries Society (AFS) journal must be carefully considered. At present, AFS currently publishes four journals in addition to Fisheries—Transactions of the American Fisheries Society, North American Journal of Fisheries Management, North American Journal of Aquaculture, and the Journal of Aquatic Animal Health. Submissions to two of these journals have increased in recent years, while submissions for the other two have remained stable. Although AFS does not have an explicit policy for the formation of a new scientific journal, the AFS Constitution does mandate membership input on publication issues via the member-driven Publications Overview Committee (POC). The AFS Constitution states that if a new journal is proposed for publication by AFS, the AFS POC will evaluate that proposal and make a final recommendation to the AFS Governing Board, executive director, and publications manager. Although other bodies can certainly approach the AFS Governing Board and/or AFS officers with requests that a new journal be considered for publication, a final recommendation to the Governing Board must come from the POC.

Unfortunately, this was not the process that was followed in 2005–2006, which ultimately culminated in the AFS Governing Board’s unanimous decision to establish a new marine and coastal journal prior to hearing input from the POC. In fact, the POC was unanimous in recommending to the AFS Governing Board that further study of the marine and coastal journal was needed. In general, the POC wanted to fully evaluate the need for a new journal as well as explore whether more could be done to encourage marine scientists to publish in existing AFS journals and to strengthen the quality and impact factors of existing AFS journals before deciding to add another journal. We will not belabor the events concerning this issue that took place over the past 12 months, but several important points do bear mention here. First, an ad hoc committee was appointed to investigate the marine and coastal journal proposal without prior discussion with the POC, bringing into question the role and responsibilities of the POC. Second, the Governing Board charged the AFS executive director with formulating a business plan for the proposed journal without any contact having been made with the POC. Finally, the Governing Board voted unanimously to establish the new journal before the POC report was even presented, and thus before the POC motion to delay any decision (allowing a thorough and deliberate discussion) could even be considered. Because the POC’s motion was never made, no further deliberation could take place, and no additional information could be obtained.

We the undersigned are concerned that such a breach of constitutionally-mandated protocol undermines the member-driven approach that has made AFS a strong organization. In protest of this breach, most of the membership of the POC resigned after the Lake Placid AFS Annual Meeting. We hope that our present message to Governing Board members is clear—that protocols articulated in the AFS Constitution should be followed, and the AFS membership should always be heard before crucial decisions are made. Ultimately, we believe that at this point a broader, membership-driven debate should guide decisions about additions to the suite of journals produced by AFS.

Dennis R. DeVries
Gary G. Grossman
David H. Wahl
Jennifer A. Stone
Fred M. Utter
Cecil A. Jennings
Deirdre M. Kimball

The authors were members of the 2005–2006 Publications Overview Committee. DeVries can be contacted at devridr@auburn.edu.
The American Fisheries Society is seeking nominations and applications for several 2007 awards. Award recipients will be honored at the Annual Meeting in San Francisco, California, in September 2007. Nominations typically require a candidate's name, full contact information, biographical information, and/or history of service to the Society. Some awards require additional nomination materials. For more information on how to nominate an individual, or organization, see descriptions below or contact the award chair. For more information you may also contact AFS Awards Coordinator Gail Goldberg at ggoldberg@fisheries.org, or 301/897-8616 x201.

**Award of Excellence**
Presented to an AFS member for original and outstanding contributions to fisheries and aquatic biology.
Nomination deadline: 1 May 2007
Contact: Paola Ferreri
School Forestry Resources
Penn State University
207 Ferguson Building
University Park, PA 16802
Phone: 814/863-2095
Fax: 814/865-3725
E-mail: cpf3@psu.edu

**Carl R. Sullivan Fishery Conservation Award**
Presented to an individual or organization for outstanding contributions to the conservation of fishery resources. Eligibility is not restricted to AFS members, and accomplishments can include political, legal, educational, scientific, and managerial successes. Nominations should include a synopsis of fishery conservation contributions; a description of the influence of those contributions on improved understanding, management, or use of fishery resources; and at least one additional supporting letter.
Nomination deadline: 14 April 2007
Contact: Mary C. Fabrizio
Department of Fisheries Science
Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, VA 23062
(For UPS or FedEx use: Route 1208 Greate Road)
Phone: 804/684-7308
Fax: 804/684-7327
E-mail: mfabrizio@vims.edu

**Excellence in Public Outreach**
Presented to an AFS member who goes the "extra mile" in sharing the value of fisheries science/research with the general public through the popular media and other communication channels. Visit www.fisheries.org and click on "Awards" to see criteria and call for nominations.
Nomination deadline: 4 May 2007
Contact: Kevin Pope
University of Nebraska Lincoln
103 Miller Hall
Lincoln, NE 68583-0711
Phone: 402/472-7028
Fax: 402/472-2722
E-mail: k pope2@unl.edu

**Honorary Membership**
Presented to individuals who have achieved outstanding professional accomplishments or have given outstanding service to the Society. Honorary Members must be nominated by at least 100 active members and elected by a 2/3 majority of active members online.
Nomination deadline: TBA
Contact: Gail Goldberg
American Fisheries Society
5410 Grosvenor Lane, Suite 110
Bethesda, MD 20815
Phone: 301/897-8616 x201
E-mail: ggoldberg@fisheries.org

**Meritorious Service Award**
Presented to an individual for loyalty, dedication, and meritorious service to the Society throughout the years; and for exceptional commitment to AFS’s programs, objectives, and goals.
Nomination deadline: 1 May 2007
Contact: Carolyn Griswold
National Marine Fisheries Service
28 Tarzwell Drive
Narragansett, RI 02882
Phone: 401/782-3273
Fax: 401/782-3201
E-mail: carolyn.griswold@noaa.gov

**Outstanding Chapter Award**
Recognizes outstanding professionalism, active resource protection, and enhancement programs, as well as a strong commitment to the mission of the Society. Two awards are given, one for small chapters and one for large chapters. Chapters should submit an application to their Division presidents to be considered. Division presidents must nominate two best Chapters from their Divisions, one with less than 100 members and another with 100 members or more. Obtain applications at www.fisheries.org, click on “Awards.”
Nomination deadline: TBA
Contact: Co-chairs, Bob Curry or Margaret Murphy
Bob Curry
1721 Mail Service Ctr.
Raleigh, NC 27699-1721
Phone: 919/707-0221
Fax: 919/707-0028
E-mail: Robert.Curry@ncwildlife.org
Margaret Murphy
QEA LLC
290 Elwood Davis Rd.
Liverpool, NY 13088
Phone: 315/453-9009
Fax: 315/435-9010
E-mail: mmurphy@qeallc.com
President’s Fishery Conservation Award
Presented in two categories: (1) an AFS individual or unit, or (2) a non-AFS individual or entity, for singular accomplishments or long-term contributions that advance aquatic resource conservation at a regional or local level. The award is administered by the Past President’s Advisory Council. A nomination package should include a strong and detailed letter describing the nominee’s contribution and the evidence for accomplishment at a regional or local level. If the nomination is for an individual, include a CV if possible. Nominations may be supported by multiple individuals by signing one nomination letter, or by submitting supporting letters in addition to the main nomination letter. Include the nominee’s title and full contact information (address, e-mail, phone).
Nomination deadline: 14 May 2007
Contact: Chris Kohler
Fisheries Illinois Aquaculture Center
Southern Illinois University
Carbondale, IL 62901-6511
Phone: 618/453-2890
Fax: 618/453-6095
E-mail: ckohler@siu.edu

William E. Ricker Resource Conservation Award
Presented to any entity (individual, group, agency, or company) for accomplishment or activity that advances aquatic resource conservation that is significant at a national or international level. The award is administered by the Past President’s Advisory Council. A nomination package should include a strong and detailed letter describing the nominee’s accomplishments and the evidence for being “significant at a national or international level.” If the nomination is for an individual, include a CV if possible. Nominations may be supported by multiple individuals by signing one letter, or by submitting supporting letters in addition to the main nomination letter. Include the nominee’s title and full contact information (address, e-mail, phone).
Nomination deadline: 14 May 2007
Contact: Chris Kohler
Fisheries Illinois Aquaculture Ctr.
Southern Illinois University
Carbondale, IL 62901-6511
Phone: 618/453-2890
Fax: 618/453-6095
E-mail: ckohler@siu.edu

Retired Members Travel Award for the AFS Annual Meeting
The American Fisheries Society has established this travel award to encourage and enable members of the Society to attend Annual Meetings, particularly those members who might play a more active role in the meeting. The Society recognizes that some retired members who desire to participate in the Annual Meeting might be inhibited for financial reasons. Retired members may not have funds for travel to meetings that were available to them while employed. Therefore, this award is meant for those members who truly have a need for financial assistance. The Society has neither means nor desire to verify financial need, so that your request for support is based on an honor system. However, you must be a dues-paying retired member of the American Fisheries Society to apply. You may request up to $1,500 for reimbursable expenses. See www.fisheries.org, and click on “Awards” to get an application.
Nomination deadline: 18 June 2007
Contact: Chris Kohler
Fisheries Illinois Aquaculture Center
Southern Illinois University
Carbondale, IL 62901-6511
Phone: 618/453-2890
Fax: 618/453-6095
E-mail: ckohler@siu.edu

Student Writing Contest
Recognizes students for excellence in the communication of fisheries research to the general public. Undergraduate and graduate students are asked to submit a 500 to 700 word article explaining their own research or a research project in their lab or school. The article must be written in language understandable to the general public (i.e., journalistic style). The winning article will be published in Fisheries. See www.fisheries.org and click on “Awards” for student writing contest rules and further description.
Submission deadline: 4 May 2007
Contact: Kevin Pope
University of Nebraska Lincoln
103 Miller Hall
Lincoln, NE 68583-0711
Phone: 402-472-7028
Fax: 402-472-2722
E-mail: kpopez2@unl.edu

Equal Opportunities Section J. Frances Allen Scholarship Award
The American Fisheries Society (AFS) is pleased to announce that applications are being accepted until 12 March 2007 (postmark date), for the J. Frances Allen Scholarship for a female doctoral fisheries student. The Allen Scholarship was established in 1986 to honor Allen, who pioneered women’s involvement in the AFS and in the field of fisheries. The scholarship fund was established with the intent of encouraging women to become fisheries professionals.
Eligibility: The qualified applicant must be a female Ph.D. student who was an AFS member as of 31 December 2006. The applicant must be conducting aquatic research in line with AFS objectives, which include “all
branches of fisheries science, including but not limited to aquatic biology, engineering, fish culture, limnology, oceanography, and sociology.”

To apply: Submit items A through D in the same package:

A. Resume (10 copies) with information in the following format

- educational history: degrees, grade point average for each degree (overall and in major), relevant courses taken;
- professional experience: positions held, level of position, years of experience at each level;
- publications: separated into refereed and other;
- presentations: “first author” implies you presented it, “second author” assumes you did not, specify if otherwise; and
- AFS participation: year joined, meeting attendance and participation, committee involvement, presentations at AFS meetings.

B. Transcripts (10 copies) from all institutions of higher education attended; include enrollment in Ph.D. program. High quality photocopies are acceptable. Please include transcripts. Do not have them sent separately.

C. Dissertation research proposal (10 copies), not to exceed 4 single-spaced pages (excluding separate title page, abstract, and references). The proposal must be submitted in the following single-spaced format with headings:

- Title page with project title, area of research (e.g., genetics, ecology, modeling), applicant's name, university, and department
- Abstract, not to exceed one half-page, describing research proposed
- Introduction of project with background and project justification
- Problem statement with specific objectives or hypotheses
- Summary of procedures and methods with justification for choices, including preliminary testing, literature references
- Expected and preliminary results
- Significance of research or anticipated application of findings
- Literature cited (follow format for Transactions of the American Fisheries Society).

D. Three letters of recommendation, one of which must be from the applicant's major advisor. One letter must be from an AFS member. Each letter should address:

1. applicant's promise as a fisheries scientist
2. potential of applicant to complete their proposed work
3. significance of the applicant's proposed research to the advancement of fisheries science.

Send applications and recommendations (in one mailing), postmarked by 12 March 2007 to:

J. Francis Allen Scholarship
American Fisheries Society
5410 Grosvenor Lane Ste. 110
Bethesda, MD 20814-2199

An application will not be reviewed if any part is missing, or if it is received after the deadline.

Criteria for Selection: Selection will be made by the J. Frances Allen Scholarship Committee of the AFS Equal Opportunities Section. Proposal reviews by scientists in appropriate fields will be solicited by the committee. Awardees will be selected on a competitive basis with emphasis placed on research promise, scientific merit, and academic achievement. Submission of an application acknowledges the applicant's acceptance of the committee's decision as final.

Public Announcement and Notification: Public announcement of the recipient of the J. Frances Allen Scholarship will be made at the 2007 AFS Annual Meeting in San Francisco, California. In addition a written announcement will appear in Fisheries and the recipient will receive an official letter of award. The recipient is encouraged to present the results of her research at an Annual Meeting of the Society. It is expected that the research findings will be published in an appropriate fisheries journal upon project completion, at which time the support from this scholarship and AFS will be acknowledged.

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Feb 4—ASLO Aquatic Sciences Meeting, Santa Fe, NM. See aslo.org/meetings/santafe2007/. Contact Helen Lemay at business@aslo.org.

Feb 7—Biennial Congress of the Indian Society of Fisheries Professionals, (CIFE), Mumbai.


Feb 8-10—Evolutionary Change in Human-altered Environments: An International Summit to Translate Science into Policy, Los Angeles, CA. See www.ioe.ucla.edu/ctr/ioesymposium.html.


Feb 15-17—Catfish Farmers of America Annual Convention and Fish Farming Trade Show, Orange Beach, AL. See www.perdido beach resort.com. Contact 1-800/634-7263.

Feb 15-19—Annual Meeting of the American Association for the Advancement of Science: Science and Technology for Sustainable Well-Being. See www.aaas.org/meetings/annual_Meeting/.

Feb 18-23—Sixth International Symposium on Ecohydrologics, Christchurch, New Zealand. See www.conference.co.nz/eco hydrologics2007. (AFS members receive a 10% registration discount.) Contact Rachel Cook, rachel@conference.co.nz.


Mar 1—AFS Midyear Governing Board Meeting, Atlanta, GA. Contact Sharon Smith, ssmith@fisheries.org, 301/897-8616 x230.


Mar 12-15—International Symposium on Tuna and Pelagic Fish Stock Assessments and Management, Shanghai, China. See www.marine.maine.edu. contact Yong Chen, ychen@maine.edu, 207/581-4303.


Apr 15-17—18th Northeastern Recreation Research Symposium, Lake George, NY. See www.esf.edu/nerr/.


May 14-15—AIBS Annual Meeting: Evolutionary Biology and Human Health and Annual Meeting of the National Science Collections Alliance, Washington, DC. See www.aibs.org/annual-meeting.


Jun 17-21—Seventh Conference on Fish Telemetry, Silkeborg, Denmark. See www.fishtelemetry.eu/.


Jun 18-21—Second International Symposium on Diadromus Fishes: Challenges for Diadromous Fishes in a Dynamic Global Environment, Halifax, Nova Scotia, Canada. See www.anacat.ca. Contact Alex Haro, Alex_Haro@usgs.govd.


Jul 11-16—Joint Meeting of Ichthyologists and Herpetologists, St. Louis, Missouri. See www.dce.ksu.edu/jointmeeting/.


Jul 22-26—Coastal Zone ‘07, Portland, OR. See www.csc.noaa.gov/cz/.

Jul 27—National Marine Educators Association Conference, Portland, ME. Contact Downeast2007@gonmea.org.


2008

Feb 28-Mar 2—Southern Division of the American Fisheries Society and West Virginia Chapter of AFS, Wheeling, WV. See www.sdfs.org/meetings.


Oct 5-9—Pathways to Success 2008 Conference: Integrating Human Dimensions into Fishes and Wildlife, Estes Park, CO. See www.warnercnr.colostate.edu/nrt/hdfw/partners.html. Contact eduke@warnercnr.colostate.edu.

2009

Aug 30-Sep 3—American Fisheries Society 139th Annual Meeting, Nashville, TN.
GUIDELINES:
Fisheries 2007 GUIDE FOR AUTHORS

MISSION STATEMENT
Fisheries is the monthly membership magazine of the American Fisheries Society. Its goal is to provide timely, useful, and accurate information on fisheries science, management, and the fisheries profession for AFS members.

Although peer-reviewed and frequently cited, Fisheries is not considered an AFS journal. Lengthy, specialized, or highly technical research articles should be submitted to one of the four AFS journals. Some types of articles which are suitable for Fisheries include fishery case histories, review or synthesis articles covering a specific issue, policy articles, perspective or opinion pieces, essays, and current events or news features. Short research articles may be considered if the research has broad implications or applications and the article can be readily understood by professionals of a variety of backgrounds. We also encourage articles that will expose our members to new or different fields and recognize the varied interests of our readers. Potential Fisheries articles do not need to appeal to all of our members, but should be of interest to at least a substantial portion.

REVIEWED ARTICLES

Features and Perspectives
We encourage submission of topical manuscripts of broad interest to our readership that address contemporary issues and problems in all aspects of fisheries science, management, and policy. Articles on fisheries management; aquatic resources; economics; educational/administrative concepts, controversies, techniques, philosophies, and developments; and other general-interest, fisheries-oriented subjects will be considered. Policy and issue papers are welcome. Papers are judged on scientific and professional merit, relevance, and interest to fisheries professionals. Features and perspectives should not exceed 4,500 words (excluding references and tables) and should not cite more than 40 references. Please consult the senior or managing editor PRIOR to submission for a length or reference limit exemption for articles of Society-wide significance.

Please submit your manuscript online using our manuscript tracking website at http://fisheries.allentrack.net. If you cannot submit your manuscript online, please e-mail or phone the managing editor for instructions (bbeard@fisheries.org or 301/897-8616 x220).

What to Submit

• Assemble manuscript in this order: title page, abstract page, text, references, tables, figure captions. Tables may included at the end of the article file or may be submitted as separate files. Figures should not be embedded in the article file and should be submitted separately.
• Authors are strongly encouraged to submit a word processing file in either Word, Word Perfect, or Text formats. Figures/images should be in TIF or EPS formats and tables should be in Excel or Word formats.
• The cover letter should explain how your paper is innovative, provocative, timely, and of interest to a broad audience. It should also include a list of colleagues who have seen the manuscript in draft. The cover letter can also be used to provide further explanation if part of the information has been published or presented previously.

General Instructions

• Consult current issues for additional guidance on format.
• Manuscripts should be double-spaced, including tables, references, and figure captions.
• Leave at least a 1-in margin on all sides. Indent all paragraphs. Number pages sequentially.
• Please number lines for use as reference points by the reviewers. In Word, this feature is found in the File menu under Page Setup.
• Use dictionary preference for hyphenation. Do not hyphenate a word at the end of a line. Use Chicago Manual of Style, 14th edition, to answer grammar or usage questions.
• The first mention of a common name should be followed by the scientific name in parentheses. Our standard is Common and Scientific Names of Fishes from the United States, Canada, and Mexico, 6th edition.
• Cite each figure and table in the text. Organize text so each is cited in numerical order.
• Use metric units of measure. Imperial equivalents may be given in parentheses.
• Define abbreviations the first time they are used in the text.
• Spell out one-digit numbers unless they are units of measure (e.g., four fishes, 3 mm, 35 sites). Use 1,000 instead of 1000; 0.13 instead of .13; % instead of percent.
• Use the name-and-year system for references in the text as follows:
  1. One author: Jones (1995) or (Jones 1995);
  2. Two authors: Jones and Jackson (1995) or (Jones and Jackson 1995);
  3. Several authors: Jones et al. (1995) or (Jones et al. 1995). But include author names in references.
  4. Manuscripts accepted for publication but not yet published: Jones and Smith (in press) or (Jones and Smith in press).
  5. Personal communications: (J. Jones, Institute for Aquatics, pers. comm.).
  6. Within parentheses, use a semicolon to separate different types of citations (Figure 4; Table 2), (Jones and Smith 1989; Felix and Anderson 1998). Arrange lists of citations chronologically (oldest first) in a text sentence.
• DO NOT cite more than three references for a specific point.
• For quotations include page number (Jones 1996:301).
Fisheries 2007 GUIDE FOR AUTHORS

- Institutional authors may be cited as acronyms in the text but must be defined in the reference list.

**Title Page**
- Type the title near the middle of the page, centered, in caps and lowercase.
- Keep the title short, preferably less than seven words; it should accurately reflect the paper’s content. Use common names.
- Below title, include author(s) name(s) and title(s). In multi-authored works, indicate which author is responsible for correspondence.

**Abstract Page**
- Type the abstract as one paragraph. You can copy and paste this into the online form.
- Do not cite references or use abbreviations in the abstract.
- Ensure that the abstract concisely states (150 words maximum) why you did the study, what you did, what you found, and what your results mean.

**Text**
- See “General Instructions.”
- Set all type at left. Boldface primary subheads and italicize secondary subheads.
- Insert tabs—not spaces—for paragraph indents.
- Italicize any words that should appear in italics.
- Avoid footnotes by including the information in the text.

**References**
- Double-space between each reference entry but do not indent text. References will be formatted during the production process.
- Alphabetize entries first by the surnames of senior authors and the first word or acronym of corporate authors; second, by the initials of the senior authors with the same surname; and third, by the surnames of junior authors. References by a single author precede multi-authored works by the same senior author, regardless of date.
- List multiple works by the same author(s) chronologically, beginning with earliest date of publication.
- Distinguish papers by the same author(s) in the same year by putting lowercase letters after the date (1995a, 1995b).
- Use a long dash when the author(s) is/are the same as in the immediately preceding citation.
- “In press” citations must have been accepted for publication, and the name of the journal or publisher must be included.
- Insert a period and space after each author(s) in the same year by putting lowercase letters after the date (1995a, 1995b).
- Do not abbreviate journal names. Insert a period and space after each author(s) in the same year by putting lowercase letters after the date (1995a, 1995b).

**Tables**
- Tables may be included with the article or submitted as separate files.
- Double-space everything, including the table title and column headings.
- Use single horizontal lines to separate column heads and to indicate the end of the table—other horizontal lines are not needed. Never use vertical lines.
- Use sentence-style captions for tables, not fragments.
- Capitalize only the first letter of the nouns.

**Illustrations**
- Illustrations are photographs, drawings, or figures. All illustrations will print in black-and-white unless an extra payment is made for color. Consult the editor about color costs if interested. Prepare illustrations using professional standards, and consult issues of Fisheries for examples.
- For review on the manuscript tracking system, we prefer digital photos (or scans). However, original film photos and slides will provide better resolution for final production. The managing editor or production editor will contact you after acceptance and let you know when to send original photos.

**Page Proofs and Reprints**
The corresponding author will receive page proofs of the laid-out article (usually sent as a PDF file via e-mail) approximately four to six weeks prior to publication. Check carefully for typographical errors and possible problems with the placement or captions of illustrations. Extensive revision is not allowed at this stage. Indicate any changes and return page proofs within 48 hours to Production Editor; AFS; 5410 Grosvenor Lane, Suite 110; Bethesda, MD 20814-2199; 301/897-8616; fax 301/897-8097; cworth@fisheries.org.
Reprint order forms will be provided to the corresponding author with page proofs. Orders should be placed with Allen Press, Inc. (fax 785/843-7251, phone 785/843-6343, reprints@allenpress.com) no later than two weeks prior to publication.

**Conditions for Publication**
Charges are US$85 per published page and are billed to the author within two months of publication. AFS members may request full or partial subsidy of their papers if they lack institutional or grant funds to cover page charges. Technical
reviews and acceptability of manuscripts are independent of the need for subsidy. All manuscripts will be reviewed by two or more outside experts in the subject of the manuscript and evaluated for publication by the science editors and editor. Authors may request anonymity during the review process and should structure their manuscripts accordingly. Papers are accepted for publication on the condition that they are submitted solely to *Fisheries* and that they will not be reprinted or translated without the publisher’s permission. See “Dual Publication of Scientific Information,” *Transactions* 110:573-574 (1981). The AFS requires an assignment of copyright from all authors, except for articles written on government time or for the government that cannot be copyrighted. Authors must obtain written permission to reprint any copyrighted material that has been published elsewhere, including tables and figures. Copies of the permission letter must be enclosed with the manuscript and credit given to the source.

**ESSAYS**

Essays are thought-provoking or opinion articles based upon sound science. Essays may cover a wide range of topics, including professional, conservation, research, American Fisheries Society (AFS), political, management, and other issues. Essays may be submitted in conjunction with a full feature article on the same topic. Essays range from 1,200–1,400 words, may include photographs or illustrations, and should not cite more than eight references. However, essays should provide scientific documentation, unlike unreviewed editorials (below).

Essays are peer-reviewed based on the following criteria: contribution to the ongoing debate, logical opinion based on good science, persuasiveness, and clarity of writing. Reviewer agreement with the opinion of the views expressed is not a criterion. Essays do not have page charges or abstracts. Essays should be formatted and submitted online as above.

**UNREVIEWED ARTICLES**

**Unit News and Other Departments**

AFS members are encouraged to submit items for the Unit News, Member Happenings, Obituaries, Letters to the Editor, and Calendar departments. Dated material (calls for papers, meeting announcements, nominations for awards) should be submitted as early as possible, but at least eight weeks before the requested month of publication. AFS Unit News and Letters should be kept under 400 words and may be edited for length or content. Obituaries for former or current AFS members may be up 600 words long. Do NOT use the online manuscript tracking system to submit these items—the text and 300 dpi electronic photos for all departments except the Calendar should be e-mailed to the managing editor at bb beard@fisheries.org or mailed to the address below. Calendar items should include the date, event title, location, and contact information, and should be sent to the Production Editor at c worth@fisheries.org. For information about submitting a Students’ Angle column, please contact Student Subsection President Justin Davis, justin.p.davis@huskymail.uconn.edu.

**Fisheries News**

Brief items for the fisheries news section are encouraged. Typical items include conservation news, science news, new programs of significance, major policy or regulatory initiatives, and other items that would be of interest to *Fisheries* readers. News items for the section should be no more than a few paragraphs; please consult the managing editor about submitting longer news articles.

**Fisheries Forum (formerly Guest Editorials)**

Authors are encouraged to submit most opinion pieces about fisheries science or management as essays for peer review. Occasionally, editorials about professional or policy issues may be inherently unsuitable for a scientific review.

Sometimes these pieces are submitted by a committee, agency, or organization. Editorials should be 750–1,500 words, may be edited for length or content, and referred for outside review or rebuttal if necessary. A disclaimer will accompany all *Fisheries* Forum editorials.

**Book Reviews**

Please contact Book Review Editor Francis Juanes at, juanes@forwild.umass.edu if you want to be added to the list of potential book reviewers. New books (preferably two copies) submitted for review should be sent to Francis Juanes, Department of Natural Resources Conservation, University of Massachusetts, Amherst, MA 01003–4210.

**QUESTIONS?**

Contact Managing Editor Beth Beard; AFS; 5410 Grosvenor Lane, Suite 110; Bethesda, MD 20814–2199; 301/897–8616, ext. 220; bb beard@fisheries.org. Detailed instructions for using the online manuscript tracking system are available at http://fisheries.allentrack.net.

Also see the *Fisheries* Guidelines for Reviewers and the Guidelines for Case Studies at www.fisheries.org.
### Unit Dates Location For More Information

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<tr>
<th>Unit</th>
<th>Dates</th>
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<tr>
<td>Alabama</td>
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<tr>
<td>Arizona-New Mexico</td>
<td>Feb 6-8</td>
<td>Albuquerque, NM</td>
<td>Pete David, 505/449-7018, <a href="mailto:cp_david@msn.com">cp_david@msn.com</a></td>
</tr>
<tr>
<td>Arkansas</td>
<td>Jan 31-Feb 2</td>
<td>Mountain View</td>
<td>Jim Wise, <a href="mailto:wise@adeq.state.ar.us">wise@adeq.state.ar.us</a></td>
</tr>
<tr>
<td>Atlantic International</td>
<td>Sep 2007</td>
<td>TBA</td>
<td>Steve Shepard, <a href="mailto:aquatics@adelphi.net">aquatics@adelphi.net</a>, 207/989-5056</td>
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<tr>
<td>Auburn University</td>
<td>TBA</td>
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<td>Bonneville</td>
<td>Mar 19-21</td>
<td>Logan, Utah</td>
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<td>California-Nevada (with Parent Society)</td>
<td>Sep 2-6</td>
<td>San Francisco, CA</td>
<td><a href="http://www.fisheries.org/sl/">www.fisheries.org/sl/</a></td>
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<td>Colorado-Wyoming</td>
<td>Feb 26-Mar1</td>
<td>Fort Collins, CO</td>
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<tr>
<td>Dakota</td>
<td>Feb 26-28</td>
<td>Bismarck, ND</td>
<td>Jason Lee, <a href="mailto:jalee@nd.gov">jalee@nd.gov</a>, 701/328-6688</td>
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<tr>
<td>Florida</td>
<td>Feb 20-22</td>
<td>Ocala</td>
<td><a href="http://www.sdfs.org/lafs/">www.sdfs.org/lafs/</a></td>
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<td>Georgia (with South Carolina)</td>
<td>Jan 23-25</td>
<td>Tybee Island</td>
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<td>Idaho</td>
<td>Feb 21-23</td>
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<td><a href="http://www.idahoafs.org">www.idahoafs.org</a></td>
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<tr>
<td>Illinois</td>
<td>Feb 27-Mar 1</td>
<td>Shelbyville</td>
<td>James Garvey, <a href="mailto:jgarvey@isu.edu">jgarvey@isu.edu</a></td>
</tr>
<tr>
<td>Indiana (with Michigan and Ohio)</td>
<td>Feb 14-15</td>
<td>Angola, IN</td>
<td>Angela Grier, <a href="mailto:agrier@dnr.in.gov">agrier@dnr.in.gov</a>, 260/244-6805</td>
</tr>
<tr>
<td>Iowa (with Kansas and Nebraska)</td>
<td>Jan 18-20</td>
<td>Council Bluffs</td>
<td>Mark Flammang, <a href="mailto:mark.flammang@dnr.state.ia.us">mark.flammang@dnr.state.ia.us</a></td>
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<tr>
<td>Kansas (with Iowa and Nebraska)</td>
<td>Jan 18-20</td>
<td>Council Bluffs, IA</td>
<td>Mark Flammang, <a href="mailto:mark.flammang@dnr.state.ia.us">mark.flammang@dnr.state.ia.us</a></td>
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<td>Louisiana</td>
<td>Feb 1-2</td>
<td>Thibodaux</td>
<td>Quentin Fontenot, <a href="mailto:quenton.fontenot@nicholls.edu">quenton.fontenot@nicholls.edu</a>, 985/449-7062, <a href="http://www.sdfs.org/laafs">www.sdfs.org/laafs</a></td>
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<td>Mexico</td>
<td>May 2-4</td>
<td>La Paz</td>
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<tr>
<td>Michigan (with Ohio and Indiana)</td>
<td>Feb 14-15</td>
<td>Angola</td>
<td>Angela Grier, <a href="mailto:agrier@dnr.in.gov">agrier@dnr.in.gov</a>, 260/244-6805</td>
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<tr>
<td>Mid-Atlantic (with Tidewater)</td>
<td>Feb 1-3</td>
<td>Lewes, DE</td>
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<tr>
<td>Minnesota</td>
<td>Mar 19-21</td>
<td>St. Cloud</td>
<td>Daniel Isermann, 218/833-8638, <a href="mailto:dan.isermann@dnr.state.mn.us">dan.isermann@dnr.state.mn.us</a></td>
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<td>Missouri</td>
<td>Feb 1</td>
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<td>Montana</td>
<td>Feb 13-17</td>
<td>Missoula</td>
<td>David Schmetterling, <a href="mailto:dschmett@bigsky.net">dschmett@bigsky.net</a></td>
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<tr>
<td>Nebraska (with Iowa and Kansas)</td>
<td>Jan 18-20</td>
<td>Council Bluffs, IA</td>
<td>Mark Flammang, <a href="mailto:mark.flammang@dnr.state.ia.us">mark.flammang@dnr.state.ia.us</a></td>
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<tr>
<td>New York</td>
<td>Feb 8-9</td>
<td>West Point</td>
<td><a href="http://www.newyorkafs.org">www.newyorkafs.org</a></td>
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<tr>
<td>Northeastern Division</td>
<td>Apr 22-25</td>
<td>Mystic, CT</td>
<td>Rod Wentworth, <a href="mailto:rod.wentworth@state.vt.us">rod.wentworth@state.vt.us</a>, 802/241-3709</td>
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<tr>
<td>North Carolina (with Virginia)</td>
<td>Feb 26-28</td>
<td>Danville, VA</td>
<td><a href="http://faculty.virginia.edu/cifs/">http://faculty.virginia.edu/cifs/</a></td>
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<td>North Central Division</td>
<td>Dec 9-12</td>
<td>Madison, WI</td>
<td><a href="http://midwest.ncd-afs.org/index.aspx">http://midwest.ncd-afs.org/index.aspx</a></td>
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<td>Feb 14-15</td>
<td>Angola, IN</td>
<td>Angola Grier, <a href="mailto:agrier@dnr.in.gov">agrier@dnr.in.gov</a>, 260/244-6805</td>
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<tr>
<td>Oklahoma</td>
<td>Feb 21-23</td>
<td>Tulsa</td>
<td>Cliff Sager, <a href="mailto:cs_odwv@hughes.net">cs_odwv@hughes.net</a>, 908-683-1031</td>
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<tr>
<td>Ontario</td>
<td>Mar 1-3</td>
<td>Orillia</td>
<td>Jack lmhof, <a href="mailto:president-elect@afs-oc.org">president-elect@afs-oc.org</a>, <a href="http://www.afs-oc.org">www.afs-oc.org</a></td>
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<td>Feb 27-Mar 2</td>
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<td>Mar 9</td>
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<td>Southern Division (with Tennessee)</td>
<td>Feb 8-12</td>
<td>Memphis, TN</td>
<td><a href="http://www.sdfs.org/meetings2007">www.sdfs.org/meetings2007</a></td>
</tr>
<tr>
<td>Southern New England</td>
<td>Jan 10</td>
<td>New London, CT</td>
<td>David Taylor, <a href="mailto:dtabay@rwu.edu">dtabay@rwu.edu</a></td>
</tr>
<tr>
<td>Tennessee (with Southern Division)</td>
<td>Feb 8-12</td>
<td>Memphis</td>
<td><a href="http://www.sdfs.org/meetings2007">www.sdfs.org/meetings2007</a></td>
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<tr>
<td>Texas</td>
<td>Feb 9 - 11</td>
<td>Lake Jackson</td>
<td>Art Morris, <a href="mailto:art.morris@tpwd.state.tx.us">art.morris@tpwd.state.tx.us</a></td>
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<td>Texas A &amp; M</td>
<td>TBA</td>
<td>TBA</td>
<td>TBA</td>
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<tr>
<td>Tidewater (with Mid Atlantic)</td>
<td>Feb 1-3</td>
<td>Lewes, DE</td>
<td><a href="http://www.sdfs.org/tidewater/">www.sdfs.org/tidewater/</a></td>
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<tr>
<td>Virginia (with North Carolina)</td>
<td>Feb 26-28</td>
<td>Danville, VA</td>
<td><a href="http://faculty.virginia.edu/cifs/">http://faculty.virginia.edu/cifs/</a></td>
</tr>
<tr>
<td>Virginia Tech</td>
<td>May</td>
<td>Blacksburg</td>
<td>Joanne Davie, <a href="mailto:davisje@vt.edu">davisje@vt.edu</a></td>
</tr>
<tr>
<td>West Virginia (with Pennsylvania)</td>
<td>Mar 9</td>
<td>Morgantown</td>
<td><a href="http://www.sdfs.org/lwvaafs/Meetings.htm">www.sdfs.org/lwvaafs/Meetings.htm</a></td>
</tr>
<tr>
<td>Western Division (with Parent Society)</td>
<td>Sep 2-6</td>
<td>San Francisco, CA</td>
<td>Bob Hughes, <a href="mailto:Hughes.bob@epa.gov">Hughes.bob@epa.gov</a></td>
</tr>
<tr>
<td>Wisconsin</td>
<td>Jan 9-11</td>
<td>Milwaukee</td>
<td>Tom Slawski, <a href="mailto:tlawski@sewprc.org">tlawski@sewprc.org</a></td>
</tr>
</tbody>
</table>

### Chapter Officers:
Please send updates to Gail Goldberg, ggoldberg@fisheries.org, fax: 301/897-8096, 5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814
Writing, Publishing, and Reviewing: 
The Students’ Perspective

Students are the future of the fisheries profession and our experiences and attitudes vary when we enter the profession (Kohler 2005). Student experiences and opinions regarding publishing are highly varied, which may lead to increased anxiety because of the importance placed on this topic. Publishing is positively linked to the ability to secure gainful employment and career advancement. As such, students feel pressure to publish, but are often uncertain about the correct approach to contribute to science, as well as benefit their future. In an effort to characterize students’ experience and opinions of the publishing process, we informally surveyed several Ph.D. students throughout the United States regarding their attitudes toward the reviewing and writing process. Our findings were originally presented as part of a symposium entitled “Written Communications: Writing and Reviewing Papers for Fisheries Journals,” held at the American Fisheries Society 135th Annual Meeting in Anchorage, Alaska, in September 2005.

We distributed 49 surveys and received 20 (41%) completed surveys. Respondents represented 13 universities in 13 states. The majority of students had experience conducting peer review (95%) and had at least one article published in fisheries or aquatic sciences journals (79%). All students indicated that they had received some training in peer review, and the types of training they preferred were largely in agreement with the training they received (Table 1). The types of training were mentoring, experience through preparing personal manuscripts, hands-on participation with an experienced reviewer, coursework, and through peer groups. It was suggested by several respondents that a workshop through a professional society (e.g., AFS) may be beneficial.

Students also had the opportunity to define components of a “good” publishable manuscript and a “poor” nonpublishable manuscript in the context of reviewing. The majority of students indicated that a manuscript should be well-written, contribute to science, and have a good study design. Conversely, components of a “poor” manuscript included improper design, poor writing, no justification, inconclusive results or unsupported conclusions, inappropriate analytical techniques, and limited contribution to the body of existing knowledge (Table 1). Students indicated that a poor manuscript is hard to define, as any combination of these shortcomings could lead to a label of a “poor.” Common challenges for students in the peer review process were inadequate qualifications, lack of confidence or experience, and time constraints.

We also surveyed students as manuscript contributors. The average history for respondents was 2.5 published manuscripts, 0.5 manuscripts in press, 1 manuscript in review, and 2.5 manuscripts in preparation. Students were authors on manuscripts representing all stages of the publication process. One student, for example, indicated the number of manuscripts in preparation as “infinite.” That student no doubt is referring to the boundless potential for our ideas and we interpret this comment as a measure of enthusiasm. Finally, many students also experienced manuscript rejections (mean = 0.75 articles rejected).

Students learned to write for publication in a variety of ways. Learning by doing or revising one’s work, extensive reading, reviewing others’ work, and coursework were the primary ways in which students indicated that they learned the writing process (Table 1). Guides for authors and participating in peer groups also were noted as useful in the process.

The majority of students described the manuscript submission process as positive (Table 1). Many of the reviews received were considered clear, concise, and constructive. However, challenges in receiving manuscript reviews included vague instructions, non-constructive comments, a seeming lack of qualifications by the reviewer, and unrealistic suggestions. Respondents also indicated that quality of feedback was variable depending on the manuscript reviewer. Neff and Olden (2006) also indicated that the peer-review process can contain a strong “lottery” component, independent of the editor and referee integrity, and likely influenced the variability in responses. This lottery component is the result of a limited number of journal referees that occasionally leads to certain unsuitable manuscripts being published and other suitable manuscripts being rejected. Although students indicated some negative aspects to the review process, they noted many good overall impressions. Of the student manuscripts that were reviewed, students generally agreed with suggested changes 80% of the time, while 50% of the time they disagreed. This disparity likely resulted because of a combination of agreements and disagreements within the same manuscript. Finally, 100% of respondents indicated that they resolved disagreements with reviewers through the editor by providing justification for their argument.

Although the publication process was viewed as generally positive by
students, some significant challenges were identified. These included time constraints, high turnaround time, working with coauthors, and synthesizing established information on research topics (Table 1). Overall, students indicated that writing and submitting manuscripts was a difficult and sometimes painful endeavor. Great writing is the product of torturous editing, pride-swallowing reviews, and lots of hard work.

The high level of importance of publishing for students was also evident in our survey. Most students (95%) indicated that publishing was extremely important to their research. Students identified a variety of reasons of why publishing was important: publishing completes the research cycle, is critical for gaining employment, demonstrates competency, is involved in personal satisfaction, and upholds standards of research (Table 1). No respondent indicated that publishing was not important to their research.

Students were also asked their opinions regarding publications of narrow or broad scope. Publications of narrow scope are often referred to as "least publishable units" (LPU). Although this term generates varied opinions, we defined it for the survey as a well-prepared manuscript with a narrow scope or limited contribution to the field. Some students strongly felt the LPU was negative, while others strongly supported them. However, most respondents indicated that both types were appropriate, depending on the journal, scope of the project, and complexity of the project. Students also indicated that having a variety of publications was valuable for future employment. Many students indicated that absolute numbers were the best for gaining employment but also that it depended on their desired position or career goals. The LPU has advantages and disadvantages that likely contributed to the variability in student opinions.

There is much debate about the LPU within scientific circles. Least publishable units are easier to organize, promote rapid dissemination of knowledge, and make available scrutiny of different aspects of a larger work in

Table 1. Selected abbreviated survey questions and percentage of student responses.

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
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<tbody>
<tr>
<td><strong>Type of peer review training experienced</strong></td>
<td></td>
</tr>
<tr>
<td>Mentoring—80%</td>
<td></td>
</tr>
<tr>
<td>Experience through personal manuscripts—70%</td>
<td></td>
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<tr>
<td>Hands-on with experienced reviewer—65%</td>
<td></td>
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<tr>
<td>Coursework—40%</td>
<td></td>
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<tr>
<td>Peer group—55%</td>
<td></td>
</tr>
<tr>
<td><strong>Type of preferred peer review training</strong></td>
<td></td>
</tr>
<tr>
<td>Mentoring—80%</td>
<td></td>
</tr>
<tr>
<td>Coursework—40%</td>
<td></td>
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<tr>
<td>Professional society (e.g., AFS workshop)—25%</td>
<td></td>
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<tr>
<td>Other (e.g., hands-on, peer group)—&lt;15%</td>
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<tr>
<td><strong>Components of “good” publishable manuscript</strong></td>
<td></td>
</tr>
<tr>
<td>Well written (e.g., clear and concise)—100%</td>
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<tr>
<td>Contribution to science—100%</td>
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<tr>
<td>Good study design—90%</td>
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<tr>
<td>Practical application—75%</td>
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<tr>
<td><strong>Components of “poor” nonpublishable manuscript</strong></td>
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<tr>
<td>Improper design—90%</td>
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<tr>
<td>Poorly written—85%</td>
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<tr>
<td>No justification—75%</td>
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<tr>
<td>Inconclusive results and unsupported conclusions—65%</td>
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<tr>
<td>Inappropriate statistics—65%</td>
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<tr>
<td>Limited contribution—60%</td>
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<tr>
<td>Inadequate sample size—35%</td>
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<tr>
<td>No application—25%</td>
<td></td>
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<tr>
<td>Other—&lt;15%</td>
<td></td>
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<tr>
<td><strong>Ways you learned how to write</strong></td>
<td></td>
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<tr>
<td>Revising own work—90%</td>
<td></td>
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<tr>
<td>Reading—80%</td>
<td></td>
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<tr>
<td>Reviewing others’ work—65%</td>
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<tr>
<td>Coursework—55%</td>
<td></td>
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<tr>
<td>Training—30%</td>
<td></td>
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<tr>
<td>Other—30%</td>
<td></td>
</tr>
<tr>
<td><strong>Quality of reviews received</strong></td>
<td></td>
</tr>
<tr>
<td>Positive (e.g., clear, concise, and constructive)—80%</td>
<td></td>
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<tr>
<td>Vague instructions—40%</td>
<td></td>
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<tr>
<td>Non-constructive comments—45%</td>
<td></td>
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<tr>
<td>Incorrect suggestions by reviewers—30%</td>
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<tr>
<td>Other—20%</td>
<td></td>
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<tr>
<td><strong>Why publishing is important</strong></td>
<td></td>
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<tr>
<td>Completes research cycle—85%</td>
<td></td>
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<tr>
<td>Critical for job—85%</td>
<td></td>
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<tr>
<td>Demonstrates competency—75%</td>
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<tr>
<td>Personal satisfaction—75%</td>
<td></td>
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<tr>
<td>Upholds standards of research—60%</td>
<td></td>
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<tr>
<td>Other—30%</td>
<td></td>
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<tr>
<td><strong>Desired future position</strong></td>
<td></td>
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<tr>
<td>Academia—80%</td>
<td></td>
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<tr>
<td>Research—45%</td>
<td></td>
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<tr>
<td>Management—15%</td>
<td></td>
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<tr>
<td>Private sector—5%</td>
<td></td>
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<tr>
<td>Other—5%</td>
<td></td>
</tr>
<tr>
<td><strong>Publication approach to be most competitive for job</strong></td>
<td></td>
</tr>
<tr>
<td>Number of publications—65%</td>
<td></td>
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<tr>
<td>Prestige of journal—55%</td>
<td></td>
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<tr>
<td>Focus of journal in relation to career—20%</td>
<td></td>
</tr>
<tr>
<td>Other—25%</td>
<td></td>
</tr>
<tr>
<td><strong>Challenges in preparing and submitting manuscripts</strong></td>
<td></td>
</tr>
<tr>
<td>Time—75%</td>
<td></td>
</tr>
<tr>
<td>Turnaround time—40%</td>
<td></td>
</tr>
<tr>
<td>Working with coauthors—25%</td>
<td></td>
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<tr>
<td>Synthesizing existing body of knowledge—25%</td>
<td></td>
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<tr>
<td>Focus—20%</td>
<td></td>
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<tr>
<td>Initiating process—20%</td>
<td></td>
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<tr>
<td>Other—20%</td>
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REPORT: EDUCATION SECTION

Time for a Change: Revision of the Process for Judging Student Presentations

The number of student presentations given at the Annual Meeting of the American Fisheries Society (AFS) has increased steadily each year from 17 (1989) to 336 (2006). The increase has created challenges in determining the Best Student Paper and Best Student Poster Awards. For example, securing enough judges to evaluate the presentations in a consistent manner is an ongoing challenge. For the 2006 Annual Meeting, there were 256 papers and 80 posters presented by students. With a target of three judges per paper and four judges per poster, a total of 251 different judges were required to cover the 1,088 judging events. Even though this target number was secured prior to the meeting, 130 of the 1,088 judging events (12%) were not evaluated during the meeting. As a result, some students only received feedback from one or two judges and could not be considered for one of the awards. Variability in judging consistency was also high, with some students receiving scores that ranged as broadly as 40 points (e.g., 54 to 94 out of 100) or as narrowly as 3 points (e.g., 71 to 74 out of 100). As a consequence, this variability more than likely plays as large a role in the outcome of the judging process as the quality of the presentations themselves. The Education Section created the ad hoc Paper and Poster Judging Changes Committee to develop a solution to alleviate problems in presentation judging. Respondents to an Education Section newsletter survey echoed the problems observed in 2006 and identified obtaining and scheduling judges, inconsistency of evaluations across judges, and a lack of timely and useful feedback to students as the primary problems with the current judging system. Given these concerns, how does the Education Section fix the problems?

During fall 2006, members of the Paper and Poster Judging Changes Committee and the Education Section Executive Committee developed a more manageable and equitable process for determining student presentation award winners. These changes will be implemented for the 2007 Annual Meeting in San Francisco, California, as a trial for the new process. The steps in this process are outlined below, but student presenters will need to consult the Education Section website or the Annual Meeting section on the AFS webpage for details.

ABSTRACT SUBMISSION

Students will be required to submit an abstract that follows the guidelines described in the Call for Papers in Fisheries. On their abstract, the student must indicate if they wish their abstract to be considered for competition for a best presentation (i.e., paper or poster, but not both) award. If they respond “no,” the presentation will be considered for inclusion in the Annual Meeting by the Program Committee but will not receive further consideration by the Judging Committee. If students indicate “yes,” they will be required to submit an application directly to the Judging Committee. Components of the application will include an extended abstract and a check-off from their mentor indicating that the study is at a stage appropriate for consideration for an award. An example of the extended abstract is posted on the Education Section and AFS web sites and will include the following: title, authors and affiliations, background, methods, results (including up to five figures and/or tables), discussion, and references. The discussion should include how the research advances knowledge of fisheries theory and/or management and what the most significant finding is and why. Extended abstracts will be limited to 3 pages in length and must be written in 12-point Times New Roman font with 1-inch page margins. The deadline for submission is 23 February 2007; applications that do not follow the format guidelines will not be considered for an award.

APPLICATION REVIEW

The Judging Committee will review submitted applications and evaluate them in terms of scientific merit, writing style, and mechanics. By 2 March 2007, the top 20 papers and top 20 posters will be selected for inclusion in special symposia to be held at the Annual Meeting. Finalists will be notified and given the option of participating in one of these symposia or remaining in an invited or contributed session. Students not selected for one of these symposia or those that decline inclusion will be assigned to an appropriate symposium by the Program Committee.

SYMPOSIA

A symposium of oral presentations selected as finalists for the Best Paper Award will be hosted by the Education Section over 2 half days (10 presentations each day). Posters will be given...
During the regular poster symposium; however, finalists will be grouped together in one area and identified appropriately. Judging will be conducted by a panel of judges using a standardized grading rubric. Judging panels will be consistent for each award category in order to ensure equity in scoring. Student papers will also be videotaped and copies of the presentations will be provided to the judges for additional review following the session. Similarly, judges will be provided with copies of student posters for similar post-presentation review. Because each presentation will be evaluated by the same judges, there will be greater consistency in the judging process and feedback will be more rapid. The Best Student Paper and Poster Awards will be announced later that fall and the winners will receive their awards at the following year’s AFS Annual Meeting.

FEEDBACK

Students in regular invited or contributed paper and poster sessions will also have an opportunity to receive feedback. Evaluation forms will be distributed to willing evaluators, and the forms will be collected and provided to the student following his/her presentation or symposium.

Proposed changes to judging student presentations should help to alleviate the problems that have plagued the process in recent years. However, the ad hoc Paper and Poster Judging Changes Committee will carefully monitor the new process and make changes as experience is accrued. Because feedback is critical, the Education Section strongly encourages comments and suggestions to ensure that the judging format meets the needs of both the student presenters and the AFS membership.

ACKNOWLEDGEMENTS

We thank the South Dakota State University Ecology Discussion group for helpful review of earlier drafts of the survey. We also thank all students who participated by completing a survey. D. Parrish, T. Selch, and K. Schuler provided valuable comments on an earlier version of this draft. Finally, we thank symposium organizers Donna Parrish, Martha Mather, and Katie Bertrand for guidance.

REFERENCES


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progress that may lead to identification of flaws and opportunities for remediation (Refinetti 1990). In contrast, some suggest LPUs unnecessarily clutter the scientific literature and should be completely avoided (Harley et al. 2004). Students also exhibited disagreements regarding the LPU, but many students remained uncertain about the best approach to publishing.

Academia was indicated most often as the respondents’ desired position. Research and management positions were also indicated as desired positions (Table 1). Students indicated that the number of publications made them most competitive for their future positions. Prestige of the journal where they published and focus of the journal in relation to their career path also were cited as important criteria to be competitive for jobs (Table 1). The influence of publication record on job competitiveness resulted in a range of responses. Some students perceived that it was “sad but true” that some employers valued quantity over quality of publications. Others indicated that the best approach was to have a strong number, with selected publications in prestigious journals. Finally, many students were unsure of what ultimately made them most competitive.

Overall, students felt anxiety and uncertainty regarding publishing. Respondents had the opportunity to comment openly at the conclusion of the survey. We present some comments that best characterized opinions and attitudes of students. Some students “wished that every manuscript was successful” (don’t we all!). When the time comes to decide between several smaller manuscripts versus one larger manuscript, “Do what makes you most happy!” We add that it is important to consider the sage advice of more experienced coauthors and consider the positives and negatives to choosing any one direction. Finally, when it comes to writing and publishing, our best advice is summarized succinctly by one student: “Work hard, grow thick skin, do what it takes to get it published.”
OBITUARIES: PROMINENT RUSSIAN GENETICISTS

Gennady Manchenko and Yuri Altukhov

Gennady Petrovich Manchenko, 62, died 13 July 2006, following 15 years of suffering from severe diabetes. He had just celebrated his 62nd birthday, when he enthusiastically entertained his many friends, and then faded away.

Manchenko was a "maestro" isozyme geneticist. He published about 100 papers on allozyme variation in very different groups of organisms, both plants and animals. But his main contributions were his 3 books: Genetics of Isozymes (in Russian, Moscow, 1977, co-authored with 6 other authors), and 2 editions of Detection of Enzymes on Electrophoretic Gels: a Handbook (CRC Press, Boca Raton, FL. 1994 and 2002). Both books have been widely read and cited, the first mostly by Russian authors and the second worldwide.

Manchenko was born in 1944 in a village on the Kuban River (Northern Caucasus). After finishing school he entered a technical college in Rostov-on-Don, then was drafted into the army, where he served for four years. He graduated from Novosibirsk State University in 1973, when he was 29. The same year he joined the Institute of Marine Biology (Far Eastern Branch of the Academy of Sciences of the USSR; now the Russian Academy of Sciences) in Vladivostok, where he continued working until his death.

Manchenko was a person of many talents: he sang well, carved wood and ivory, cooked well and was a most charming company. He was always filled with life and initiative. His many friends and colleagues will always remember his hospitality, friendliness and warmth, his good humor and cheerfulness. He lives on through these rich memories.

—Alexander Pudovkin

Academician Yuri Petrovich Altukhov, 70, director of the Vavilov Institute of General Genetics in Moscow, Russia’s principal centre of genetics research, died from cancer on 27 October 2006. Altukhov was known internationally to fish biologists chiefly through his work on Pacific salmon. However, this was but one aspect of his comprehensive grasp of population and evolutionary genetics of animals and plants (he had worked on Karakul sheep, chickens, silkworms, spruce trees, cotton, barley, wheat, and people), especially conservation and rational management of genetic diversity. He was born in the Voronezh region of the former USSR, and gained his first degree from the Department of Physiology at the Fishery Technological Institute in Moscow in 1959. After three years of research at the Karadag Biological Station of the Ukrainian Academy of Sciences, he moved to Moscow State University, obtaining his Ph.D. in 1964. He became a senior researcher there, receiving a State Science and Technology Prize in 1966. In 1967, he became head of the Genetics Laboratory at the Institute of Marine Biology in Vladivostok, moving back to Moscow in 1972 to take charge of the Population Genetics Laboratory at the Institute of General Genetics. He was promoted to professor at Moscow State University in 1976, and to the directorship of the institute in 1992. He was elected Academician at the Russian Academy of Sciences in 1997. He was the founder and leader of the Russian school of population genetics, and authored many books, his first on fish in 1974. Subsequently, his books have been published in English, including Salmonid Fishes: Population Biology, Genetics and Management, by Blackwell in 2000, and his most recent book on Intraspecific Genetic Diversity: Monitoring, Conservation and Management, by Springer in 2006. He will be remembered principally for his original contributions to population genetics, especially his concept that adaptive evolution results in an optimum genetic diversity ensuring population genetic stability, and his argument that sustainable use of natural resources depends critically on maintenance of that genetic stability. He also will be remembered as a leading communicator of Russian genetic work and ideas to the western world, and of western work to Russia, which he achieved through his own work, through numerous international conferences and scientific collaborations, and now vicariously through his students holding academic posts in the United States, United Kingdom, Israel, and Korea. We had known Yuri for almost 30 years, a giant intellect and a restless but genial friend, liable to get embarrassingly bored at meetings listening to less than accomplished speakers, and to burst into song at dinner parties. We have lost a generous, colorful, challenging colleague.

—Gary Carvalho and John Thorpe
UPDATE: SAN FRANCISCO MEETING SOCIALS

To maximize networking opportunities and celebrate our society’s accomplishments, the 2007 Planning Committee will host five exciting socials in San Francisco. The exhilarating rhythms of Taiko Dojo (traditional Japanese drumming) will welcome us to the Pacific on Sunday evening September 2 at the downtown Marriott. The Marriott’s impressive Yerba Buena ballroom is also the scene of Monday’s Trade Show and Poster Social. See the latest innovations and interact with authors but clear a path for the Kei Lun Martial Arts Performers!!

Students and all members who support their professional development will enjoy a job fair and social on Tuesday evening September 4 at the Aquarium of the Bay.

You’ll have one last chance to bid farewell to colleagues at the closing reception on Thursday evening September 6 before leaving your heart in San Francisco. Please check the meeting website www.fisheries.org/sf/ for the latest planning updates.

On Wednesday, September 5, everyone will enjoy breathtaking views of the Golden Gate, Alcatraz, and Fisherman’s Wharf from the San Francisco Maritime National Historic Park’s Hyde Street Pier. We have secured exclusive access to the Pier and its historic vessels for this showcase event.
and geographic barriers to enable discussion and reflection on scientific, management, and environmental issues of common concern. A petition was signed by 75 participants and sent to the parent Society to create the official certification for the Mexico Chapter within the Western Division of AFS in 2006. Mauricio Ramirez-Rodriguez (researcher from the Interdisciplinary Center for Marine Sciences, CICIMAR) is the Chapter’s first president; Salvador E. Lluch-Cota (researcher from the Northwest Center for Biological Research, CIBNOR) is the president elect, and Oscar Sosa Nishizaki (researcher from the Center of Scientific Research and Graduate Education of Ensenada, CICESE) is the secretary-treasurer.

The Mexican Chapter’s main objectives are to increase communication of fisheries interest both within Mexico and between Mexican and other international professionals, investigate the most promising approaches for maintaining membership in AFS by Mexican fisheries professionals and students, assist with the organization and promotion of AFS-sponsored professional fisheries meetings in Mexico, and identify Mexican fisheries conservation issues of concern to AFS and the Mexican Fisheries Society.

Mexican scientists have long desired a formal voice for fisheries science within their country. To this end the Mexican Fisheries Society (Sociedad Mexicana de Pesquerias; MFS) was also officially established in 2006, with the goal to facilitate communication among members and encourage the development of professional activities related to fisheries and fish conservation in Mexico. The specific objectives of the MFS are to promote and evaluate the development and progress of all branches of fisheries and related sciences, and their application throughout Mexico; to compile and distribute, among members and other interested people, technical and other relevant information related to fisheries and fisheries science through meetings and publications; to develop teaching and fisheries training programs to be implemented in colleges, universities, and professional institutions; and to provide continuous training to those who work in the areas of fisheries and related activities. The MFS has joined as a full member of the World Council of Fisheries Societies.

In celebration of the formation of the Mexican Chapter of the American Fisheries Society and the Mexican Fisheries Society, the first biannual meeting entitled “Challenges of the Marine and Fisheries Sciences in Mexico” will take place in La Paz, Baja California Sur, Mexico, on 2-4 May 2007. The main idea for this conference is to facilitate communication among scientists interested in Mexican fisheries and provide an opportunity to promote understanding among regional and federal research and educational institutions, non-governmental organizations, and state policy makers on conservation and fisheries issues in Mexico. The conference will be hosted by CIBNOR with the collaboration of the CICIMAR-IPN, CICESE, the National Fisheries Institute (INP), and the American Fisheries Society. The Mexico Chapter is also organizing a proposal to bid for the 2011 AFS Annual Meeting to be held in Mazatlan.

The establishment of the Mexican AFS Chapter along with the broader concept of the Mexican Fisheries Society makes a new dynamic for fisheries conservation, policy, and management in Mexico and for our shared aquatic resources. The scientific collaborations and communication networks that develop from these important relationships will serve to fulfill many hopes and dreams from Mexico, Canada, the United States, and our other international partners for integrated, sustainable management of aquatic resources across traditional boundaries and jurisdictional barriers, providing a focused and creative approach to “looking downstream and downcurrent”—the theme of my 2007 AFS Plan of Work.
environmental review process that precipitates project delays (see *Fisheries* 30[5]:10-19). To improve the process, USFS published proposed amendments to Title 36 Code of Federal Regulations (CFR) parts 241, 251 and 261 (see *Federal Register* 71[221]:66715-66720). Relevant sections of the USFS Manual would also be revised to reflect the changes. The proposed amendments would establish criteria for state piscicide use on National Forest System lands, outside designated Wild and Scenic Rivers or Congressionally-designated Wilderness and Wilderness Study Areas. A provision that state piscicide applications outside designated Wilderness and Wilderness Study Areas are not “special uses,” requiring special use authorization, would be added along with provisions for closure of an area, if necessary under specific circumstances, to prohibit piscicide applications. Comments on the proposed changes were due, in writing, by 16 January 2007.

—AFS Task Force on Fishery Chemicals
Fish Management Chemicals Subcommittee
Postdoctoral Research Associate in Fish Genetics, Hubbs-SeaWorld Research Institute (HSWRI), San Diego and NOAA SWFSC, La Jolla, CA.

Responsibilities: Conduct genetic studies that will allow HSWRI to evaluate and if necessary refine breeding protocols for white seabass (Atractoscion nobilis) to ensure that the stockable fish produced for enhancement match the genetic diversity of the wild population. Specifically, apply genetic techniques to (1) understand spawning patterns, (2) identify parent-offspring relationships among fish that are released, (3) study the possibility of culture-induced selection in the hatchery environment, and (4) compare genetic diversity of released fish to that of the wild stock.

Qualifications: Ph.D. in a relevant field granted within the past 5 years. Salary: $31,000–38,000 per year plus benefits.

Closing date: 1 March 2007.
Contact: mdrawbridge@hswri.org.

Postdoctorial Scientist, Department of Fish, Wildlife, and Conservation Biology, Colorado State University.

Responsibilities: Investigate effects of non-native brook trout invasion on linked stream-riparian food webs.

Qualifications: Earned Ph.D. in aquatic or fisheries ecology, substantial field experience sampling aquatic biota in streams or other aquatic systems, ability to manage field projects, skills in statistics and computers, and refereed publications. Willingness to conduct back-country research and travel during summers. Expertise in food web ecology and stable isotopes also desirable.

Salary: Commensurate with qualifications.
Closing date: For full consideration, apply by 20 January 2007, but position open until filled.
Starting date: April 2007 preferred.
**National Marine Fisheries Service (NMFS) / Sea Grant Joint Graduate Fellowship Program in Population Dynamics and Marine Resource Economics**

**Description**
- Fellowships for highly qualified Ph.D.-level graduate students interested in careers in: (1) population dynamics of living marine resources and development and implementation of quantitative methods for assessing their status, and (2) economics of conservation and management of living marine resources.
- Support for up to three years for Population Dynamics Fellowships, and up to two years for Marine Resource Economics Fellowships.
- Approximately two fellowships awarded each year in each discipline, with overall maximum of 12 Fellows at any time.
- Fellows work closely with mentors from NMFS Science Centers or Laboratories and may intern at NMFS facility on thesis research or related problem.

**Program Goals**
- Encourage qualified applicants to pursue careers in and increase available expertise related to: (a) population dynamics and assessment of status of stocks of living marine resources, or (b) economic analysis of living marine resource conservation and management decisions.
- Foster closer relationships between academic scientists and NMFS.
- Provide real-world experience to graduate students and accelerate their career development.

**Eligibility**
- Must be United States citizen.
- Prospective Population Dynamics Fellows must be admitted to Ph.D. program in population dynamics or related field (applied mathematics, statistics, or quantitative ecology) at academic institution in United States or its territories.
- Prospective Marine Resource Economics Fellows must be in process of completing at least two years of course work in Ph.D. program in natural resource, marine resource, or environmental economics or related field.

**Award**
- Grant or cooperative agreement of $38,000 per year awarded to local Sea Grant program/host university.
- 50% of funds provided by NMFS, 33 1/3% provided by National Sea Grant Office (NSGO), and 16 2/3% provided by university as required match of NSGO funds.
- Disbursement of award for salary, living expenses, tuition, health insurance, other fees, and travel determined by university.

**Relevant Dates**
- Application deadline—early February 2007 (see Sea Grant website for details—www.seagrant.noaa.gov/funding/rfp2006.html).
- Fellowship start date: 1 June 2007.

**Contact**
- Dr. Terry Smith
  National Sea Grant College Program
  1315 East-West Highway
  Silver Spring, MD 20910
  301/713-2435
  terry.smith@noaa.gov
- Any state Sea Grant program—
  www.nsgo.seagrant.org/SGDirectors.html
- Any participating NMFS facility—
  www.nmfs.noaa.gov/science.htm
addition, food, housing, and equipment will be provided.  

**Closing date:** 12 February 2007.  
**Contact:** See www.cianet.org. Direct questions to Trenten T. Dodson, Senior Biologist, tdodson@cianet.org, 907/283-5761.

**Director,** Bureau of Fisheries, Pennsylvania Fish and Boat Commission, Bellefonte.  
**Responsibilities:** Perform administrative and advanced professional work in planning and directing statewide fisheries biology and fish culture programs.  
**Requirements:** Two years of experience as a Fisheries Biologist 4; or six years of progressively responsible professional experience in fisheries biology, aquatic biology, aquatic ecology, or equivalent fields, two of which must have been in an administrative or supervisory capacity; and a master’s degree in aquatic biology, aquatic ecology, fisheries biology, or equivalent fields. A doctoral degree in aquatic biology, aquatic ecology, fisheries biology, or equivalent fields may be substituted for three years of the required professional experience.  
**Salary:** $67,580–102,729, depending on experience.  
**Closing date:** 9 February 2007.  
**Contact:** Applications must be received or postmarked by 9 February 2007, after which the announcement will be suspended. See www.scsc.state.pa.us.

**Cutthroat Trout Conservation Intern,** National Park Service, Yellowstone National Park, Wyoming.  
**Responsibilities:** Assistance with cutthroat trout preservation and restoration; removal of nonnative fish; lake and stream monitoring for fish, macroinvertebrates, and/or water quality; applied research aimed at conservation of cutthroat trout; and assistance with lab processing of samples, data entry, and verification.  
**Qualifications:** Show evidence of college coursework and/or work experience in an area of aquatic ecology and/or fisheries. Must demonstrate a strong professional interest in these areas.  
**Salary:** Student Conservation Program (SCA) Internships include paid housing and a biweekly living stipend. See www.thesca.org/internships/ for more information about position benefits.  
**Closing date:** Apply by 15 February 2007. Announcements for position code 4541 (mid-May–early Aug) and 4543 (early Aug–late Oct) will appear on the SCA website by mid-December.  
**Contact:** To apply for these positions, you must use the SCA website at www.thesca.org/internships/ and either register and submit an online application or download an application and mail it in to SCA. THIS IS IMPORTANT—You must select Yellowstone National Park, Fish-Fisheries as your preferred work area and position type, respectively. Your application should include a detailed resume, cover letter, and the names and contact information for three professional references. Todd M. Koel, Supervisory Fisheries Biologist, Yellowstone Center for Resources.
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