

Fisheries

DECEMBER 2006
VOL 31 NO 12



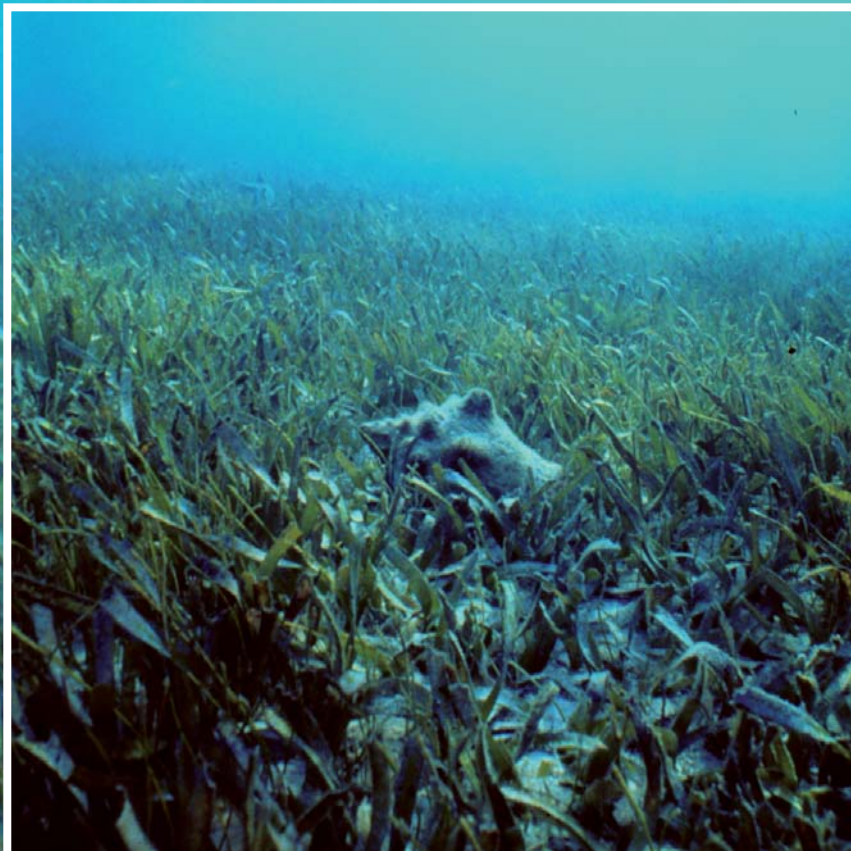
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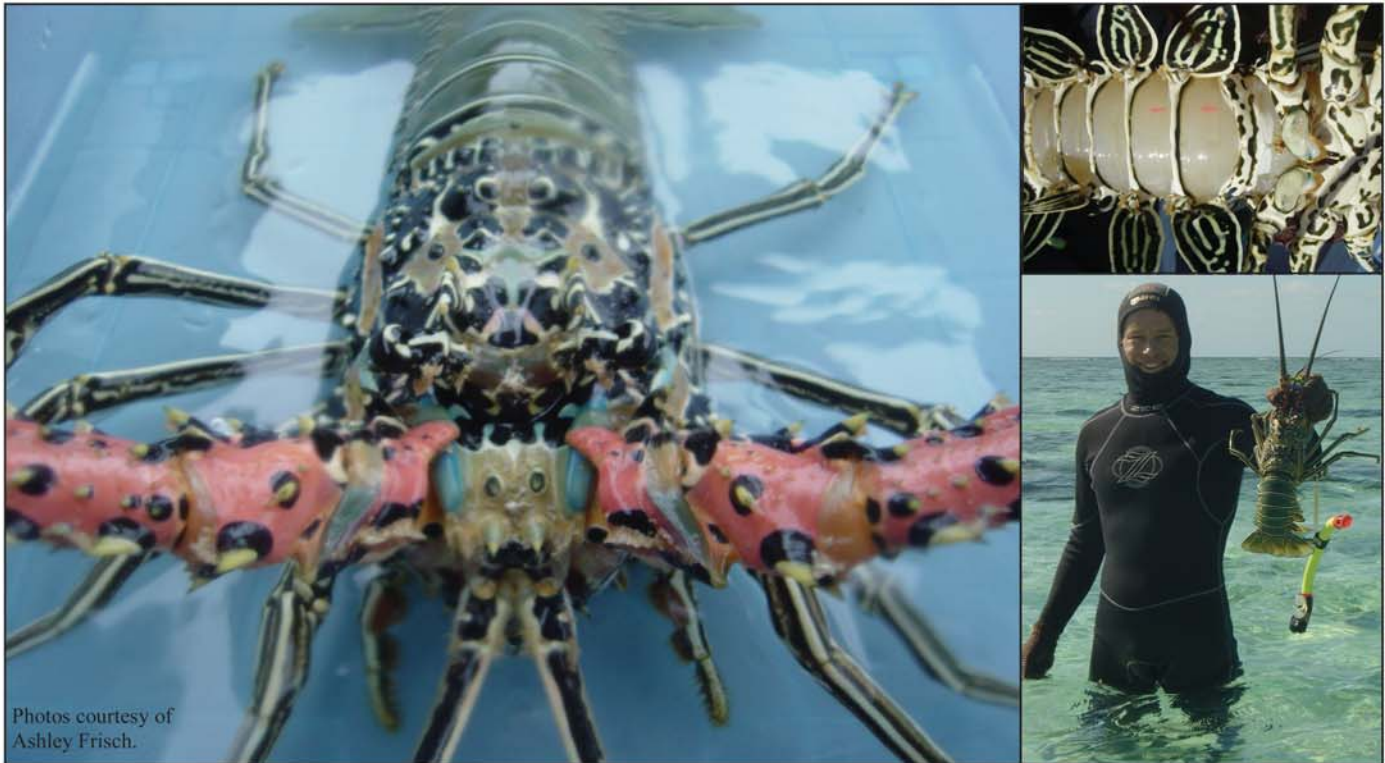
The Center for Independent Experts

**Impending Trade Suspensions
of Caribbean Queen Conch**

Open Water Aquaculture Essay



Discovering the Painted Crayfish



Painted crayfish *Panulirus versicolor* (above) are widely exploited throughout the coral reefs of the Indo-Pacific region, including Australia's Great Barrier Reef. They command a high price but relatively little is known about their biology and population dynamics.

Ashley Frisch, at James Cook University, (photo lower right) is beginning to unlock some of the painted crayfish's secrets. His studies first required a technique to identify individuals. Ashley tested NMT's injectable Visible Implant Elastomer tags and found them to be highly suitable⁽¹⁾ (photo top right). By using a combination of tag colors and locations, he devised a system for identifying up to 30,000 individuals.

Ashley's work now focuses on the population dynamics of the painted crayfish. He found that male crayfish live

in coral reef dens. If the den is large enough for more than one crayfish, the male can attract females to share his den. Ashley's work also revealed that males with the largest dens can attract more than one female and increase their reproductive potential. Males with dens large enough to attract females must fastidiously defend them from other male crayfish, about one third of the population, that don't have dens large enough to share with a female. These "bachelor" males constantly roam the reef searching for a better den.

NMT is delighted to advise on projects and to help set up tagging programs, anywhere in the world. Please contact us if we can help with yours.

⁽¹⁾Frisch, A.J. and J.A. Hobbs. 2006. Long-term retention of internal elastomer tags in a wild population of painted crayfish (*Panulirus versicolor* [Latreille]) on the Great Barrier Reef. *J. Exp. Marine Biol. and Ecol.*

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FEATURES



590 FISHERIES ADMINISTRATION

The Center for Independent Experts: The National External Peer Review Program of NOAA's National Marine Fisheries Service

The Center for Independent Experts provides timely peer reviews of NOAA Fisheries' science products. The center's structure and operations, and impacts to NOAA's science, are described.

Stephen K. Brown, Manoj Shrivani, David Die, David B. Sampson, and Tina A. Ting

601 FISHERIES MANAGEMENT

Impending Trade Suspensions of Caribbean Queen Conch under CITES:

A Case Study on Fishery Impacts and Potential for Stock Recovery

Strong, adaptive management actions are immediately needed to protect the remaining Caribbean queen conch stocks. If not implemented soon, CITES intervention resulting in an export moratorium may be warranted.

Charles A. Acosta



COVER: Harvest of queen conch (*Strombus gigas*) is prohibited in the Florida Keys.

CREDIT: Heather Dine, NOAA photo library



ESSAY

607 FISH CULTURE

Toward Sustainable Open Ocean Aquaculture in the United States

The current status of open ocean aquaculture in the Exclusive Economic Zone of the United States, interest in open ocean aquaculture activities, the regulatory environment, and the potential for sustainable development are examined.

Robert R. Stickney, Barry Costa-Pierce, Donald M. Baltz, Mark Drawbridge, Churchill Grimes, Stephen Phillips, and D. LaDon Swann

COLUMNS

584 PRESIDENT'S HOOK

The Nuances of Grey and Open Access Publishing at AFS

The move to electronic open access journals at AFS will increase our information transfer and address critical time-to-publication needs in the field of fisheries science and management without any nuance of grey.

Jennifer L. Nielsen

611 DIRECTOR'S LINE

The Web We Weave

The revamped AFS website continues to incorporate member-suggested improvements and its members-only section offers exclusive features to AFS members.

Gus Rassam

DEPARTMENTS

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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.

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DECEMBER 2006
VOL 31 NO 12

Fisheries

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COLUMN: PRESIDENT'S HOOK

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The Nuances of Grey and Open Access Publishing at AFS

In today's world, what is grey literature? Fisheries scientists and managers do not always communicate through the strict rules of peer-reviewed journal articles or books. Many scientists who are members of AFS work for agencies, organizations, or companies with traditional and accepted communication paths that are not submitted for formal publication in the research literature. These documents include research or technical reports, database depositories, granting documentation, teaching material, guidelines and protocols, information and outreach products, or translations of printed material. All of these products hold significant practical value, but are lumped into the general category of non-conventional or "grey" literature.

The term grey literature brings to mind issues of questionable authority, weak science, apathy, indifference, and unregulated publication. But this is frequently not the case. Significant information value is preserved in documents and data held in repositories without formal outside review. They support very relevant, specific purposes that are not appropriate or sufficient for formal peer review in scientific publications or specialized journals (Mason 2006). Until recently, discussions on the value of grey literature were basically internal to the organizations generating these products. However, libraries have been digitizing and assembling collections of rare technical reports not found in the commercial scientific literature for quite a while (Kreitz et al. 1997). Various attempts have been made to provide sourcing for grey literature, such as the British Library Document Supply Centre, the Russian Union Catalogue of Grey Literature, the Canadian Institute for Scientific and Technical Information, and the Monthly Catalog of U.S. Government Publications. With the transformation by Internet search engines and universal document retrieval opportunities, the access to unique and rich sources of grey literature has become more open.

The international role of the Internet means that grey literature is widely disseminated and used. Universally, students search the web for information and specific content more frequently than they visit books or libraries (Lesk 1999). Since 1994, the Grey Literature Network System has helped stu-

dents, librarians, publishers, and researchers in the writing and cataloging of grey literature (see GreyNet.org and the *International Journal on Grey Literature*). While organizations issuing and disseminating grey literature are responsible for the documents produced, the nuances of grey are quickly losing their negative connotations and, thanks to the Internet, are now widely cited. The importance of grey literature has been increasing and is widely viewed as a relevant source of information produced for meaningful, practical purposes (De Castro and Salinetti 2004).

So what has been the role of grey literature in science? Auger (1989) argued the value of grey material to the sciences to be quick access, greater flexibility, raw data storage, and the opportunity to go into considerable detail not available in standard publications. In another study, Gelfand (1998) found grey literature on science policy, scientific protocols, and web sites covering scientific journalism to be extremely valuable to communications among scientists. The incorporation of video and sound at many of these sites enhances opportunities to interact in an open exchange of ideas not commonly found in the published literature. Grey literature also provides citizens with information needed to make decisions about their own lives and the societies where they live, linking seemingly esoteric science more comfortably to the public. In a world of instantaneous communications, grey literature is gaining significant importance as a source for public information due to the freedom of content and access on the web. But the quality and content of grey information is highly variable and still considered somewhat subjective.

In traditional scientific literature, quality of content and editorial presentation meet well recognized uniform requirements. This has not been universally true for grey literature. But that is rapidly changing with new international guidelines proposed for grey literature production and dissemination (GLISC 2006). As AFS moves into electronic publishing with open access through our new marine and coastal journal, we are diving head first into a sea of publications awash with grey material. When we communicate through this information-rich medium, we need to draw the line clearly between grey literature and peer-reviewed products

that come from AFS. Implementing easier access, broader dissemination, and rapid electronic communication of science without direct paper copy does not mean AFS will slacken editorial scope, reduce review criteria, or loose prestige. I think quite the contrary. There is a new creativity in electronic publishing where AFS can provide leadership and vision and set a standard for the rest of the resource science community. The history of best science at AFS will maximize the value of our open access publications based on a long track record of professional integrity while still providing new tools that better link our scientists and their work to the public. The move to electronic open access journals at AFS will increase our information transfer and address critical time-to-publication needs in the field of fisheries science and management without any nuance of grey.

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The Acoustic Tag Update

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Using Acoustic Tags to Track Fish January 11-12, 2007, Seattle, WA USA addresses all aspects of tracking fish movement with acoustic tags, including three-dimensional tracking with sub-meter resolution. A variety of freshwater, marine, estuary and aquaculture applications are covered.

Using Hydroacoustics for Fisheries Assessment, January 18-19, 2007, Seattle, WA USA covers mobile and fixed-location survey techniques. Subjects include basic hydroacoustic theory, deployment logistics, data collection and processing, and typical results. Split-beam, dual-beam, single-beam, and multi-frequency techniques are discussed in detail.

According to Mr. Craig Haskell of the USGS, "The instructors were great, and have continued to make themselves available then and now as I continue working with the system." To get a course outline or a registration form, visit us online at HTIsonar.com or call us at 206-633-3383. Space is limited.

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Wild Trout IX

The Wild Trout IX Program Committee is soliciting abstracts for presentations and posters. Wild Trout IX, to be held 9–12 October 2007 at the West Yellowstone Holiday Inn, will offer a unique forum for professionals and trout anglers to interact, to get to know each other in an informal setting, and to be exposed to the latest wild trout science, technology, and philosophy. Papers will focus on the needs of working-level wild trout professionals, conservationists, and trout anglers. Please send brief abstracts (200-300 words or less) to committee co-chairs (Dirk.miller@wgf.state.wy.us) by 1 April 2007.

The program committee is interested in papers related to the following topics: balancing native trout with introduced trout, habitat enhancement and restoration, catch-and-release fisheries, genetic considerations for managing wild trout,

and invasive species (vertebrates, invertebrates, and plants). For more information about Wild Trout IX, visit www.wildtroutsymposium.com.

—Spencer Turner



Women Evolving Biological Sciences

Women Evolving Biological Sciences (WEBS) is an annual three-day symposium aimed at addressing the retention of female scientists and issues related to the transition of women from early career stages to tenure track positions and leadership roles in academic and research settings. The goal is

to increase significantly the retention and promotion of women in academia in biological sciences, in order to create greater diversity in academic and scientific leadership. WEBS thus targets early career women in the biological sciences with an emphasis on ecology and evolutionary biology. In particular, WEBS focuses on women who have earned their doctoral degrees within the past 2–8 years and who do not have tenure, in order to address the critical transition period from graduate studies and post-doctoral positions to permanent

research and teaching positions. WEBS participants are current post-docs, research scientists, and assistant professors.

The symposia will provide a forum for professional development, including awareness and improvement of academic leadership skills, opportunities to establish mentoring relationships, and resources for developing professional networks. Each symposium will include speakers and small group activities, as well as opportunities for the participants to interact in casual, unstructured settings. Speakers will be mid-career and senior female scientists who will share their own stories and lead discussions and activities on topics such as life/work balance, time management, running a research lab, managing a budget, networking and mentoring, course development, and career pathways to leadership. The first WEBS symposium is scheduled for 14–17 October 2007 outside of Seattle, Washington; see www.webs.washington.edu.

—Claire Horner-Devine

AIFRB 50th Anniversary Symposium

The American Institute of Fishery Research Biologists (AIFRB) is celebrating its 50th anniversary by convening an international symposium on "The Future of Fishery Science in North America." The symposium will be 13–15 February 2007 in Seattle, Washington. The research opportunities and challenges of fishery science for the next decade will be considered in the context of the science in support of fishery-management decision-making, policy, and technology. Outcomes from the symposium will influence emergent issues and critical scientific questions relevant to fisheries worldwide. The symposium is a unique occasion to assemble leaders active in conservation, management, and sustainability to present insights and new approaches to current and future scientists who will be working to achieve and maintain the sustainability of global fisheries resources in an increasingly complex environment. Bill Hogarth, assistant administrator of NOAA Fisheries, is scheduled as one of two keynote speakers. See www.aifrb.org for more information.

—Bill Zahner

Got Fish Guts?

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UPDATE: LEGISLATION AND POLICY

Jessica Geubtner

AFS Policy coordinator
Geubtner can be reached
jgeubtner@fisheries.org.



New leadership for science and environment committees

The takeover by Democrats of both chambers of the U.S. Congress may be significant for the future of fisheries. Among the important changes in Congressional leadership is the ascendancy of Rep. Nancy Pelosi (D-CA) to Speaker of the House following the 2006 lame duck session. Pelosi has long been considered a strong ally of environmentalists and aquatic concerns. Among her actions to help fisheries, Pelosi drafted language and secured funding that revived once-endangered Sacramento River winter-run Chinook salmon. Additionally, Pelosi supported efforts to deliver disaster assistance to West Coast salmon fishermen and funds to rebuild Klamath fish stocks, and fought for protection of anadromous watersheds and coastal fish habitats.

Among the notable changes to committee leadership in the Senate is the head of the Environment and Public Works Committee. Losing the top spot on the committee is James Inhofe (OK-R), who will likely be replaced by Barbara Boxer (D-CA). Inhofe may also lose his place as the ranking minority member on the committee.

New committee assignments are still being set, but some forecasts are being made. Rep. Bart Gordon (D-TN) will likely chair the House Science Committee. Indications are that Gordon would like to maintain the committee's traditions of bipartisanship. Additionally, Gordon is expected to show interest in funding for scientific programs, continuing to boost U.S. competitiveness in the global research market, improving science education programs, and reducing the politicization of science. Taking the reins of the House Energy and Commerce Committee will be a former chairman, Rep. John Dingell (D-MI). Dingell has previously sided with Republicans on climate change issues, but has announced plans to hold hearings on climate change policy.

The change to the leadership of the House Resources Committee may have been one of the biggest gains for environmentalists and scientists concerned with resource extraction and endangered species legislation. Chair Richard Pombo (R-CA) was defeated by John McNERney (D-CA), an

engineer with experience in alternative energy technologies. Rep. Nick Rahall (D-WV) will likely take over the chairmanship of the Resources Committee. He has not set an agenda, but some in the environmental community think that he will not pursue Pombo's agenda to weaken the Endangered Species Act or promote drilling in the Arctic National Wildlife Refuge. Rep. Henry Waxman (D-CA) is expected to head the House Government Reform Committee, charged with oversight of the federal government. Waxman may include among his priorities a review of the Bush Administration's science record, the perceived politicization of science, and the impact of funding reductions at agencies such as the Environmental Protection Agency. Rep. David Obey (D-WI) is expected to chair the House Appropriations Committee.

House and Senate divided on NOAA budget

The House and Senate remain \$1 billion apart on the budget for the National Oceanic and Atmospheric Administration (NOAA) for fiscal year 2007. NOAA has been operating under the House appropriations bill, which cuts the agency's budget by over \$500 million to \$3.4 billion in FY 2007, since the new fiscal year began on 1 October. In contrast, the Senate Appropriations Committee approved a bill in July that would increase NOAA's budget by nearly \$500 million to \$4.4 billion. However, the full Senate failed to complete action on the bill before it adjourned for the elections. The fate of NOAA's budget may be determined by a House-Senate conference committee that is charged with reconciling the differences between the two bills. If the House and Senate were to split the difference between the two bills, then NOAA's FY 2007 budget would be nearly the same as its FY 2006 budget.

The House and Senate bills both protect the budget of the National Weather Service. The House bill would cut funding for other NOAA programs, including research programs, in order to achieve \$500 million in budget cuts. In contrast, the Senate bill would provide substantial increases for NOAA research programs.

- Office of Oceanic and Atmospheric Research (OAR): The Senate bill would increase OAR funding by 26% to \$467 million in FY 2007. In contrast, the House bill would cut OAR funding by 11% to \$328 million. The Senate mark for OAR is 42% or \$139 million above the House mark.
- Ocean and Coastal Research: Within OAR, the Senate bill would increase funding for Ocean and Coastal Research by 43% to \$181 million. The House bill would cut funding by 27% to \$93 million. The Senate mark is 96% or \$88 million above the House mark.
- Sea Grant College Program: The House bill would cut funding for the Sea Grant College Program by 5% to \$52 million in FY 2007. The Senate bill would increase funding for the Sea Grant Program by 53% to \$84 million. The Senate mark for the Sea Grant Program is 61% or \$32 million above the House mark.
- National Ocean Service (NOS): The Senate bill would increase NOS funding by 28% to \$631 million in FY 2007. The House bill would cut NOS funding by 36% to \$315 million. The Senate mark is 100% or \$315 million above the House mark.
- National Marine Fisheries Service (NMFS): The Senate bill would increase NMFS funding by 22% to \$814 million. The House bill would cut NMFS funding by 19% to \$539 million. The Senate mark is 51% or is \$275 million higher than the House mark.

Large reductions in funding for NOAA are inconsistent with the recommendations of the U.S. Commission on Ocean Policy and the Pew Oceans Commission. The chairs of these commissions, Adm. James D. Watkins and Leon E. Panetta, issued a joint letter expressing their concern that the proposed funding cuts would be imposed at a time when there is clear recognition of the growing number and severity of problems that are compromising the health and associated economic benefits generated by the nation's oceans, coasts, and Great Lakes.

FISHERIES CURRENTS: SCIENCE NEWS FROM AFS

Australian common carp trap shows promise

The common carp is perhaps the world's most invasive fish species, found on every continent except Antarctica. Common carp compete with native fish and often come to dominate freshwater fish communities. In a recent article in the *North American Journal of Fisheries Management*, a group of Australian researchers introduces a new trap that exploits an unusual attribute of the species—its tendency to jump out of the water to escape. The “Williams cage” can be installed in fishways in weirs or other constricted stream areas to capture common carp as they migrate upstream during warmer months. The cage includes two compartments, divided by jumping baffle. The jumping common carp are captured in the upper compartment, while non-jumping native Australian fish are periodically crowded into a lower compartment and automatically released. Results indicate that the trap successfully captured 88% of the common carp that came through a weir fishway, while allowing the passage of 99.9% of native fish. The authors speculate that the trap could be used to capture other jumping carp species or even used in reverse to separate non-jumping invasive sea lampreys from jumping trout and salmon species in the Great Lakes area. **Managing a Migratory Pest Species: A Selective Trap for Common Carp**, by Ivor G. Stuart, Alan Williams, John McKenzie, and Terry Holt. *North American Journal of Fisheries Management* 26:888-893. Stuart can be contacted at Ivor.Stuart@dse.vic.gov.au.

A new tool to predict longline bycatch survival

One of the greatest challenges in managing longline fisheries is the uncertainty about the survival rate of animals caught as bycatch and then released. In a recent article in *Transactions of the American Fisheries Society*, a group of researchers used a combination of blood analyses and high-tech pop-up satellite archival tags (PSAT) to determine if it was possible to predict survival for blue sharks caught on longlines near the Hawaiian Islands. Blood samples were taken for each shark brought on board (both dying and healthy), and those thought likely to survive were released with PSATs that recorded depth and temperature for a period of months before popping off to rise to the surface to transmit their data to a satellite. The researchers focused on two blood variables that differed between dying and surviving sharks. Models based on those blood variables indicate that 95% of the blue sharks released in good condition would be

expected to survive, which was confirmed by the PSAT data. Overall, 90-95% of blue sharks survive being caught on longlines and released. Further research is needed to see if this method can be applied to other sharks, billfish, and sea turtles. **Predicting Postrelease Survival in Large Pelagic Fish**, by Christopher D. Moyes, Nuno Fragoso, Michael K. Musyl, and Richard W. Brill. *Transactions of the American Fisheries Society* 135:1389-1397. Moyes can be contacted at moyesc@biology.queensu.ca.

Site selection crucial to freshwater artificial reef success

Although artificial reefs have been extensively used in marine settings, little research has been conducted on the effectiveness of artificial reefs in large freshwater bodies like the Great Lakes. Researchers from the Illinois Natural History Survey studied an artificial reef designed to attract smallmouth bass in southwestern Lake Michigan near Chicago. Researchers counted fish using SCUBA diver surveys and estimated catch rates using gill nets at the artificial reef and a similar non-reef reference site. The researchers also surveyed recreational anglers about their awareness and use of the reef. Reporting in the *North American Journal of Fisheries Management*, the researchers found catch rates of all fish species did not differ between the reef and the reference site, although divers generally saw more fish at the reef. Water temperature affected the appearance of most fish more than the artificial structure. The reef did attract more smallmouth bass and rock bass compared to the reference site, but not until the water warmed up each summer. It also created prime habitat for invasive round gobies. Unfortunately, the artificial reef was too far from local boat ramps to generate much angler use. The researchers suggest positioning freshwater artificial reefs in areas where the water warms more quickly and which are more easily accessible to anglers. **If You Build It, Will They Come? Fish and Angler Use at a Freshwater Artificial Reef**, by Sara M. Creque, Matthew J. Raffenberg, Wayne A. Brofka, and John A. Dettmers. *North American Journal of Fisheries Management* 26:702-713. Creque can be contacted at screque@uiuc.edu.

Constructed habitats providing good coho production

The loss of off-channel or floodplain habitats is thought to be one of the major factors that limit coho salmon production in the Pacific Northwest. Sloughs, side channels, and off-channel ponds provide both spawning and rearing areas for coho smolts, as well as refuge from high river flows. Millions of dollars have been spent on floodplain restoration, either in reconnecting existing natural habitats or creating entirely new side channels and ponds. But how well are these constructed habitats working? In a recent article in *Transactions of the American Fisheries Society*, scientists studied years of coho smolt trapping data from 30 constructed, restored, and natural floodplain habitat sites. They found the constructed habitats provided the same level of smolt production as natural habitats. The most important factor was the size of the wetted area, with smaller habitats similar to beaver ponds providing the most smolts. More shoreline irregularity and cover also seemed to increase the length of the smolts. **Coho Salmon Smolt Production from Constructed and Natural Floodplain Habitats**, by Phil Roni, Sarah A. Morley, Patsy Garcia, Chris Detrick, Dave King, and Eric Beamer. *Transactions of the American Fisheries Society* 135:1398-1408. Roni can be contacted at phil.roni@noaa.gov.

REEF CASE

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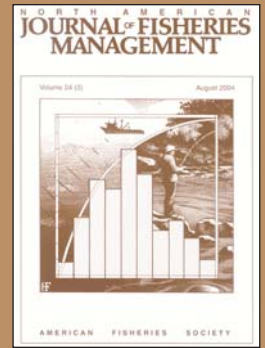
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Volume 26
Number 4
November 2006



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[Management Brief] **Spatial Allocation of Shrimp Catch Based on Fishing Effort: Adjusting for the Effects of the Texas Opening.** John G. Cole, Benny J. Galloway, Larry R. Martin, James M. Nance, and Michael Longnecker, pages 789-792.

Point Sampling by Boat Electrofishing: A Test of the Effort Required to Assess Fish Communities. Nicolas W. R. Lapointe, Lynda D. Corkum, and Nicholas E. Mandrak, pages 793-799.

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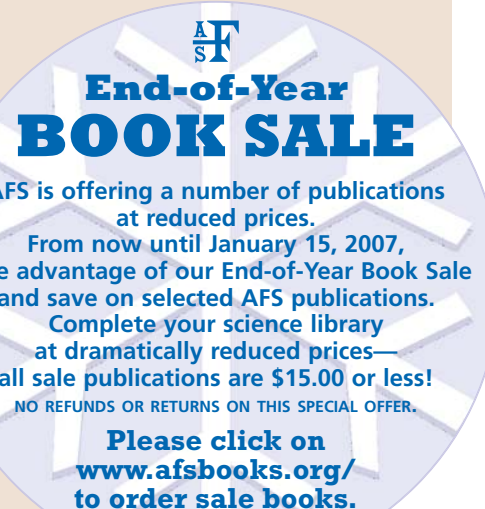
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FEATURE: FISHERIES ADMINISTRATION

The trawl surveys conducted by NOAA Fisheries' Northeast Fisheries Science Center provide key fisheries-independent data used for assessing the stocks managed under the Northeast Multispecies Fisheries Management Plan.

The Center for Independent Experts: The National External Peer Review Program of NOAA's National Marine Fisheries Service

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ABSTRACT: Requirements are growing for peer review of the science used for governmental management decisions. This is particularly true for fisheries science, where management decisions are often controversial. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service instituted the Center for Independent Experts (CIE) in 1998 as a national peer-review program. Operations of the CIE, run under a contract with the University of Miami, maintain the independence of reviewers from the agency, and follow strict conflict of interest guidelines. Reviews by the CIE fulfill the requirements of the Information Quality Act and the Office of Management and Budget's Peer Review Bulletin. The CIE completed 101 reviews between 1999 and September 2006. Ninety-eight reviewers have participated in CIE reviews, with 72% of them coming from overseas. Case studies involving groundfish data and stock assessments, and marine-mammal abundance, are described, including the scientific issues, CIE operations, requirements for the reviews, conclusions of the reviewers, and the agency's responses. Impacts of the CIE on the agency's science include improvements to regional stock assessment processes and to stock-assessment and field-survey methods, and reductions in contentious challenges to the agency's science.

INTRODUCTION

Peer review is a vital element of the scientific process, playing a central role in determining research priorities, funding, and publication. It has been defined as "an organized method for evaluating scientific work which is used by scientists to certify the cor-

rectness of procedures, establish the plausibility of results, and allocate scarce resources..." (Chubin and Hackett 1990:2), and "a form of deliberation involving an exchange of judgments about the appropriateness of methods and the strength of the author's inferences" (OMB 2004:2). The

American Fisheries Society (AFS) recently commented on the value of independent peer review for fisheries science, including the stimulation of new ideas, clarification of ideas, and increased rigor in analyses and conclusions (Rassam and Geubtner 2006). The AFS also identified peer review as a component of the best available science for fisheries (Sullivan et al. 2006).

Many management agencies base regulatory decisions in part on the work of their own scientists, or on research they receive under contract, which can lead to perceived conflicts of interest and to challenges to the credibility of their science and management decisions. In addition, some agencies have been publicly accused of “gagging” their scientists if their work involves controversial topics (e.g., Revkin 2006). Subjecting agency science to independent peer review is an approach increasingly used to address these problems. For example, the U.S. Environmental Protection Agency (EPA) has adopted a highly detailed process for incorporating peer review into regulatory procedures, including documentation of the results of the review (USEPA 2000). Also, a policy incorporating independent peer reviews into listing and recovery actions under the Endangered Species Act has been in place since 1994 (USFWS and NMFS 1994).

The National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NOAA Fisheries) has a long tradition of involving outside experts in external peer reviews of the science underlying management decision making and the programs that generate this science. The scope and independence of these reviews varies widely, ranging from informal reviews by colleagues (e.g., an internal report), to peer reviews conducted by scientists from other NOAA Fisheries science centers and academic institutions (e.g., stock assessments used as scientific advice by fishery management councils for setting quotas), to large, complex reviews of topics of national significance, often conducted by the National Research Council. The outside experts providing these reviews typically have been internationally-recognized academics or leading governmental scientists from the United States or other countries. Historically the participation of the reviewers has usually been gratis, with NOAA covering only travel costs. However, due to greatly increasing demands for peer review, and the complexity of the reviews, this situation is changing rapidly for NOAA

Fisheries, and for other regulatory agencies as well.

This article provides an overview of the Center for Independent Experts (CIE), NOAA Fisheries’ national program for conducting formal peer reviews of the agency’s science products. The article covers the role the CIE fills in meeting the agency’s needs for peer review, the structure of the program, its operations, and case studies that describe the impacts of CIE reviews on some scientific issues and assessment processes.

ESCALATING PEER-REVIEW REQUIREMENTS

To adapt to the growing emphasis on the use of scientific information in fisheries management decisions, in recent years the federal government, including NOAA Fisheries, has repeatedly sought external advice on how to improve the agency’s science, including the role of peer review, and then developed and implemented plans to follow that advice (Table 1).

The role of peer review in fisheries management at the national level was addressed by the U.S. Commission on Ocean Policy (USCOP). Recommendation 19-4 in the USCOP’s final report (2004) states that NOAA Fisheries, the fishery management councils, and interstate fisheries commissions “should develop a process of independent review of the scientific information relied on by Scientific and Statistical Committees.” Three procedures were recognized: a standard annual review to ensure that data and models are correct; an enhanced review conducted on a 3-5 year cycle, which would evaluate models and assessment procedures to assess the state of the art; and an expedited review for highly controversial results. The CIE was specifically mentioned as the type of organization that could provide the enhanced and expedited reviews. The U.S. Administration’s response (CEQ 2004) explicitly supports the use of peer-reviewed science in fisheries management.

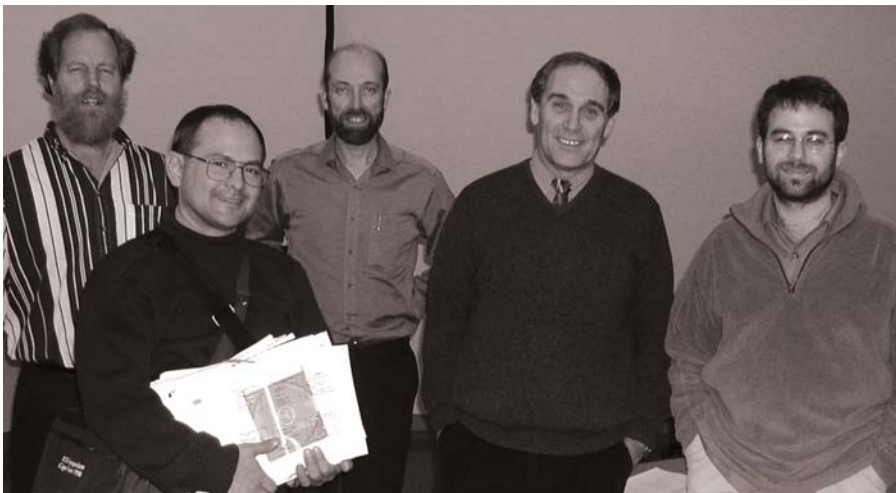
The trend towards incorporating peer review into regulatory processes has culminated in the Information Quality Act (IQA) of 2000, Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554), and the implementing policies established by the Office of Management and Budget in the *Information Quality Bulletin for Peer Review* (PRB; OMB 2004). The PRB establishes minimum standards for federal agencies when peer review is

required. Two categories of science are recognized: (1) highly influential scientific assessments, which could have the potential impact > \$500 million in any year, or are novel, controversial, precedent-setting, or have significant inter-agency interest; and (2) influential scientific information, which is information an agency can reasonably determine will have a clear and substantial impact on important public policies or private sector decisions. The PRB established requirements for public disclosure of and access to peer review planning; selection of reviewers, including expertise and balance, conflicts of interest, and independence; peer review mechanism (e.g., panel versus letter review); transparency; and management of the peer review process. Although the assessments conducted by NOAA Fisheries may only occasionally reach the level of a highly influential scientific assessment, much of the science routinely conducted by NOAA Fisheries falls into the influential scientific information category. NOAA Fisheries increasingly relies on the CIE for conducting peer reviews that are considered highly influential scientific assessments or influential scientific information.

THE CENTER FOR INDEPENDENT EXPERTS

The CIE provides independent and timely reviews of the science upon which many of NOAA Fisheries’ management decisions are based. For fisheries management, the decisions are required under the Magnuson-Stevens Fisheries Conservation and Management Act as amended in 1996. For protected species, the decisions are required under the Endangered Species Act of 1973 as amended or the Marine Mammal Protection Act of 1972 as amended. Compared to reviews conducted by the National Research Council (NRC), CIE reviews are more narrowly focused on specific scientific issues, and are conducted over a shorter timeline, typically two to four months. Consequently, CIE reviews are considerably less costly than NRC reviews. Initiated in 1998, the CIE is now run under a contract with the University of Miami’s Cooperative Institute for Marine and Atmospheric Studies (CIMAS; www.rsmas.miami.edu/groups/cie/).

The structure and operation of the CIE have been designed to ensure the quality, relevance, and independence of the reviews. Independence is maintained by eliminating any role for NOAA in selecting or paying the reviewers, or in approving the contents



The CIE panel that participated in the February 2003 workshop on Northeast groundfish assessments (see Case Study1).

of reviewers' reports. Also, strict conflict-of-interest policies are followed. To ensure quality and timeliness, the University of Miami pays CIE reviewers for their work, and requires them to sign contracts with

well-defined deliverables and schedules. Most reviews are initiated through requests from the NOAA fisheries science centers, with specific requirements described in a statement of work. Some reviews are initi-

ated as part of a legal settlement, or at the request of NOAA Fisheries, NOAA, or the Department of Commerce.

There is no requirement for the agency to accept or act on the recommendations provided by CIE reviewers, nor is there a comprehensive mechanism that tracks the agency's responses. In some highly sensitive cases (see Case 1 below), the agency does formally respond to CIE reviews.

CIE Reviews and Products

The CIE conducts on-site and correspondence reviews. For on-site reviews, the CIE experts are sent to meetings, workshops, or other fora organized by NOAA Fisheries. They usually participate in a peer-review panel, which may consist only of CIE reviewers, or a mixture of CIE and other reviewers. In some cases, a CIE expert may chair a panel, with responsibilities for coordination and ensuring that the tasks of the panel are completed. In correspondence reviews, the CIE experts conduct all review-related activities from their home location.

Table 1. Recent recommendations to NOAA Fisheries and agency responses relevant to peer review.

Reference	Key statement on peer review
Recommendations	
NRC 1998a:116	The committee recommends that NOAA Fisheries conduct (at reasonable intervals) in-depth, independent peer review of its fishery management methods to include (1) the survey sampling methods used in the collection of fishery and fishery-independent data, (2) stock assessment procedures, and (3) management and risk-assessment strategies.
NRC 1998b:75	Ensure that a greater number of independent scientists from academia and elsewhere participate in the Stock Assessment Review Process [with respect to the Northeast groundfish stock assessments]...
NRC 2000:156	NOAA Fisheries, in conjunction with the regional councils, should review all aspects of its data collection activities, on a fixed, publicly-announced schedule including all types of fishery-dependent and fishery independent data. Such reviews should include both a scientific peer review and a stakeholder review.
NRC 2000:165	A greater degree of independence in the peer-review process is needed in order to maintain the integrity and scientific credibility of the NOAA Fisheries assessments....every assessment should be externally reviewed on a regular basis, for example, every three to five years.
NRC 2002:5	NOAA Fisheries should continue to use and seek advice and review from independent sources. In the past, NOAA Fisheries has been criticized for the lack of independent review of its stock assessments....Hence, independent review should be a fundamental component of developing stock assessments.
NRC 2004:7	NOAA Fisheries should establish an explicit and standardized peer review process for all documents that contain scientific information used in the development of fishery management plans.
U.S. COP 2004:235	Recommendation 19-4. The National Marine Fisheries Service, working with the Regional Fishery Management Councils and the interstate fisheries commissions, should develop a process for independent review of the scientific information relied on by Scientific and Statistical Committees.
Responses and planning documents	
U.S. DOC 2001:25	The CIE provides a mechanism for accessing a worldwide pool of highly-qualified fisheries scientists, statisticians, and other experts.
U.S. DOC 2004a:44	Objective 1.5: Use stock assessment workshops, peer reviews, and other fora to ensure that our information and advice are developed through an open and collaborative process.
U.S. DOC 2004b:2	Scientific peer review depicted in conceptual model of stock assessment process for protected species.
CEQ 2004:19	The Administration supports the use of peer-reviewed science in resource management decisions. ...the President directs NOAA to establish guidelines and procedures for the development and application of scientific advice for fisheries management decisions, in consultation with the Regional Fishery Management Councils, Interstate Fishery Commissions, stakeholders, and other agencies as appropriate.

The CIE generally requires that reviewers complete reports that describe the review activities, present all relevant findings, and draw conclusions and recommendations. Each reviewer usually provides a separate, independent report. Sometimes CIE reviewers also contribute to panel reports, though these are not considered CIE products. In a few recent projects, one of the reviewers, typically a panel chair, has provided a summary report, which consolidates the views of each individual report. This is not developed as a consensus document, since there has been no process for reaching consensus. On points where all panelists agree, this is noted. Where opinions diverge, each viewpoint is summarized. The individual reviewer reports are appended to the summary report, ensuring that all detailed information is provided.

CIE STRUCTURE

The CIE operates in a dynamic environment, in that it reviews, modifies, and accelerates its operating procedures as required for the reviews needed by NOAA Fisheries, while maintaining its core independence. The CIE structure consists of a coordination team and a steering committee, which work together in developing and updating CIE operating procedures, identifying and selecting reviewers, and reviewing background material, review reports, and other related documents. The coordination team consists of a primary and an external coordinator, a manager, and an intern, as well as ancillary personnel that provide support in contracts and accounting. The steering committee, comprising three senior scientists, provides scientific oversight.

The CIE coordination team is responsible for daily operations. The manager and intern identify and contact experts in various marine science fields to maintain a reviewer database, work with the coordinators in developing reviewer candidate lists, interface with the steering committee in selecting reviewers, draft contracts and related legal material as part of contracting experts to serve as CIE reviewers, and handle review logistics. The primary coordinator oversees daily operations, serving as the official CIE contact with NOAA Fisheries, reviewers, and others; directing reviewer identification and selection; and working with the manager and intern on other operational matters. The primary coordinator also acts as the main liaison with the steering committee, providing them with review and process-related developments, and serving as the point of contact between the

steering committee and NOAA Fisheries. The external coordinator acts on behalf of the primary coordinator on reviews, processes, and issues on which the primary coordinator may be perceived to possess a conflict of interest. Currently, the CIE coordination team is set up such that the primary coordinator, whose primary research interest is in the Atlantic, manages all West Coast-based reviews, and the external coordinator, whose primary research is in the Pacific, manages all East Coast-based reviews.

Comprising three senior scientists, the CIE steering committee is responsible for selecting reviewers, making final decisions concerning conflict of interest, and determining all other CIE-related issues that could not be resolved by the coordination team. Steering committee members serve three-year terms, and are replaced on a staggered schedule, thereby ensuring continuity. The steering committee collectively possesses expertise on fishery stock assessment, marine mammals and protected marine species, and ecology and ecosystem science.

CONFLICT OF INTEREST

To ensure that the CIE maintains the highest level of independence, the CIE and NOAA Fisheries developed a strict conflict of interest policy, which has been designed to be consistent with OMB (2004) requirements. Prior to participating in any CIE review, every expert is required to sign a conflict of interest (COI) statement (www.rsmas.miami.edu/groups/cie/ciecoi.htm). This statement outlines the conditions under which an expert is considered to be free from any conflict that would preclude participation in a CIE review. Reviewers are required to sign this statement for every review in which they participate, and are required to provide the CIE with any materials relevant to a potential conflict, such as a curriculum vitae and published articles and opinions. The CIE evaluates these materials before offering a review to an expert.

NOAA Fisheries participates in the COI evaluation only to the extent that the agency can provide additional information, which may have been unavailable to the CIE, that could affect an expert's eligibility. In such cases, NOAA Fisheries may request that the CIE revisit the eligibility of an expert, but NOAA Fisheries does not have a decision-making role regarding the expert's selection as a CIE reviewer. Additionally, NOAA Fisheries cannot request rejection of an expert based on the expert's view of the agency, and can only provide information

that is germane to the issues in the COI statement.

Many of the COI requirements involve financial conflicts. An expert may not participate as a CIE reviewer if he/she has received funds in the past three years or is seeking funds and/or employment from sources with vested interests in resources for which NOAA Fisheries has stewardship responsibilities. These sources include industry or environmental groups, non-governmental organizations, foundations, and any entity involved in relevant litigation. Additionally, an expert is considered to have a conflict if they have received or are seeking sole-source or non-competitive funding from NOAA Fisheries or interested state or local governments. These restrictions also apply to immediate family members of potential CIE reviewers.

The other COI requirements address conflicts arising from a history of advocacy or perceptions. A potential reviewer with a well-formed position or history of advocacy for a specific viewpoint relevant to the fishery, or a perceived conflict of interest relevant to the specific issue or fishery being reviewed, is considered ineligible. These types of conflicts may only be relevant to a specific issue. In such cases an expert may be eligible for other reviews.

REVIEW PROCESS

To begin the annual cycle of CIE reviews, the NOAA Fisheries project manager compiles a list of proposed reviews prior to the beginning of the fiscal year. This list is updated as needs change during the fiscal year. The list includes details on the topic, type of review, number of reviewers, expertise required, level of effort, location, and schedule. The list is used by NOAA Fisheries for scheduling and prioritizing reviews, and by both the agency and the CIE for planning, coordination, and budget management. NOAA Fisheries has instituted a prioritization process to ensure maximum benefit from the expenditures for CIE peer reviews (Table 2). At the beginning of a fiscal year, the prioritization factors are applied to the initial list of proposed reviews by the NOAA Fisheries project manager. These priorities are reviewed and approved by the NOAA fisheries science center directors and the chief scientist, and are re-evaluated as circumstances evolve over the course of the fiscal year.

A typical CIE review requires two to four months from initiation to delivery of final review reports (Figure 1). This pro-



As is typical of peer reviews, the scientists involved with the Northeast groundfish reviews focused intently on technical issues.

cess can be expedited if necessary. A review is initiated by NOAA Fisheries by selecting a high-priority review from the annual list of proposed reviews. The NOAA Fisheries project manager and the CIE develop a statement of work and cost estimate, which are entered into a work order, the legal document that formally assigns a review to the CIE under the contract. The statement of work provides background information and specifies requirements for the number and expertise of reviewers and the activities required of the reviewers, such as documents that must be read, meetings that must be attended, and the outline for any report that each reviewer must produce. It also covers budget and schedule.

Once the CIE receives a draft statement of work, the coordination team searches for potential candidates for that review, based on the expertise required. To ensure independence from NOAA Fisheries, the agency has no role in this process. The coordinator and manager consider candidates from the pool of experts that the CIE retains for this purpose, and may also search online databases and journals for additional candidates. Once suitable candidates have been identified, the coordination team contacts each expert to determine interest and availability and evaluates potential conflicts of interest. The final list of candidates, along with curricula vitae, is placed on the CIE's restricted-access web-

site, from which the steering committee selects the final reviewer(s).

Following approval of the reviewers, the CIE manager develops contracts and organizes logistics. The contracts are between the University of Miami and each reviewer. NOAA is not a party to these contracts. Logistics include providing reviewer contact information to NOAA Fisheries, and setting up travel arrangements. The agency must provide all background material to the CIE and the reviewers well in advance of review activities. All correspondence between reviewers and NOAA Fisheries is copied to the CIE to ensure transparency.

In contrast to the anonymity of reviewers maintained in most academic peer review processes, information on the iden-

Table 2. Factors considered by NOAA Fisheries in prioritizing proposed CIE reviews. These factors are considered in the order given.

1. High economic impact, controversy, or potential for establishing a precedent with wide-ranging implications.
2. Benchmark assessments prompted by a new fishery or protected resource management action, or by a major change in a stock assessment model or input data that will have a major impact on stock status determination.
3. The scientific information to be reviewed provided new or innovative research results, or used new or innovative methods, with clear application to fisheries or protected resource management.
4. The scientific information or assessment has not undergone independent peer review within the past five years, and new data or methods may be needed to improve the scientific basis for management.
5. The scientific information to be reviewed has significant interagency interest.
6. The assessment is an annual update of an existing assessment with the addition of a new year of data, but no change in the assessment model.
7. The purpose of the review is to improve NOAA Fisheries's scientific operations.

Figure 1. Steps of the CIE review process.

Step	Responsible party	Duration
1. Peer review requested	NOAA Fisheries client (science center, regional office, or headquarters office)	1-3 months
2. Statement of work/work order developed	NOAA Fisheries headquarters and CIE	
3. Reviewers selected, brought under contracts	CIE	
4. Review activities completed	Reviewers contracted to CIE	2-3 weeks
5. Reports submitted to CIE	Reviewers contracted to CIE	
6. Reports reviewed, approved, submitted to NOAA Fisheries	CIE	2-3 weeks
7. Reports accepted, sent to NOAA Fisheries client	NOAA Fisheries headquarters	

tities of CIE reviewers is not restricted. Most of the reviews that include workshops attended by CIE reviewers are open to the public. In some cases, the names of the reviewers are posted on the Internet (e.g., the South East Data Assessment and Review [SEDAR] web site, maintained by the South Atlantic Fisheries Management Council). Also, the names of CIE reviewers can be obtained from NOAA Fisheries upon request. The time-course of CIE reviews is too short to routinely post this information on the Peer Review Bulletin web site, which is updated only every six months.

The statement of work contains deadlines for when the reviewers must submit draft review reports to the CIE, and for when the CIE must provide the final review reports to NOAA Fisheries. Many reviews involve panel meetings or workshops. Some panels consist only of CIE reviewers, while others are a mixture of CIE and other reviewers. In some of these cases, the CIE also provides a panel chair. The chair does not provide a review report, but rather provides independent leadership of the panel and facilitates its functioning. The chair may also contribute to panel reports, which may or may not be CIE products. Generally, reviewers have two weeks following any offsite meeting to produce draft reports, and the CIE has another two weeks for internal review and approval. In extraordinary conditions, the CIE completes expedited reviews, providing reports to NOAA Fisheries in one week or less after receipt. When CIE reviewers are required to contribute to panel reports in addition to producing their own review report, they must do so in accordance with the panel's schedule.

The CIE coordination team and steering committee are both responsible for reviewing draft review reports. The steering committee reviews them for accuracy, relevance, and quality, and assesses whether they meet the requirements of the statement of work. The coordination team also comments on these issues, but focuses mainly on formatting and editing. The CIE manager submits final reports to NOAA Fisheries, and the agency's project manager makes a final determination as to whether the reports meet the statement of work requirements. At this point NOAA Fisheries can require revisions to address specific shortcomings, such as missing items identified in the statement of work,

but cannot request changes in content or conclusions.

Publication of Reviews

Completed review reports are the property of NOAA Fisheries. The reports are provided to the entity within the agency that originally requested the review. They are not considered privileged information, so the reports are generally available upon request. Some reports of high public interest are published on the Internet (see Case 1 below).

CHALLENGES ENCOUNTERED WITH CIE REVIEWS

Occasional difficulties have occurred during or following CIE reviews. During reviews, problems can occur when the requirements in the statement of work are not clear, when the process followed during a review workshop deviates from the process outlined in the statement of work, or when additional information is provided that was not available when the statement of work was written. In such cases, reviewers might produce reports that do not meet their contractual requirements, which may necessitate revisions to the reports and cause delays in their delivery. Care in designing and implementing a review process and in writing the statement of work with well-defined and appropriate products can minimize these occurrences.

Despite having well-crafted statements of work and smoothly implemented review workshops, some reviewers' reports may not contain appropriate or useful analysis or recommendations. Contracts between the CIE and the reviewers provide some measure of quality control, but the purpose of CIE reviews is to obtain the freely expressed opinions of the individual reviewers. The reviewer's comments are accepted as long as they have addressed the specific elements identified in the statement of work. Because of this, some reviews have contained comments that are inappropriate or are not feasible to implement. Reviews of this nature represent a lost opportunity, and could sometimes put the agency in the awkward position of ignoring the advice that it had sought.

There are some topics that remain controversial, even after an independent peer review. A few interested parties have challenged the agency or the CIE itself over the credibility of a review. These chal-

lenges have focused on review processes, rather than the scientific issues that were the subjects of the reviews. A point of contention has been the perceived conflict of interest on the part of a reviewer, such as whether or not a reviewer has a history of advocacy for a specific viewpoint.

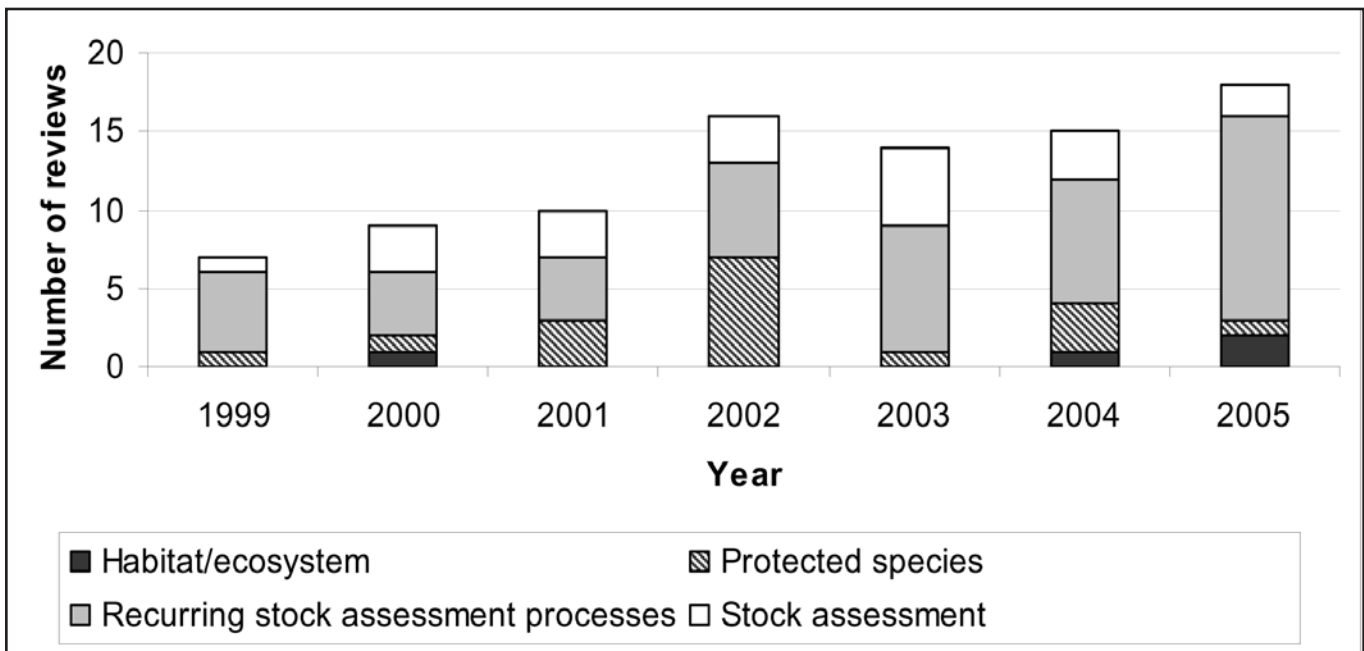
PROFILE OF CIE REVIEWS AND REVIEWERS

The CIE completed 101 reviews between 1999 and September 2006, averaging about 13 reviews per year. The number of reviews per year has increased over time, reaching 18 in 2005 (Figure 2). Most reviews have covered recurring fish stock assessment meetings and workshops, other fish stock assessments, essential fish habitat, ecosystem health and function, and impacts of habitat alteration. Over time there has been an increase in the number of reviews for recurring stock assessment processes: the Stock Assessment Review Committee (SARC) for the Northeast; the South East Data Assessment and Review (SEDAR) for the Southeast, Gulf of Mexico and Caribbean; and the Stock Assessment and Review (STAR) for the Pacific Coast. These recurring processes now all depend on reviewers from the CIE. A substantial portion of CIE reviews has involved protected species of marine mammals, sea turtles, and anadromous fishes, covering topics such as population structure, abundance estimates, and impacts of fishing and other anthropogenic factors. The CIE has provided experts in other fields as diverse as veterinary science, physiology, animal behavior, genetics, biochemistry, toxicology, geomorphology, oceanography, economics, and hydrology.

NOAA Fisheries pays the CIE for the reviews. The costs include payments made by the University of Miami to the reviewers and the university's costs for the running the program. For the 2006 schedule, costs per review ranged from \$18,600 for a desk review, involving three reviewers working for a total of 15 days with no travel, to \$98,500 for a review panel involving international travel and four reviewers working for a total of 61 days.

Over the 1999-September 2006 period, the CIE contracted a total of 98 reviewers. CIE experts have participated in an average of 2.2 reviews, with a maximum of 19. To ensure that experts are not perceived as being part of recurring or other assessment

Figure 2. Numbers and types of CIE reviews, 1999-2005. Recurring stock assessment processes are those incorporated into regional assessment processes (SARC, SEDAR, and STAR).



processes, the CIE generally does not allow participation by the same experts in consecutive reviews or in more than one review that addresses a particular issue. This promotes independence and diversity of input, and prevents development of potential conflicts of interest.

Primarily because of conflict of interest concerns, 72% of the CIE reviewers have come from outside the United States (Figure 3). In addition to avoiding even the perception of a conflict of interest, reviewers from overseas often provide a fresh point of view and a greater sense of independence. The tradeoff is that foreign reviewers generally lack local knowledge and familiarity with U.S. laws and management priorities. These factors are compensated for by requiring reviewers to prepare for their reviews by reading an extensive set of background documents.

CASE STUDIES

The case studies described below illustrate successful CIE reviews, including the circumstances surrounding the reviews, the activities and deliverables required of the reviewers, and the impacts of their reviews. Case Study 1 describes a crisis in a key agency science program, which the CIE helped to resolve, and which had lasting impacts on both CIE and agency operations. Case Study 2 describes a comparatively routine scientific review, in which the

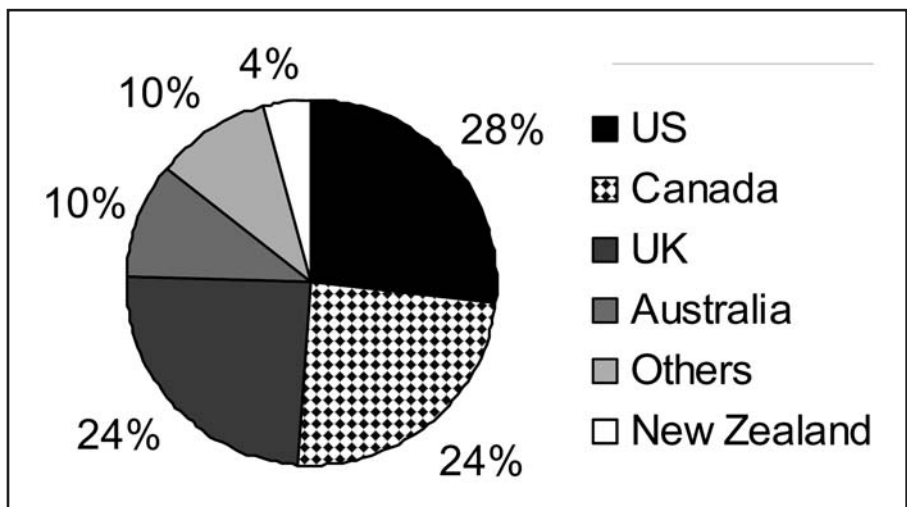
recommendations of the reviewers provided useful guidance for improving a specific project.

Case 1: "Trawlgate," Amendment 13, and the Groundfish Assessment Review Meeting

Twenty groundfish stocks are managed under the Northeast Multispecies Fishery Management Plan (FMP). These stocks have been traditional mainstays of the commercial fishing sector in New England. Their decline has been widely reported in the scientific literature (e.g., NRC 1998b) and in other media for the broader public (e.g., Fordham 1996). In

2001 estimates of fishing mortality rates (or proxies) were available for 19 of the 20 stocks. Of those 19 stocks, fishing mortality rates declined between 1994 and 2001 for 15, and increased for only 4, and biomass estimates had increased for 19 of the 20 stocks since 1995 (US DOC 2002). Nonetheless, based on stock assessments derived in large part from data generated by standardized trawl surveys conducted using the Northeast Fisheries Science Center's (NEFSC's) *Albatross IV*, the rebuilding rates were determined to be below rebuilding targets. To comply with rulings of the U.S. District Court, in 2002

Figure 3. Nationalities of CIE reviewers, 1999 through September 2006.




the New England Fishery Management Council proposed Amendment 13 of the FMP, which required major cuts in commercial fishing. The public debate over Amendment 13 became highly contentious and politicized.

The issue that became known as "Trawlgate" burst onto the scene in this already highly charged atmosphere in the autumn of 2002 (Daley and Cook 2003; Van Zile 2003). Commercial fishermen speculated that the cables connecting the net to the winches on the *Albatross IV* were not properly marked, leading to uneven cable lengths on port and starboard and potentially skewing the net while fishing. The offset ranged from less than one inch at 100 meters of deployed cable, to just under 6 feet at 300 meters of deployed cable. This apparent defect perhaps caused the nets to be towed asymmetrically during eight bottom-trawl surveys conducted between 2000 and 2002. Acrimonious challenges to the credibility of the surveys, the resultant stock assessments, and Amendment 13 immediately followed.

These events required rapid and credible responses from NOAA Fisheries (www.nefsc.noaa.gov/survey_gear/). The NEFSC conducted gear performance experiments and detailed analyses of the degree to which the surveys in question had affected the groundfish stock assessments. A public workshop, termed the Groundfish Assessment Review Meeting (GARM), was held in October 2002 to present the results of these studies. A second public peer-review workshop was held in February 2003 to review the results of the GARM and for broader discussions of the trawl surveys, groundfish assessments, biological reference points for Amendment 13, and stock rebuilding projections. In addition, the NOAA Administrator ordered all of the fisheries science centers around the coasts of the United States to develop and implement written protocols for conducting their trawl surveys.

Three independent peer reviews conducted by the CIE were critical to establishing the scientific credibility of these responses. The first of these reviews was of the October GARM, which was attended by two CIE reviewers. Their reports concurred with the NEFSC's analyses showing that the trawl offsets did not have a major effect on the survey data, and that the data could be used in the assessments underlying Amendment 13 (Darby 2002; Volstad 2002). The CIE provided a panel of four reviewers plus a panel chair for the February peer-review workshop. The four panelists each provided an individual review report. The chair provided a report summarizing the views expressed in the four panelist reports (Payne 2003), which was a new type of CIE product at the time. These reports concluded that the sensitivity tests carried out by the NEFSC scientists had demonstrated that the survey data could be used unadjusted in the groundfish stock assessments, and made numerous technical recommendations regarding the surveys and assessments. The NEFSC compiled a point-by-point response to the reviews from the February peer-review workshop (www.nefsc.noaa.gov/groundfish/response.pdf), and committed in a letter to the New England Fishery Management Council to follow up on the major points raised by the reviewers (www.nefsc.noaa.gov/groundfish/cover.pdf). These reviews and follow-up actions effectively put an end to the Trawlgate matter (S. Murawski, NOAA Fisheries, personal communication). Subsequently, the council adopted Amendment 13. Finally, the trawl protocols developed by NOAA Fisheries were reviewed by two CIE (Godo 2003; Walsh 2003) and four other reviewers, including two commercial fishermen. Protocols requir-



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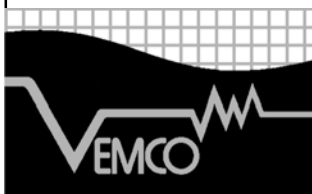
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ing frequent, precise re-measurements are now in place in all NOAA fishery science centers. A positive aspect of this episode is that these protocols ensure more standardized and repeatable sampling.

Case 2: Abundance of the coastal bottlenose dolphin in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002

After massive die-offs of bottlenose dolphins in the late 1980s, NOAA Fisheries declared the Atlantic stocks of coastal bottlenose dolphin (*Tursiops truncatus*) to be depleted, and created a Coastal Bottlenose Dolphin Take Reduction Team (TRT), consisting of scientists, recreational and commercial fishermen, and representatives from the environmental community. The TRT was responsible for recommending policies to reduce incidental takes of bottlenose dolphin by gill-net fisheries. Because most of the available estimates of dolphin abundance were speculative, the NOAA Southeast Fisheries Science Center (SEFSC) undertook research to estimate bottlenose dolphin abundance in the U.S. Atlantic coastal waters. Several aerial surveys were conducted over the continental shelf between New Jersey and Florida, and extensive skin-biopsy samples were collected during 2001 and 2002 to enable genetic identification of coastal versus offshore morphotypes and to describe their spatial distributions. A report on these activities, entitled "Abundance of the Coastal Morphotype of Bottlenose Dolphin, *Tursiops truncatus*, in U.S. Continental Shelf Waters Between New Jersey and Florida During Winter and Summer 2002" (Garrison et al. 2003), was the subject of a CIE review during February 2003.

The CIE selected a panel of three internationally recognized scientists, with expertise in stock assessment, genetics, and marine mammalogy, to review this report by correspondence. The statement of work for the review specified that the reviewers evaluate: (1) the appropriateness of the design, execution, and analysis of the aerial surveys; (2) the appropriateness of the statistical methodologies used to distinguish the spatial distributions and habitats of the coastal versus offshore morphotypes; (3) the appropriateness of the resulting abundance estimate for coastal bottlenose dolphins; and (4) whether

potential biases had been adequately identified and appropriate measures of statistical uncertainty had been included in the resulting abundance estimates.

The panelists independently concluded that the aerial survey had followed an appropriate design and used adequate methods for data analysis, had used appropriate statistical methods for distinguishing coastal from offshore dolphins, and had produced reasonable estimates of coastal bottlenose dolphin abundance. In addition, the reviewers made several recommendations that subsequently resulted in modifications to the process of surveying coastal bottlenose dolphins. For example, concerns about potential changes in dolphin abundance and inter-annual variability in distribution led SEFSC personnel to schedule surveys in winter 2003 and summer 2004 that filled data gaps left by the biopsy sampling during 2002. Other issues raised by the reviewers were considered by NOAA Fisheries, but not acted on. One reviewer noted that the research report did not consider the estuarine dolphin populations, whose presence in the survey area could have influenced the coastal dolphin abundance estimates.

IMPACTS OF THE CIE ON NOAA FISHERIES' SCIENCE

The CIE has had significant impacts on the science conducted by NOAA Fisheries. Perhaps the most tangible impacts have been at the scale of the recurring regional stock assessment and review processes: the SARC for the Northeast; SEDAR for the Southeast, Gulf of Mexico, and Caribbean; and STAR for the Pacific. CIE reviewers are now integral to all three of these processes, because of the benefits their presence provides. Recent SARC review panels have been composed entirely of CIE reviewers. Based on the experiences from the February 2003 groundfish peer-review panel, SARC review panels now have a chair provided by the CIE. In addition to running the panel, the chair provides a report summarizing the comments of the other reviewers, which is a product more easily used by the clients. SEDAR panels are now a mix of CIE and other reviewers. The SEDAR reviews typically utilize a chair supplied by the CIE. The STAR panels are also a mix of CIE and other reviewers. Although these

recurring processes differ somewhat in detail, all involve the peer review of stock assessments that have been developed by NOAA Fisheries, and the products of these processes, including the CIE reviews, are provided as management advice to the regional fisheries management councils.

Many of the tangible impacts of CIE reviews are at the scale of the specific projects, such as constructive criticisms leading to modifications to stock assessments, field methods, and applied research projects. The case studies described above are examples. The tuna/dolphin issue in the Eastern Tropical Pacific provides an ongoing example of CIE reviews impacting a high-profile NOAA Fisheries science program. In the yellowfin tuna purse-seine fishery, nets are deployed around dolphin schools that associate with the tuna and are easier to detect. Historically this fishery killed up to 350,000 dolphins per year (U.S. DOC 2000). With the passage of the Marine Mammal Protection Act in 1972 and subsequent legislation, such as the International Dolphin Conservation Program Act in 1997, direct, observed mortality caused by fishing operations has been greatly reduced. The dolphins are still encircled by the nets, but most are released alive. Nonetheless, the affected dolphin populations have not recovered. The CIE has conducted a total of eight peer reviews on aspects of this problem between 1999 and 2006. The seven reviews conducted between 1999 and 2002 addressed ecosystem carrying capacity, physiological, and behavioral changes caused by the stress of encirclement by the purse seines, and stock assessment methods for determining dolphin populations. After the 2002 reviews, NOAA Fisheries developed a new research plan for determining why the populations are still not recovering (US DOC 2006). The 2006 CIE review evaluated this plan, providing constructive criticisms of the scope, organization, and proposed methods.

Although the benefits are not easily quantified, the CIE has also had intangible impacts on NOAA Fisheries' science and the management that depends on it. CIE reviews have quelled controversy when the agency's science has been challenged, as described in the Trawlgate case study. In reference to the CIE, the U.S. Commission on Ocean Policy (2004) stated, "Although the center's experts


have examined a number of controversial topics, their reviews have so far been less subject to challenge than internal NMFS peer reviews." Even when reviewers report legitimate shortcomings in the science, the very fact that the agency has brought in independent reviewers is a key first step in identifying and solving the problems and bolstering science quality and credibility over the long term.

FUTURE IMPROVEMENTS

Quality assurance for the reviewers and the review process, and assessment of the impacts of reviews on the agency's science, are issues that may receive attention in the future. These types of information could be useful for improving the quality of the products delivered to NOAA Fisheries and improving how reviews are conducted, as well as for eliminating individuals from the reviewer pool who do not perform adequately. Questionnaires have been drafted to address some of these issues, but they have not been fully developed or used, and there has been no substantive consideration of performance metrics. Currently the quality of reviews is assessed informally by the CIE's coordination team and steering committee. There is no formal mechanism for obtaining feedback from NOAA Fisheries on the quality or relevance of the reviews. There is some risk in providing a forum for the agency to evaluate the reviewers, as it could compromise the independence of the reviewer selection process. Other than through the contents of their reports, there is no mechanism by which reviewers can provide feedback to the CIE about the reviews in which they participate.

CONCLUSIONS

The CIE has proven to be a successful approach for obtaining independent peer reviews of NOAA Fisheries' science products. Where the science has been of high quality, the CIE's reviews have generally provided independent confirmation. This outcome has bolstered the credibility of the agency's science to a wide range of stakeholders, and helped to reduce the contentiousness that can accompany management decision making in the face of competing economic and societal values. Where reviewers have identified shortcomings, their recommendations have often provided valuable guidance for improvements. As such, the CIE could be a model for other natural resource and environmental agencies.

It can be anticipated that the need for peer review will continue to increase in the foreseeable future. Demand from within NOAA Fisheries for CIE reviews is continuing to grow, fueled in part by the requirements of the Information Quality Act and the OMB Peer Review Bulletin. As fisheries management begins to transition from the current single-species focus to ecosystem-based approaches, the underlying science and management decisions will become more complex, which will likely lead to an increased need for independent peer review. It is probable that other regulatory agencies at all levels of government will experience similar growth in the need for peer review. Thus, entities that can meet this need, like the CIE, will likely become more common as time goes on. 

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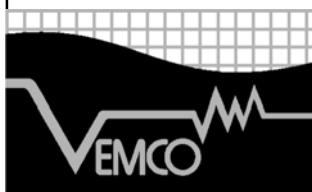
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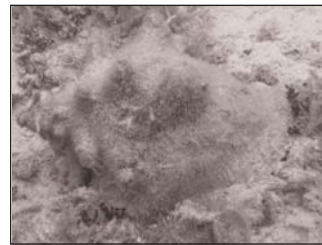
The Center for Independent Experts was started through the efforts of William Fox and Elizabeth Clarke, when they were respectively director and biological oceanographer at the NOAA Fisheries Office of Science and Technology. Terry Smith, Lance Garrison, and Elizabeth Clarke from NOAA Fisheries and John Carmichael from the South Atlantic Fisheries Management Council provided information used in developing the case studies. Steven Murawski and John Boreman provided insiders' perspectives on the events surrounding Amendment 13, and Paul Rago provided the photographs. Tom Barry and Aric Bickel have provided excellent operational support for the CIE. Drafts of this article benefited from comments from Samuel Pooley, James Weinberg, and William Richards. The comments of two anonymous reviewers provided another demonstration of the value of peer review in improving the quality of science products.

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FEATURE: FISHERIES MANAGEMENT

Impending Trade Suspensions of Caribbean Queen Conch under CITES: A Case Study on Fishery Impacts and Potential for Stock Recovery



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ABSTRACT: The Convention on International Trade in Endangered Species (CITES) Authority issued injunctions in 2003 and 2004 to halt export trade of Caribbean queen conch (*Strombus gigas*) from several countries and initiated reviews of a number of other conch-producing countries. The current regulatory framework for regional conch fisheries has obviously failed to protect stocks. I present a case study of the Belize conch fishery to examine fishing impacts, effectiveness of existing regulations, and potential for population recovery. Fishery-independent data from a no-take marine reserve indicated that unfished density and biomass were nearly an order of magnitude greater than in comparable fished areas. Size structure of the protected population showed that an average of 38% of the legal catch may consist of juvenile conch. The spawning potential ratio indicated that the fished stock is severely over-exploited, and furthermore, the protected population has not compensated to make the local fishery sustainable. Under these conditions, a moratorium under CITES may be warranted. Until stock assessment models are refined, action should be taken to reduce juvenile fishing mortality, extend closed seasons, and enforce a network of functional no-take reserves in essential habitat.

INTRODUCTION

Queen conch (*Strombus gigas*) is a commercially-valuable marine gastropod that ranges throughout the Caribbean to Bermuda. It is the basis of a lucrative export market to the United States and Europe that was estimated at \$60 million USD in 2001 (CITES 2003). Fishing pressure is intense and has led to significant declines in most populations over the past two decades. The conch fishery crashed in Florida and has not recovered to exploitable levels despite a 20-year fishing moratorium and an active reintroduction program (Glazer and Berg 1994). The status and trends of regional queen conch fisheries led to listing of the species on Appendix II of the Convention on International Trade in Endangered Species (CITES) in 1990. The International Union for the Conservation of Nature (IUCN) categorized the species as "commercially threatened" on the 1994 Red List (Groombridge 1994). More recently, the CITES Authority imposed a suspension of the export trade from the

Dominican Republic, Honduras, and Haiti in 2003 based on evidence for declining stocks and the absence of an effective regulatory framework (Theile 2001; CITES 2003). In 2004, additional suspensions were implemented for Antigua and Barbuda, Barbados, Dominica, and Trinidad and Tobago. Fisheries in 13 other countries were categorized as "of possible concern."

Queen conch is harvested in over 25 Caribbean countries, but fishery regulations vary considerably (Berg and Olsen 1989; Chakalall and Cochrane 1997). For example, regulations may include shell size and/or meat weight limits (Bahamas, Bonaire, Puerto Rico and the U.S. Virgin Islands, St. Kitts and Nevis, St. Vincent and the Grenadines, Turks and Caicos Islands), closed season (Mexico, Puerto Rico and the U.S. Virgin Islands, Venezuela), and prohibition of fishing using scuba technology (Turks and Caicos Islands). Some countries (Bahamas, Dominica, Panama) have set landings or export quotas, but verification is difficult due to insufficient monitoring and report-

ing (CITES 2003). A few countries have no fishery regulations or management plans for this species.

Belize is one of 13 countries from which the CITES Authority has requested stock assessment and management plans. I used a long-term dataset on queen conch population fluctuation in a large, isolated no-take marine reserve in Belize to conduct a fishery-independent assessment of the potential productivity of the stock. These data were compared to equivalent data from adjacent fishing grounds to evaluate fishing impacts and the efficacy of the existing fishery regulations. Results from the Belize case study are discussed in relation to regional fishery management and whether intervention by CITES is warranted.

THE BELIZE QUEEN CONCH FISHERY

Belize is the seventh largest exporter of processed conch meat. The fishery regulations include a closed season from 1 July to 30 September, a minimum shell length of 17.8 cm or processed meat weight of 85 g, and prohibition of fishing using scuba equipment. The closed season was designated to encompass the reported peak period of reproductive activity during summer months. Commercial fishermen are issued licenses, but no limited entry system or individual catch quota has been established. Landings of conch and other commercial species are recorded as catch sold to exporters. There are few reliable estimates of the total landings that include catch sold in the legal local market, the illegal market for under-sized conch, and poaching by foreign

fishers from neighboring countries (CITES 2003). Fishing is concentrated in relatively shallow water < 10 m deep in seagrass meadows, sand-algal flats, and near shallow coral reefs.

Maximum queen conch landings in Belize was reported as 1,200 metric tons (mt) in 1972, but landings declined rapidly after this period (CITES 2003; Camillo 2004). The mean annual catch reported by Belize fishery managers was about 200 mt between 1990 and 2004, but these figures were substantially higher than those verified by CITES. In response to the CITES notification, the Belize Fisheries Department set an export quota of 228 mt, plus a "local consumption" quota of 12 mt per year based on maximum sustainable yield (MSY) estimates (Anon. 2004). The Belize conch fishery was considered stable based on exports (Anon. 2004), even though landings are currently a fraction of the past maximum, fishing effort has clearly increased, and yield estimates are based on short time-series data (CFMC 1999; Camillo 2004).

FISHERY-INDEPENDENT SURVEYS AND ANALYSIS

Data were collected at Glover's Reef atoll, Belize, from 1997 to 2004. Preliminary sampling on east-west transects across the atoll indicated that primary conch habitat consisted of shallow (1-5 m) back reef and patch reef margins with clean sand substratum (spawning habitat), sparse seagrass, and abundant macroalgae *Laurencia* spp. (primary food source; Stoner 2003) (Figure 1). The soft silt substratum in the deeper lagoon and the dense coral cover on the forereef

appeared to be unsuitable for conch. Glover's Reef was designated a marine protected area in 1993, but full-time enforcement was absent until 1998. Fishing is allowed in the General Use Zone (266 km²) and prohibited in the Conservation Zone (72.3 km²).

Queen conch were surveyed on a quarterly basis in the no-take Conservation Zone and the fished General Use Zone in a stratified random sampling design. Within each zone, sampling was conducted on 12 replicate 4 x 50 m belt transects (4 random transects at 3 general locations per zone) in seagrass/algal flats and on 5-m belt transects around the margins of 8 patch reefs. All conch were measured for total shell length (SL; to nearest 0.5 cm) from the tip of the spire to the siphonal groove. Adult conch have determinate shell growth in which lengthening ceases with the onset of sexual maturity as a flared shell lip develops (Egan 1985). The marginal shell lip continually thickens with age, but sexual maturity might be reached up to one year after the initial formation of the shell lip (Appeldoorn 1988). Thickness of the shell lip (LT; to nearest 1 mm) was measured and presence of a shell lip > 1 mm thick was taken as an indication of maturity. Reproductive activity was noted by the presence of egg masses or occurrence of mating or spawning.

For analysis, size classes were defined as: (1) juvenile recruit < 12 cm SL, (2) large juvenile > 12 cm SL without shell lip, (3) adult with flared shell lip. Fluctuations in density (log+1 transformed data) were analyzed using a doubly multivariate repeated measures analysis of variance (RMANOVA) with size classes and zones as between-subjects factors. Pillai's trace statistic was used to detect differences in density, and Bonferroni tests were used for post-hoc comparisons of factor levels. The error covariance matrix was inspected using Mauchley's test of sphericity, and homogeneity of error variances were checked using Levene's test of equal variances.

Change in exploitable adult biomass was assessed from individual adult weights calculated using shell morphometrics (Appeldoorn 1988):

$$\log(MW) = -1.357 + 2.571 \log(SL) + 0.135 \log(LT)$$

where MW: meat weight in g

SL: shell length in cm

LT: shell lip thickness in mm.

The trapezoidal rule of integration was used to compare the magnitude of biomass differences in the no-take and fished areas over the seven year survey period. Spawning stock biomass (SSB) within protected and fished areas was then calculated as (Ault et al. 1998):

$$SSB = \int_{L_M}^{L_L} B(L|a,t) dL$$

where B = \sum biomass at shell length L|a,t

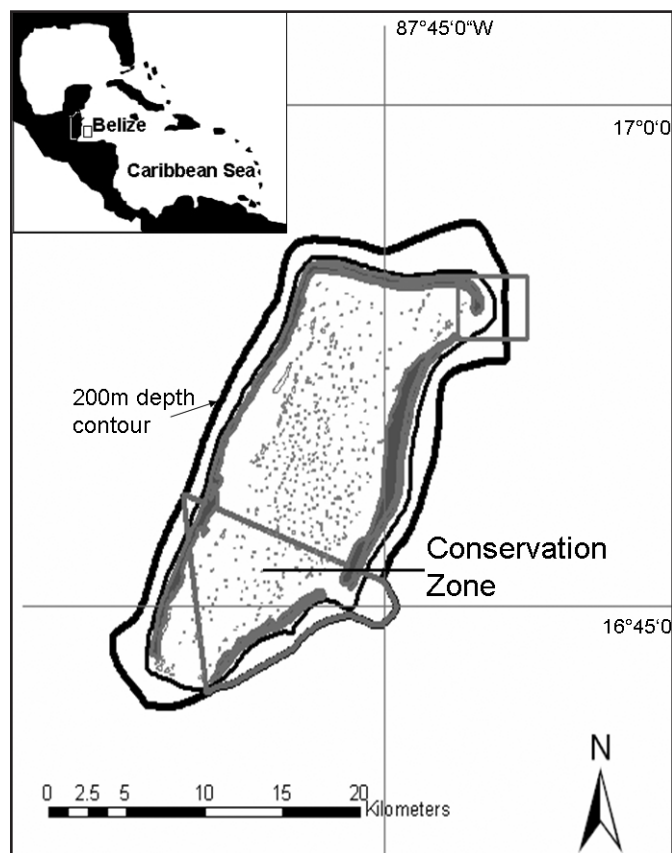
L_L = maximum shell length with shell lip

L_M = minimum shell length with shell lip.

The SSB estimates were used to calculate the reproductive potential for replenishing the stock and sustaining this fishery as the Spawning Potential Ratio (SPR; Goodyear 1993):

$$SPR = SSB_{\text{fished}} / SSB_{\text{unfished}}$$

Figure 1. Map of the Glover's Reef atoll, Belize, showing the no-take marine reserve (Conservation Zone). All other areas are fished (General Use Zone).



SPR was calculated on an annual basis from quarterly moving averages of biomass per unit area. The benchmark for the $SSB_{unfished}$ estimate was taken as the maximum annual biomass recorded in the no-take zone.

FISHERY IMPACTS

With the paucity of reliable catch and effort data, fishery-independent data from this no-take reserve with relatively consistent enforcement yielded valuable insights into fishing impacts and potential productivity. The density of adult conch in this population increased significantly since 1998 (Pillai's = 0.682, $F = 3.543$, $P < 0.0001$), primarily in the no-take zone (mean±SE: 240.3 ± 50.6 per ha) compared to the fished zone (range from 10.9 ± 5.9 in 1999 to 41.9 ± 15.3 in 2000; Bonferroni $P < 0.0001$; Figure 2). The mean densities in the fished zone were well below levels at which depensation has been shown to occur in conch populations (Stoner and Ray-Culp 2000; Gascoigne and Lipcius 2004).

Occasional sharp declines in adult density occurred in the no-take zone in 2003 and 2004. Conch may undertake ontogenetic movement to deeper habitats with age (Stoner and Sandt 1992). However, extensive deep-water habitats for conch were lacking in this atoll, and no migrations were recorded during survey periods or during mark-recapture and telemetry experiments (Acosta 2002; Acosta et al. unpublished data). These declines instead qualitatively coincided with extended periods of no enforcement at the reserve (manager's log, Glover's Reef Research Station; A. Branson, pers. comm.), and as such, may be due to occasional poaching.

The density of large juveniles was greater in the no-take zone ($P = 0.02$), but the density of recruiting juveniles was similar in both areas ($P = 0.99$). One possible explanation for this discrepancy is that current fishery regulations allow fishing of all conch > 17.8 cm SL regardless of whether a shell lip is present. An average of 37.9% (range 0 to 92%) of the potential catch in the no-take zone in any given year consisted of juveniles (Figure 3).

There were no differences in the trends for individual adult weight, averaging

Figure 2. Summary of quarterly fluctuation in density of three age classes of queen conch in no-take and fished areas of Glover's Reef. Blank spaces represent missing surveys. Standard error estimation and statistical analysis are presented in text.

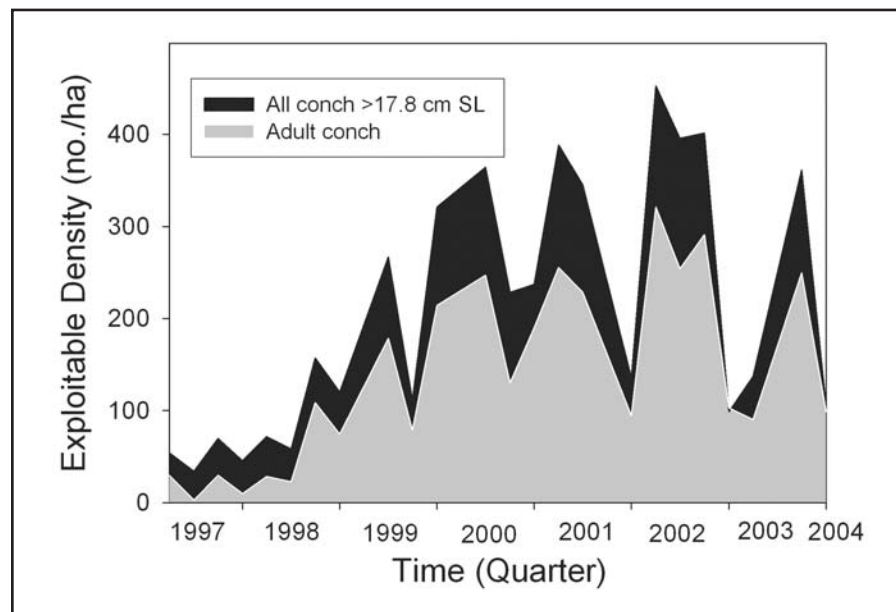
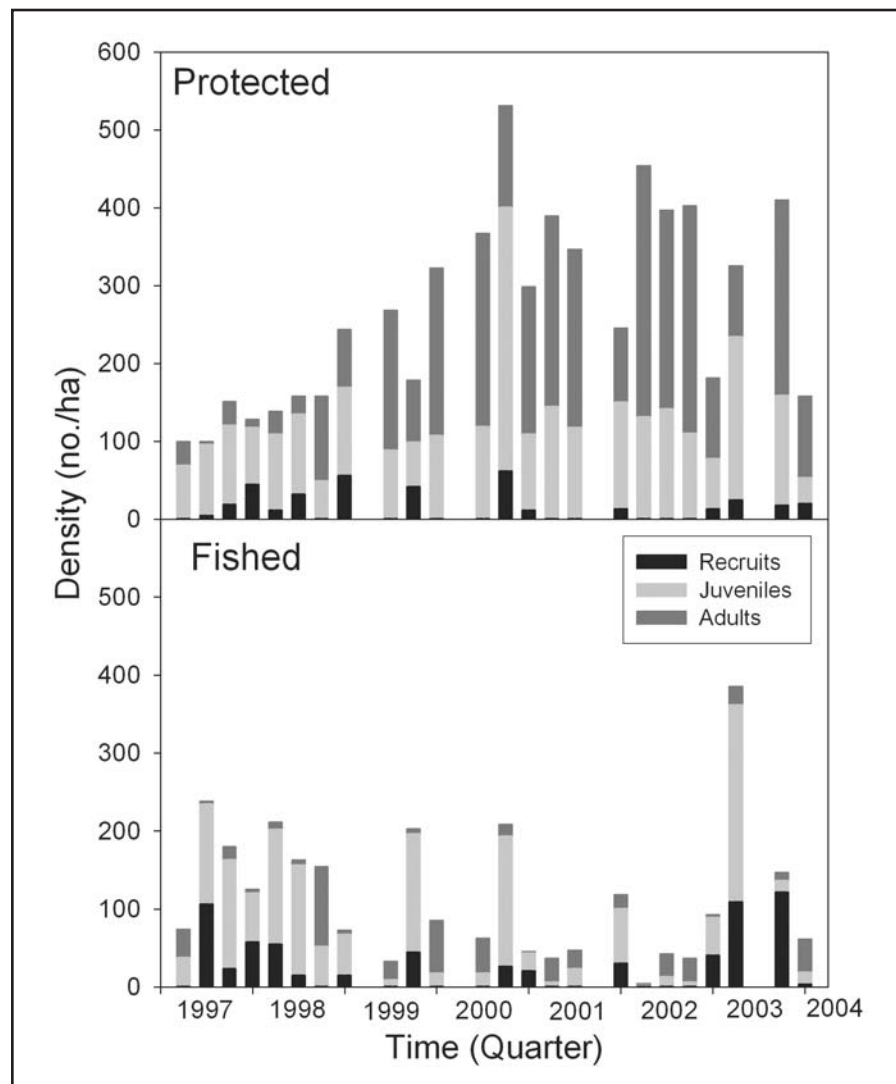


Figure 3. Density of adult queen conch with fully-formed shell lips, compared to density of all conch larger than the minimum fishable size (> 17.8 SL) in the protected population.

174.5±9.8 g in the no-take zone and 160±9.4 g in the fished area (Figure 4). Due to density changes, mean adult biomass increased in the no-take zone from 4.8±2.2 kg/ha in 1997 to 36.7±7.1 kg/ha in 2002 (Figure 4), whereas mean biomass in the fished zone ranged from 5.9±1.9 in 1998 to 1.7±0.7 kg/ha in 1999. Over time, therefore, exploitable biomass in the no-take zone (506 kg/ha) was approximately six times greater than in

the fished area (85 kg/ha). Assuming similar productivity in fished and no-take habitats, the fishery may remove more than 80% of the exploitable adult biomass every year.

The SPR for the queen conch population at Glover's Reef increased from 0.13 in 1997 to a maximum level of 0.29 in 2000 (Figure 5). The point of overfishing is assumed to be 30% of the SPR as defined by Rosenberg et al. (1996). If we

assume this is a self-recruiting population, it remained overexploited even with substantial increases in density and spawning stock biomass over 5 years. The population increase in the no-take zone (21% of the total area) has still not compensated for the intensity of fishing in exploited habitats. Finally, spawning activity was recorded as early as May and as late as November, compared to the designated closed season of July to September.

PRIORITIES FOR RECOVERY AND SUSTAINABILITY

The CITES Authority has requested assessments and management plans for queen conch from Belize and 12 other countries. Current problems with conch stock assessments discussed in a 1999 report included short catch-effort time series data and unreliable estimates of landings (CFMC 1999). Berg and Olsen (1989) showed that results of two MSY estimates for the Bahamas that differed by at least an order of magnitude.

A major problem is the legal standard for fishable conch based on shell length or meat weight set in 1978. Size at maturity in conch is highly variable, and the 17.8 cm SL size regulation provides for legal fishing of a substantial proportion of juveniles (Appeldoorn 1988). On average, almost 40% of the fishable conch population at Glover's Reef was immature. Equally ineffective is the alternative regulation for legal meat weight of 85 g. Estimated mean adult meat weight was twice this legal standard. Again, the regulation likely allows for legal fishing of juveniles. These results are consistent with previous studies (e.g., Gibson et al. 1983). The current practice of processing meat and discarding shells at sea facilitates transportation, but it makes limiting the catch to adults difficult to regulate. Currently, only Martinique and St. Vincent/Grenadines are reported to prohibit fishing of conch without flared shell lips (Chakalall and Cochrane 1997). Adaptive management options include requiring market delivery of conch in shells or substantially increasing the minimum size/weight regulation to encompass variability in maturity. Both options would decrease total landings initially but would likely increase yield per recruit (YPR) within a few years.

The Belize fishery closed season from July to September is based on early studies on the Florida conch population (D'Asaro

Figure 4. Mean individual biomass of adult queen conch (±1 SE; lower panel) and total spawning stock biomass (SSB; upper panel) in no-take (filled circles) and fished zones (open circles) at Glover's Reef, Belize.

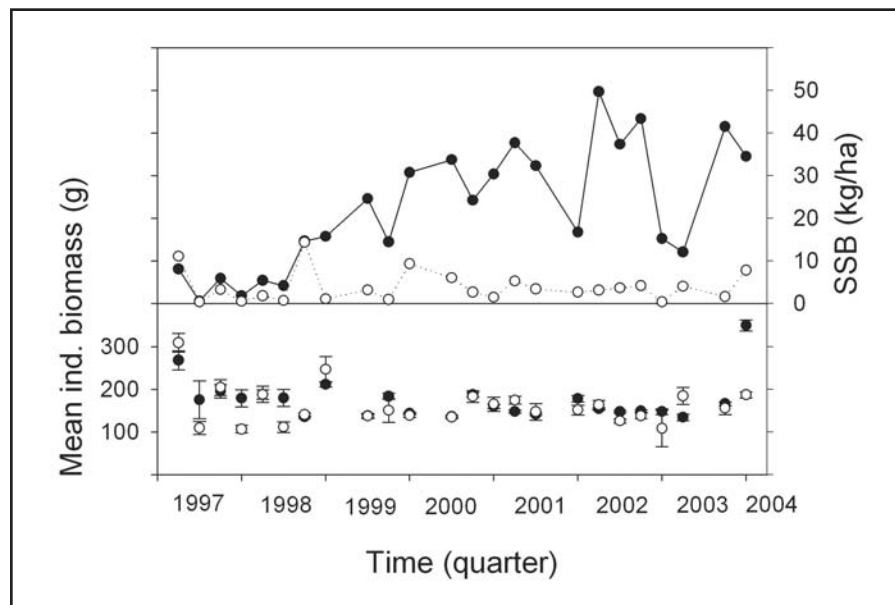
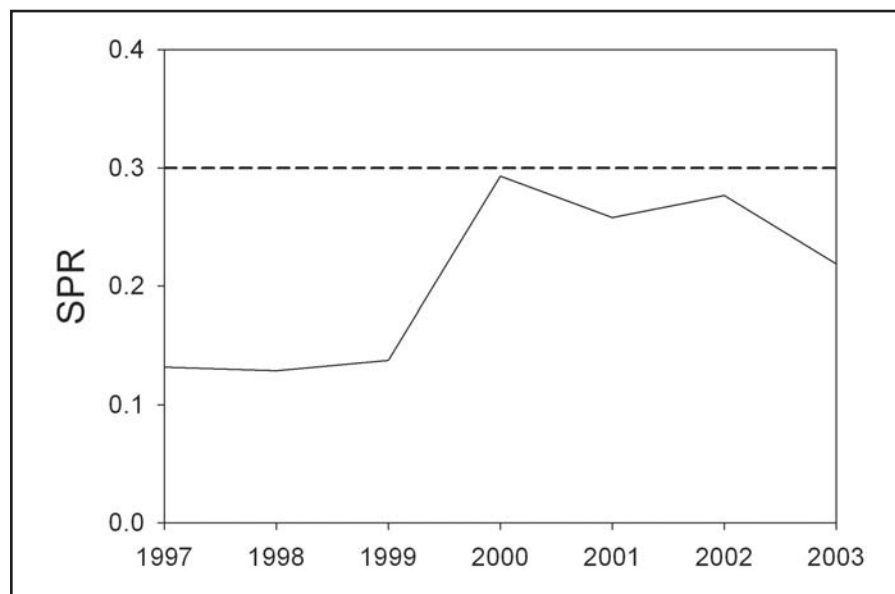


Figure 5. Spawning potential ratio (SPR) of the queen conch population at Glover's Reef, Belize. The point of overfishing is shown as 0.3 of the SPR (dashed line).




1965). The majority of spawning in most populations is concentrated in the summer months, but the breeding season in populations farther south in the Caribbean may be substantially longer, perhaps even year-round (see Stoner et al. 1992 for review). The actual breeding season at Glover's Reef is consistent with this latter pattern, extending from early May through late November. Reproductive output would likely increase with a longer closed season because adult conch may spawn multiple times during a breeding season. Additionally, an extended closure might allow more first-year breeders to reproduce (Gascoigne and Lipcius 2004), as opposed to the current fishery that imposes high mortality on older juveniles and first-year adults.

Overall density and biomass of conch at Glover's Reef have increased by nearly an order of magnitude, supporting predictions of a previous spatially-explicit population model for this particular reserve (Acosta 2002). Assuming that occasional poaching is not limiting the SPR to < 0.3 , what increase in size of the no-fishing area would increase the SPR to a sustainable level? The predicted increase in conch abundance is approximately 50% if the no-fishing area is 31% of the total area (Acosta 2002), compared to the current 21%. This would potentially increase the SPR to well over 0.3 to compensate for current fishing levels. Studies in other Caribbean reserves showed similar increases in abundance (Stoner and Ray 1996; Béné and Tewfik 2003), whereas no population increases were apparent in others (Schweizer and Posada 2002; Torres and Sullivan-Sealy 2002). Differences in survey methods, length of time series, and the lack of information on enforcement and poaching are problematic for further comparisons.

Nevertheless, the theoretical foundation of the role of enforced no-take zones in fisheries management is well established (e.g., Guénette et al. 1998). For most sedentary species with high fishing mortality, no-take reserves with optimal configuration (size, shape, essential habitats) are expected to increase yield through increased reproduction and recruitment (Hastings and Botsford 1999). However, for the particular case of the Glover's Reef conch population, the protected area does not compensate for overfishing or depensation in the fished area. This may be due to any number of

factors including insufficient habitat area under protection, insufficient self-recruitment, or poaching.

The response to the CITES notification by Belize fishery management was largely based on the reliance on eight marine reserves (several of which currently have little or no full-time enforcement) and the reported existence of a deep water stock of uncertain size (Anon. 2004). No changes in fishery regulations were proposed. In effect, future yield and sustainability of this conch fishery are based solely on the assumption that spawning stocks from these two sources will continue to supply adequate numbers of recruits to support current and future fishing levels. While there is a distinct possibility of self-recruitment within the Belize barrier reef ecosystem (Cowen et al. 2006), no reliable stock-recruitment models for queen conch have been developed.

Are stronger restrictions on Caribbean queen conch fisheries under CITES warranted? Closing export markets for conch would certainly impose significant economic hardships on the conch-producing countries (FAO 2004). In the case of Belize, this restriction would decrease their export fisheries market by more than 25%. The results reported here indicate that these stocks continue to be severely overcapitalized and that regional fishery management needs to be more adaptive to preclude CITES intervention. In addition to establishing and enforcing no-take reserves, immediate action can be taken to strengthen regulations to reduce juvenile fishing mortality and increase reproductive output. 



ACKNOWLEDGEMENTS

I thank the Belize Fisheries Department, the staff of the Glover's Reef Research Station, and the Wildlife Conservation Society for field assistance and support. A. Branson, J. Gibson, D. Westby, and two anonymous reviewers provided extensive feedback and recommendations. This is contribution No. 027 of the Glover's Reef Research Station.

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ESSAY: FISH CULTURE

Toward Sustainable Open Ocean Aquaculture in the United States

ABSTRACT: In response to a request by American Fisheries Society President Christopher Kohler, we examined the current status of open ocean aquaculture in the Exclusive Economic Zone (EEZ) of the United States, interest in open ocean aquaculture activities, the regulatory environment, and the potential for sustainable development. There is currently little interest in establishing facilities within the EEZ by the commercial sector, largely because of the lack of a formal regulatory structure, though that may be changing as Congress develops legislation on aquaculture in the EEZ. Current U.S. open ocean research and commercial activities are in state or territorial waters. The National Oceanic and Atmospheric Administration is poised to take the primary regulatory lead in the EEZ, with other federal agencies, such as the Minerals Management Service, Army Corps of Engineers, and Environmental Protection Agency participating. Under proposed legislation, coastal states would have the opportunity to comment on facilities in the EEZ adjacent to their jurisdictions. A variety of concerns pertaining to open ocean aquaculture development have been put forward that relate to environmental sustainability. We conclude that in the absence of large-scale facilities in the EEZ and associated research in conjunction with such facilities, the potential risks of open ocean aquaculture cannot be adequately evaluated. Data obtained from open ocean sites in other countries may or may not be applicable in this country's EEZ, but international cooperation in sharing environmental information from open ocean aquaculture operations can help researchers and regulators develop environmental safeguards and have them in place, if and when open ocean aquaculture becomes a commercial reality in the United States.

BACKGROUND

Late in 2005, American Fisheries Society President Christopher Kohler formed an ad hoc Open Ocean Aquaculture Committee to look at development of aquaculture in the U.S. Exclusive Economic Zone (EEZ), develop a summary of the existing situation, and begin to understand where this nation may be going in the future. The committee, chaired by R.R. Stickney, first met by conference call in November 2005. While the group recognized that there is a potential for employing open ocean aquaculture to produce fishes for purposes of stock enhancement, the decision was made to focus this report on aquaculture development in the U.S. EEZ for commercial foodfish production.

Some early publications on permitting in the EEZ, such as Stickney (1997) remain relevant, but the committee also sought more recent information. One significant resource was the final report of the U.S. Commission on Ocean Policy (2004). Recommendations from Chapter 22 of that document include amending the National Aquaculture Act to designate the National Oceanic and Atmospheric Administration (NOAA) as the lead federal agency for marine aquaculture and to create an Office of Sustainable Marine Aquaculture within NOAA; charging the Office of Sustainable Marine Aquaculture with developing a comprehensive permitting, leasing, and regulatory program; and expanding research, outreach, and technology transfer funding.

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The National Aquaculture Act of 2005, which was reintroduced in 2006 (hearings were held but the bill has not been voted on at the time of this writing), calls for coordination by NOAA with other agencies, the fishery management councils, and the coastal states.

The Congressional Research Service updated a 2004 report on open ocean aquaculture (Borgatti and Buck 2006) that discussed the existing regulatory environment and mentioned NOAA's role as the lead agency in promoting development of the industry. Of interest is that currently a state with an approved Coastal Zone Management Plan (CZMP) can veto federal permits in the EEZ adjacent to their state if the permits are not consistent with the CZMP.

The most recent comprehensive look at permitting in the EEZ for open ocean aquaculture (Cicin-Sain et al. 2005) concluded that NOAA is the preferred lead agency to develop the regulatory scheme and suggested that NOAA create an Office of Offshore Aquaculture. As an agency within the Department of Commerce which has an interest in the

economic viability of such aquaculture activities, NOAA is well placed to be the lead agency. Thus, there appears to be broad consensus for NOAA being the lead agency with respect to aquaculture in the EEZ.

Cicin-Sain et al. (2005) made numerous recommendations with respect to collaboration among the various agencies that would be involved in the permitting process. In addition to NOAA, there would be involvement by the Minerals Management Service, NOAA Fisheries (which is a line office in NOAA), and the Environmental Protection Agency. (The Army Corps of Engineers should also be mentioned in this regard.) They suggested that four types of leases should be developed: research leases, short-term leases to enable firms time to further develop their business plans, long-term leases for those with fully developed open ocean aquaculture business plans, and emergency leases to allow rapid response for temporary relocation of a facility when circumstances warrant. Recommendations for environmental review and monitoring of open ocean aquaculture facilities were also developed to address carrying capacity, impacts from waste products on the water and sediments, potential genetic impacts, disease, and other issues.

We obtained additional information from Michael Rubino (michael.rubino@noaa.gov), who coordinates aquaculture activities for NOAA Fisheries. He provided information relating to the NOAA's role in open ocean aquaculture, the need for development of open ocean aquaculture in the U.S. EEZ, the legislation that has been introduced to Congress, and other documents. The Gulf of Mexico Fisheries Management Council has prepared a draft amendment on the regulation of open ocean aquaculture in Gulf waters and is presently finalizing that document prior to its adoption (Wayne Swingle, Gulf of Mexico Fisheries Management Council, pers. comm.).

In the past several years, numerous meetings in North America and Ireland focused on open ocean aquaculture have been held. Each led to publication of a symposium volume (Table 1). A book edited by Bridger (2004) chronicled research activity in the Gulf of Mexico in conjunction with development of open ocean aquaculture in that water body. The volume includes sections on constraints and sustainability.

Borgatti and Buck (2006) reported that open ocean aquaculture facilities (including those dedicated to research as well as commercial production) can be found in Australia, Chile, China, France, Ireland, Italy, Japan, Mexico and Norway. Cobia (*Rachycentron canadum*) are being produced by Aquasense, LLC in South Eleuthera, Bahamas, and off Calebra Island, Puerto Rico. The only two permitted commercial open ocean farms in U.S. state waters can be found in Hawaii. Cates International produces Pacific threadfin (moi; *Polydactylus sexfilis*) while Kona Blue Water Farms, LLC is producing amberjack, Hawaiian yellowtail (kampachi; *Seriola rivoliana*). Both companies target local markets.

PRINCIPAL IMPEDIMENTS

A variety of issues have been raised with respect aquaculture in the marine environment. Perhaps the most widely cited papers critical of the activity are those of Goldberg and Triplett (1997), Naylor et al. (1998, 2000), and Goldberg et al. (2001). The most widely targeted species for criticism have been penaeid shrimp grown in brackish water ponds and salmon produced in net pens. The criticisms range from issues associated with water quality, impacts on the benthos, use of fishmeal in aquatic animal feeds, use of exotic species and maintenance of genetic integrity to those associated with noise, odors, and interference with navigation. Strong condemnation of a plan to establish a fish and shellfish farm in association with a decommissioned drilling platform

off California was lodged by Belton et al. (2004) who viewed such activities as "a disaster waiting to happen." There have been numerous articles and stories in the media about marine aquaculture, many of which have been critical of the activity.

The aquaculture community has responded to the criticisms by addressing the issues raised and developing sustainable practices in conjunction with mariculture facilities, particularly in North America and Europe. Publications dealing with responsible and sustainable marine aquaculture include Bardach (1997), Costa-Pierce (2002) Stickney and McVey (2002), Bridger and Costa-Pierce (2003), and Jana and Webster (2003).

The focus of attention to date has been largely on mariculture in protected coastal waters. As demonstrated in a study by Parametrix (1990), proper siting of net pen facilities associated with salmon culture in the state of Washington was critical to addressing environmental issues. Biosecurity is important to prevent escapement, thereby addressing the issues of exotic species use and maintenance of genetic integrity. One commonly heard notion is that by moving offshore, producers would avoid many of the criticisms that have been raised with respect to facilities established in coastal waters (see for example, Belton et al. 2004). However, as the need to develop regulations for mariculture in the EEZ became recognized, many of the same criticisms raised by critics of inshore mariculture operations were extended to the offshore as well.

With the Food and Agriculture Organization of the United Nations reporting that world capture fisheries peaked a decade or so ago (see www.fao.org) while demand for fish and shellfish increases throughout the world, aquaculture is seen as the primary source of additional supplies. Worldwide, aquaculture continues to grow, though FAO data consistently show that freshwater finfish production dwarfs that from the marine environment at present.

Table 1. Open Ocean Aquaculture Symposia.

Titles	Locations (Dates)	References
Open Ocean Aquaculture	Portland, Maine, USA (1996)	Polk (1996)
Open Ocean Aquaculture '97	Maui, Hawaii, USA (1997)	Helsley (1998)
Third International Conference on Open Ocean Aquaculture	Corpus Christi, Texas, USA (1998)	Stickney (1999)
Open Ocean Aquaculture IV	St. Andrews, New Brunswick, Canada (2001)	Bridger and Costa-Pierce (2003)
Farming the Deep Blue	Limerick, Ireland (2004)	www.eventznet.ie/ev/ac/bim/deepblue

Proponents of offshore aquaculture see the open ocean as a highly desirable place to establish operations, while opponents see major threats to the environment.

A properly designed and regulated permitting system should ensure that open ocean aquaculture operates without inflicting environmental damage. Major challenges that continue to face the industry involve designing and deploying cages that can withstand storms, dealing with the logistics of working many kilometers from land, and finding species that bring sufficiently high prices to overcome the large difference in costs associated with rearing fish in protected coastal waters as opposed to exposed offshore areas.

Much of the debate surrounding open ocean aquaculture has been focused on exercising strict control over an industry that has yet to be developed to any extent. The committee conducted a very informal e-mail survey of companies known to committee members (approximately 30 were contacted) to determine if there was interest within the commercial aquaculture community in moving into the open ocean. Only seven responses were obtained, so the survey cannot be considered to have scientific credibility, nor was it designed with scientific rigor in mind. The survey was revealing to the extent that lack of a regulatory environment in the U.S. EEZ was seen as an impediment by respondents. No facility has as yet been established in the U.S. EEZ and there appears to be little interest in establishing such a facility in the absence of a regulatory framework and permitting process.

Two responders indicated that expansion into open ocean aquaculture was a current priority for their companies. One of those two reported an interest in installing fish cages in federal waters, while the other reported an interest in working in both state and federal waters. Among the five companies that indicated they were not interested in moving offshore, two had a primary focus on freshwater species, one said aquaculture was ancillary to their activities, and two referred to issues associated with the uncertainty of the regulatory and leasing situation.

In response to a question about whether additional federal research funding is needed to develop demonstration sites, responses ranged from “no” to “possibly.” Additional comments on the regulatory situation were made and the

lack of sources of sufficient fingerlings for stocking cages (need for hatcheries) was cited as a major impediment. In response to the final question in the survey that asked respondents what they would like to see in the way of a federal policy on open ocean aquaculture, the following points were mentioned:

- The United States needs to develop regulations and policies that make investing in U.S. open ocean aquaculture more attractive than investing in other countries.
- Leases longer than 10 years should be available, as should long-term loan opportunities.
- There should be “one-stop shopping” for all federal and state permits.
- Regulations should be realistic and encourage investment in open ocean aquaculture.
- Incentives would not be needed if the proper regulatory environment were in place.
- Permitting and regulatory constraints need to be reduced as incentives for investment in capital-intensive open ocean aquaculture systems.
- Clear guidance on how oil and gas platforms can be converted to aquaculture sites needs to be developed.
- Permits should be closely monitored by NOAA Fisheries so poorly managed operations can be improved or eliminated.
- Federal policy should be comprised of clear rules, rapid decision making, and include a predictable process that involves a fixed time frame.

Clearly, there is frustration with the lack of a regulatory framework and a clear permitting process in federal waters. In those areas the states are much further along. Recognition of that problem is not only being voiced by those interested in open ocean aquaculture, but also by government, nongovernmental organizations, the research community, and others.

The “which comes first” situation with open ocean aquaculture in the EEZ is not only associated with permitting. The lack of marine hatchery infrastructure to support the production of sufficient numbers of fingerlings to stock into cages to provide a commercial-scale proof of concept is a major issue. In addition, the engineering of cages and mooring systems must be developed to better protect stocks from storm damage and predators, and also to

maintain operational efficiency for feeding fish and cleaning the cages.

The committee recognizes that there are open ocean aquaculture systems in exposed waters in other countries that are showing commercial promise, though the majority of the activity continues to be in moderately to fairly sheltered waters. In addition to having low labor costs and less concern about potential mariculture-related environmental problems in many parts of the world, some countries provide subsidies and/or tax incentives to open ocean aquaculture operations, all of which put the United States at a competitive disadvantage while the demand for seafood by the American public continues to increase.

RECOMMENDATIONS


We cannot know with any certainty whether aquaculture in the U.S. EEZ will become a commercial reality to any significant extent or even which species may bring high enough returns on investment to entice investment in open ocean culture operations. We do know that there is a need to test the concept in the U.S. EEZ. With that in mind, the committee has developed the following recommendations.

1. Put open ocean aquaculture legislation on the fast track through Congress and encourage the Fishery Management Councils to adopt amendments to their management plans that will provide a permitting framework in the absence of broader legislation.
2. Support the development of an Office of Sustainable Aquaculture in NOAA that would provide “one-stop shopping” for moving through the regulatory and permitting process.
3. Encourage the federal and state agencies that will be involved to sign memoranda of understanding (MOUs) with NOAA under which a smooth and efficient process for obtaining permits would be developed. Those agencies would include, but not be limited to U.S. Fish and Wildlife Service, Minerals Management Service, U.S. Army Corps of Engineers, the coastal states (through their Coastal Zone Management Programs), and perhaps others.
4. Develop a regulatory environment that protects native marine communities, native fisheries, and the environment

while not imposing unreasonable monitoring requirements in recognition of the fact that the first commercial facilities will be operating largely as research operations. Increasing the frequency and intensity of monitoring as well as adding parameters to be monitored may be required as research facilities expand into commercial production.

5. Promote the establishment of commercial hatcheries in regions of the country where interest in open ocean aquaculture is strong and support the funding of research on appropriate species of commercial value that might be produced in those hatcheries.
6. Expand NOAA's aquaculture research funding and promote collaboration between university researchers and industry in developing both open ocean aquaculture facilities and the hatcheries and development of species required to stock the facilities.

These recommendations would support the first steps toward development of an open ocean aquaculture industry that would be both economically and environmentally sustainable. As the industry

develops and data are gathered, regulators, producers, and researchers will be better able to develop guidelines for species selection, stocking densities, facility footprints and distances between sites, environmental monitoring and reporting requirements, and deal with other issues that may arise using the adaptive management approach. 

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



The Web We Weave

You may have noticed it recently—the AFS website (www.fisheries.org) has been redone. The address and most of the contents are the same but almost everything else is not.

The primary motive behind the change was to switch to a database structure that allows changes be made efficiently, i.e., in a way that once a change is made once, there'd be no need to repeat the change in every linked page. And when you deal with literally thousands of pages in a complex website such as ours, you can imagine the savings both in staff time and in the expediency of posting the changes.

As expected, the reactions have run the gamut from saying that the new site is great to saying it is lousy. The most criticism we received was related to the jobs

page, which we also expected, since that is the most frequently visited part of our website. Most of those comments were quite to the point and we have already improved that area substantially, but there is still a ways to go there.

We are gathering all the feedback we get, assimilating it, and making the changes needed to satisfy most of the critical reactions so far. But keep your comments coming and address them to me. I promise that we are taking them to heart.

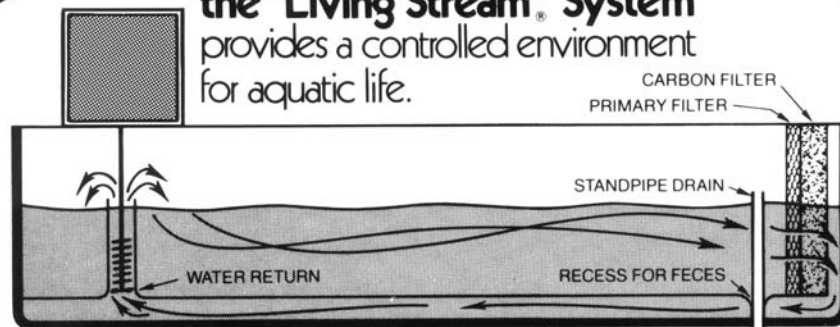
Soon, by the way, we will have a Members Only area on the website that will include features like access to the Online Membership Directory, specific news for membership, and current issues of *Fisheries* magazine. Which is a round-

about way of announcing that the long-inactive online membership directory functionality is back in place. It allows you to find information about fellow members and colleagues. The new database also allows you to update your personal information such as address and e-mail directly, without the delays of sending a request for changes to main@fisheries.org.

For those who have renewed their membership or joined online: you should have received an instantaneous confirmation of your order. More importantly, the fulfillment of your order, whether it is for membership renewals or journal subscriptions, will be much more rapid with the new system in place.

As usual, I welcome all comments and suggestions.

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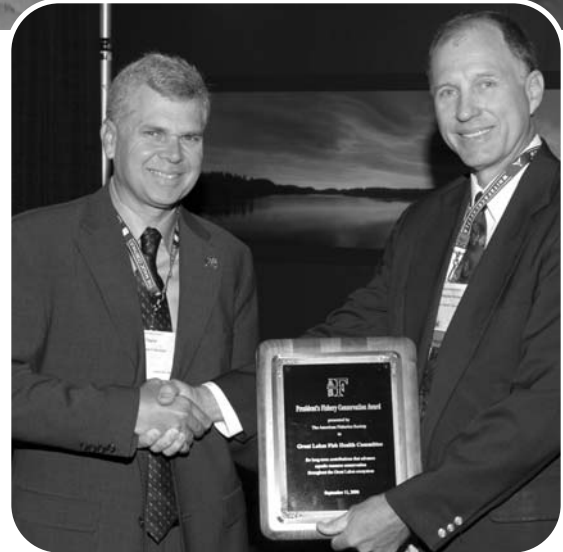
ANNUAL AWARDS

AFS 136TH ANNUAL MEETING
LAKE PLACID, NEW YORK
SEPTEMBER 2006

PHOTOS BY JIM CLAYTON



Carl Walters receives the AWARD OF EXCELLENCE from Chris Kohler. Walters, a professor at the Fisheries Centre, the University of British Columbia, is renowned for his work in fisheries stock assessment and ecosystem modeling. He uses mathematical modeling and computer simulation techniques to improve understanding of the dynamics of exploited marine, freshwater, and land-based ecosystems, and to find more effective methods of managing them.



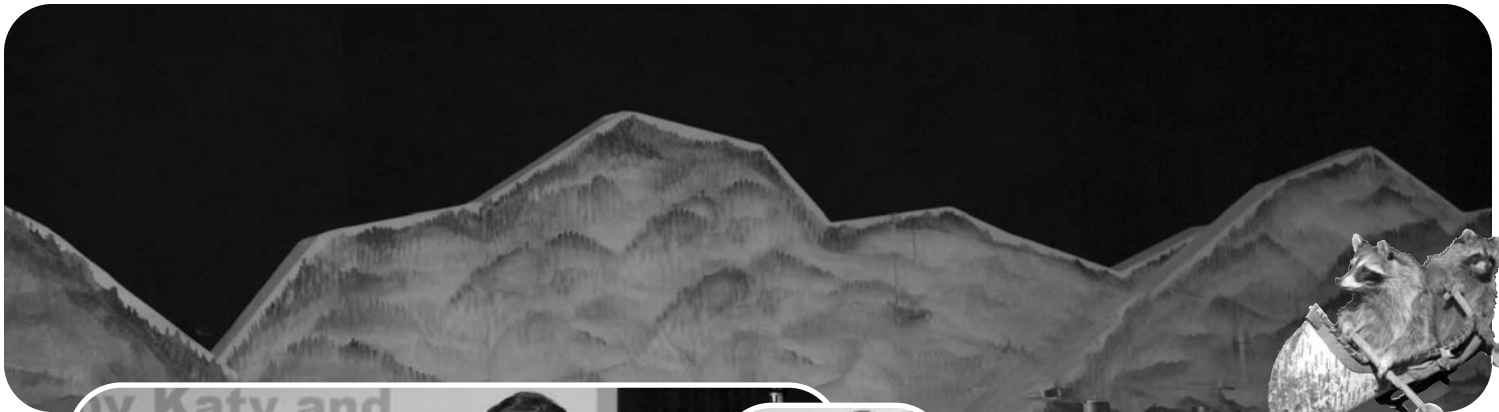
The Great Lakes Fish Health Committee (GLFHC), represented by William Taylor, receives the PRESIDENT'S FISHERY CONSERVATION AWARD from Chris Kohler. The award recognizes the collective accomplishments of the fish health professionals, managers, and researchers who have served on the committee since its inception in 1973. The GLFHC developed principles and programs for preventing and containing serious fish diseases.



The Resource Evaluation and Assessment Division (READ) of the Northeast Fisheries Science Center of the National Marine Fisheries Service at Woods Hole, represented by Fred Serchuk, receives the WILLIAM E. RICKER RESOURCE CONSERVATION AWARD from Chris Kohler. The READ provides the scientific basis for Northeast fisheries management and has engaged in long-term effort to supply high quality scientific advice to fishery managers who deal with chronic problems of bycatch and overfishing.



Christopher Goddard receives the MERITORIOUS SERVICE AWARD from Chris Kohler. Goddard, executive director of the Great Lakes Fishery Commission since 1995, holds faculty appointments at the University of Michigan and Michigan State University. His dedicated service to AFS and fisheries science includes serving as past president of the Canadian Aquatic Resources Section of AFS, and on the board of directors of AquaNet, the Governors Advisory Panel on Invasive Species, and the board for Michigan Sea Grant.



The CARL R. SULLIVAN FISHERY CONSERVATION AWARD, "The Sully," is awarded to C. Jeff Cederholm (posthumous) and accepted by his wife, Katie, and daughter, Heidi. Larry Dominguez (right) speaks about Cederholm's contributions. Over the past decade, Cederholm was instrumental in the development of streamside protection guidelines in a landmark statewide Habitat Conservation Plan. Recent accomplishments include the lead authorship of a chapter in a book on wildlife habitat for Oregon State University Press, entitled: *Pacific Salmon and Wildlife—Ecological Contexts, Relationships, and Implications for Management*. He assisted in the organization of an international symposium on salmon nutrient and ecosystem health, held in Eugene, Oregon, in April 2001. The Sully is presented to an individual or organization for outstanding contributions to the conservation of fishery resources.

DISTINGUISHED SERVICE AWARDS

Eric E. Knudsen (not pictured), consulting fisheries scientist, received the Distinguished Service award for his commitment, dedication, and focus while serving as program co-chair for the record-breaking Anchorage 2005 Annual Meeting, his dedicated service while serving as president of the Western Division, and his consistent and continuous efforts to create quality science publications through AFS books and journals.



William J. Wilson receives the DISTINGUISHED SERVICE AWARD from Chris Kohler. Wilson, a NOAA employee, is honored for his distinguished service, vision, leadership, and superb organizational skills during the 2005 AFS Annual Meeting in Anchorage, Alaska.



Michael D. Porter, U.S. Bureau of Reclamation, receives the DISTINGUISHED SERVICE AWARD from Chris Kohler. Porter is acclaimed for his ongoing leadership in continuing education training for AFS members in geographic information systems (GIS).



Joseph E. Hightower receives the EXCELLENCE IN FISHERIES EDUCATION AWARD from Chris Kohler. At the U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Hightower is a tremendous educator, a first-rate scientist, and an active participant in AFS. His commitment to students is refreshing. His passion for learning and teaching is infectious. He provides high-quality classroom instruction, constantly updating his instructional materials to include new advances in the field and modifying his approach in response to student suggestions.



Ralph Manns, Fishing Information Services, receives the EXCELLENCE IN PUBLIC OUTREACH AWARD from Chris Kohler. Since receiving a M.S. in fisheries science from Southwest Texas State University 25 years ago, Manns has worked tirelessly to disseminate fishery science breakthroughs to anglers. He has written widely in fishing magazines, including dozens of features and hundreds of short articles for *In-Fisherman Magazine*, as well as columns for several other publications.



OUTSTANDING CHAPTER AWARDS

The Oregon Chapter, represented by Robert Hughes (top center photo), and the Wisconsin Chapter, represented by Joe Hennessy and Justine Hasz (top right), receive large (> 100 members) chapter OUTSTANDING CHAPTER AWARDS from Chris Kohler. The Tennessee Chapter, represented by Fred Heitman and fellow Chapter members, receives the small (<100 members) chapter OUTSTANDING CHAPTER AWARD from Chris Kohler.

The Oregon Chapter is recognized for support of the Hutton Junior Fisheries Biology Program, their newsletter, *Piscatorial Press*, three continuing education workshops, and many other excellent activities. The Wisconsin Chapter is recognized for helping to host the 2007 Annual Midwest Fisheries and Wildlife Conference, their web site, award-winning newsletter, and actively voicing support for its mission to improve conservation and sustainability of fishery resources. The Tennessee Chapter strives to protect and enhance aquatic resources and recognize achievements with awards to scientists, students, and "friends." The Chapter also sells tee shirts that promote awareness of Tennessee fishes.



Jesse Trushenski receives runners-up plaque for the J. FRANCES ALLEN SCHOLARSHIP from Chris Kohler. Trushenski is a Ph.D. candidate and studies the joint influence of micronutrients and stress on innate immunity and metabolism of hybrid striped bass with Kohler at the Aquaculture Center at Southern Illinois University.

Allen Scholarship winner Virginia Shervette (not pictured) is a Ph.D. candidate at Texas A&M University and studies wildlife and fisheries sciences with Frances Gelwick. Her dissertation focuses on comparing and contrasting the role habitats play in community structure, growth, and predator/prey interactions of estuarine nekton species.



The East Carolina University Student Subunit (ECU AFS), represented by Co-Presidents Kelly Register and Rebecca Deehr, and fellow ECU AFS members, receives the OUTSTANDING STUDENT SUBUNIT AWARD from Chris Kohler. ECU AFS members help plan, host, speak at, give poster talks at, and attend a large number of professional meetings including the International Dogfish Symposium, Estuarine Research Federation, Southeastern Association of Fish and Wildlife Agencies Meeting Fifth Annual AFS Student Colloquium, AFS-Tidewater Meeting, and the AFS Annual Meetings.



BEST PAPER AWARDS

Optimizing Trout Farm Effluent Treatment by Stabilizing Trout Feces: A Field Trial by Alexander Brinker (left), Wolfgang Koppe, and Roland Rösch wins **BEST PAPER IN THE NORTH AMERICAN JOURNAL OF AQUACULTURE** (67:244–258).

Seasonal Fishery Dynamics of a Previously Unexploited Rainbow Trout Population with Contrasts to Established Fisheries by Brett T. van Poorten and John R. Post won the **MERCER PATRIARCHE AWARD FOR THE BEST PAPER IN THE NORTH AMERICAN JOURNAL OF FISHERIES MANAGEMENT** (25:329–345).

Across-Species Comparisons of Spatial Scales of Environmental Effects on Survival Rates of Northeast Pacific Salmon Fisheries Management by Brian J. Pyper, Franz J. Mueter, and Randall M. Peterman won the **ROBERT L. KENDALL BEST PAPER IN TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY** (134:86–104).

DNA Vaccination against Channel Catfish Virus Results in Minimal Immune Response and Is Not Efficacious against Challenge by Heather Harbottle, Karen P. Plant, and Ronald L. Thune won the **BEST PAPER IN THE JOURNAL OF AQUATIC ANIMAL HEALTH** (17:251–262).



AFS/SEA GRANT OUTSTANDING STUDENT PAPER AWARD WINNERS

Spatio-temporal analyses of loggerhead sea turtle interactions with pelagic fisheries by Beth Gardner (left) wins the AFS/SEA GRANT OUTSTANDING STUDENT PAPER AWARD, which is presented by Chris Kohler. Gardner attends Cornell University.

Growth and recruitment rates of juvenile blue crabs in Chesapeake Bay by Brandon J. Puckett, University of Maryland, Center for Environmental Science won AFS/SEA GRANT OUTSTANDING STUDENT PAPER AWARD.

HONORABLE MENTIONS

Interactive effects of flood frequency and fishes on ecosystem structure and function by Brian Bellgraph, Montana State University

Resource overlap between sauger and walleye in the Missouri River, Montana: Implications for declining sauger populations by Katie Bertrand, Kansas State University.



STUDENT WRITING CONTEST

Winning papers will be published in an upcoming issue of *Fisheries*. The award recognizes students who do an excellent job communicating the value of fisheries research to the general public.

Big bass in rivers? You're kidding me! by Andrew Rypel (not pictured) won first place in the STUDENT WRITING CONTEST. Rypel attends the University of Alabama.

Mosquito-Eating Machine or Native Species Monster? Assessing the Impacts of Western Mosquitofish Stockings in Indiana Waters by Rebecca Zeiber (left) receives the second place award from Chris Kohler. Zeiber attends Purdue University.



Effects of gravel mining on detection probabilities for selected Mobile River Basin fishes by Cari-Ann Hayer receives the BEST STUDENT POSTER AWARD from Chris Kohler for her poster, which was presented at the 2005 AFS Annual Meeting in Anchorage, Alaska. Hayer attends Auburn University.

Does grass bed planting stimulate the food web and juvenile bass abundance in a drawdown reservoir? by Donald Ratcliff receives Honorable Mention. Ratcliff attends Utah State University.

Golden Membership Awards

recognize individuals who have been AFS members for 50 years.

The class of 1956 includes:

Robert L. Burgner
 Albert C. Jones
 Fred P. Meyer
 Spencer H. Smith
 Bruce B. Collette
 William R. Nicholson
 Henry A. Regier
 David W. Robinson



The JOHN E. SKINNER MEMORIAL FUND provides monetary travel awards for deserving graduate students or exceptional undergraduate students to attend the AFS Annual Meeting. The winners are:

WINNERS

Michael Bailey, University of Maine
 Andrew Carlson, University of Wyoming
 Bart Durham, Texas Tech University

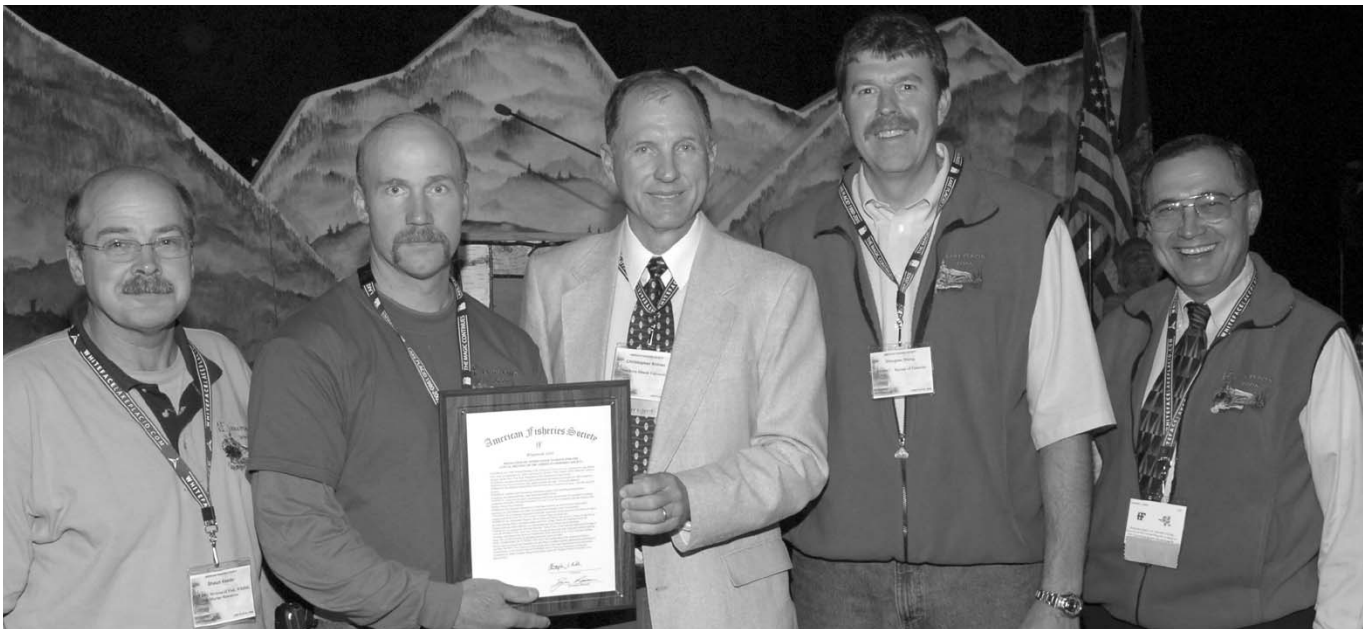
Janice Kerns, Tennessee Tech University
 Thomas Lang, University of Arkansas at Pine Bluff
 Heidi Lewis, Southern Illinois University Carbondale
 Kathy Mills, Cornell University
 Quinton Phelps, South Dakota State University
 Mark Rogers, University of Florida
 Jesse Trushenski, Southern Illinois University
 Rebecca Zeiber, Purdue University

HONORABLE MENTIONS:

Benjamin Ciotti, University of Delaware
 Robin DeBruyne, Central Michigan University
 Dustin Edwards, University of Connecticut
 David Rowe, Iowa State University
 William Smith, University of North Carolina



The AFS Past Presidents Luncheon honored the following past and future AFS presidents: (front row) Christine M. Moffitt, Richard A. Ryder, Stanley A. Moberly, and Fred Harris; (middle row) Kenneth L. Beal, Mary Fabrizio, William W. Taylor, Charles C. Coutant, Ira Adelman, William Franzin, and Donald Jackson; and (back row) Jack Wingate, Robert F. Carline, Jennifer Nielsen, Barbara Knuth, and Christopher Kohler.



Ed Mills, Ed Woltmann, Chris Kohler, Douglas Stang, and Shaun Keeler display the Resolution of Appreciation to Hosts for the Annual Meeting of the American Fisheries Society.

"...Now, therefore, be it resolved that the membership of the American Fisheries Society having enjoyed the hospitality of Lake Placid, extends its hearty appreciation and thanks to our hosts, the New York Chapter of the AFS and the New York State Department of Environmental Conservation; to the General Chair Ed Woltmann and his Planning Committee; to Program committee Co-chairs Douglas Stang and Ed Mills; and to the Program Poster Committee Chair Shaun Keeler."

Congratulations to Winners of 2006 AFS Section Awards

The following AFS Sections announced award winners at the Annual Meeting in Lake Placid, New York:

FISHERIES MANAGEMENT SECTION

Hall of Excellence

Wayne Hubert
Bob Carline

Award of Merit

Fred Janssen

Conservation Achievement Award

Great Lakes Fishery Commission
Missouri River Natural
Resources Council

Award of Excellence

Jerry Rasmussen

EDUCATION SECTION

Certificate of Appreciation for editing and producing the Second Edition of The AFS Guide to Fisheries Employment
David Hewitt

ESTUARIES SECTION

Nancy Foster Habitat Conservation Award
Elliott Norse

Student Travel Award

Bernice Bediako, Bradly Trumbo,
Benjamin Ciotti and William Smith

FISH CULTURE SECTION

Student Travel Award

Jesse Trushenski

NAJA Most Significant Paper 2005

Winner

Optimizing Trout Farm Effluent Treatment by Stabilizing Trout Feces: A Field Trial by Alexander Brinker, Wolfgang Koppe, and Roland Rosch

Honorable Mentions

Effect of Oxygen Management on Culture Performance of Channel Catfish in Earthen Ponds by Eugene Torrans

Pond Production and Fatty Acid Profiles of Fillets of Channel Catfish Reared on Diets with Different

Protein Sources by R. L. Hedrick, T. J. Popma, and D. Davis

GENETICS SECTION

James E. Wright Award

Melinda R. Baerwald and Molly R. Stephens (co-winners)

Stevan Phelps Memorial Award

Anthony J. Gharrett, Andrew P. Matala, Eric L. Peterson, Andrew K. Gray, Zhouzhou Li, and Jonathan Heifetz,

MARINE FISHES SECTION

Oscar E. Sette Award

Kenneth Sherman

SOCIOECONOMICS SECTION

Stephen Weithman Award

Kathy Mills



CALENDAR: 2006 FISHERIES EVENTS

See more job listings at www.fisheries.org;
click on Calendar.

AT Dec 3-6—**67th Midwest Fish and Wildlife Conference**, Omaha, NE. See www.midwest2006.org. Contact Mark Porath, Mark.Porath@ngpc.ne.gov, 402/471-7651.

Dec 4-6—**Pacific Northwest Fish Culture Conference**, Portland, OR. See www.fws.gov/nwfcc2006. Contact Doug Olson, doug_olson@fws.gov, 360/604-2500.

Dec 9-13—**Third National Conference on Coastal and Estuarine Habitat Restoration: Forging the National Imperative—Restore America's Estuaries**, New Orleans, LA. See www.estuaries.org/conference. Contact Kristin Hoelting, conference@estuaries.org, 206/624-9100.

Dec 11-15—**American Geophysical Union Fall Meeting**, San Francisco, CA. See www.agu.org/meetings/fm06/?content=search.

Dec 15-19—**Ninth Biennial Conference of the International Society for Ecological Economics**, Delhi, India. See www.ISSE2006.com.

2007

Jan 7-9—**Coolwater Fish Culture Workshop**, Allamuchy, NJ. Contact hatchery0@comcast.com.

Jan 8-12—**Western Section of the Wildlife Society's Natural Resources Communication Workshop**, Chico, CA. Contact Jon Hooper, jhooper@csuchico.edu, 530/898-6557.

Jan 11-12—**Using Acoustic Tags to Track Fish Course**, Seattle Washington. See www.HTIsonar.com. Contact Caroline Mercado, cmercado@HTIsonar.com.

Jan 18-19—**Hydroacoustics for Fisheries Assessment**, Seattle Washington. See www.HTIsonar.com. Contact Caroline Mercado, cmercado@HTIsonar.com.

Feb 1-2—**National Council for Science and the Environment Seventh National Council for Science, Policy, and Environment**, Washington, DC. See www.NCSEonline.org. Contact conference2007@NCSEonline.org.

Feb 4-9—**ASLO Aquatic Sciences Meeting**, Santa Fe, NM. See aslo.org/meetings/santafe2007/. Contact Helen Lemay at business@aslo.org, 800/929-2756.

Feb 6-9—**Symposium on the Sustainability of the Arctic-Yukon-Kuskokwim Salmon Fisheries**, Anchorage Alaska. See www.aykssi.org/prod/index.htm. Contact Sherri Pristash, fyconf@uaf.edu, 907-479-5141.

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.

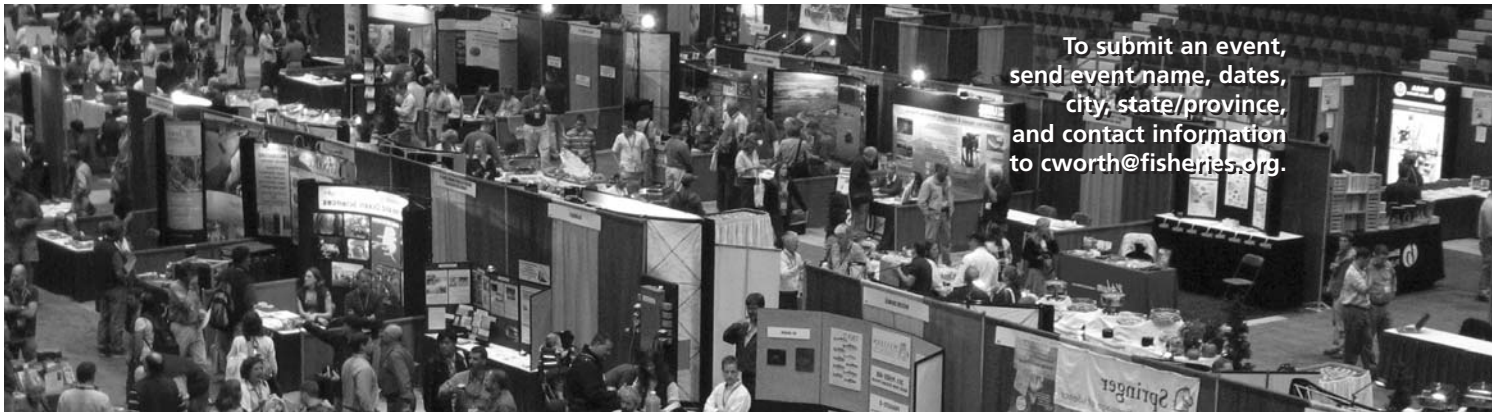
AF Feb 8-11—**Southern Division of the American Fisheries Society and Tennessee Chapter of AFS**, Memphis, TN. See www.sdafs.org/meetings/2006.

Feb 11-14—**Arabian Seas International Conference on Science and Technology of Aquaculture, Fisheries, and Oceanography**, Kuwait. See www.stafo.edu.kw (under construction). Contact Suliman Almattar, (+965) 5711293.

Feb 13-15—**American Institute of Fishery Research Biologists Symposium: The Future of Fishery Science in North America**, Seattle, WA. See www.aifrb.org.

AF Feb 18-23—**Sixth International Symposium on Ecohydraulics**, New Zealand. See www.conference.co.nz/ecohydraulics2007. (AFS members receive a 10% registration discount.) Contact Rachel Cook, rachel@conference.co.nz.

Feb 26-Mar 2—**98th Annual National Shellfisheries Association Meeting**, San Antonio, TX. See www.was.org/meetings/ConferenceInfo.asp?MeetingCode=AQ2007.



To submit an event, send event name, dates, city, state/province, and contact information to cworth@fisheries.org.

AFS Mar 7-10—**AFS Midyear Governing Board Meeting**, Atlanta, GA. Contact Sharon Smith, ssmith@fisheries.org, 301/897-8616 x230.

Mar 7-10—**25th Annual Salmonid Restoration Conference**, Santa Rosa, CA. Contact 707/923-7501.

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 3-5—**Pathways to Resilience: Sustaining Pacific Salmon in a Changing World**, Oregon. See www.Oregonstate.edu/conferences/resilience/. Contact conferences@oregonstate.edu.

AFS Apr 22-25—**63rd Northeast Fish and Wildlife Conference**, Groton, CT. See www.neafwa.org.

May 14-16—**New Strategies for Urban Natural Resources: Integrating Wildlife, Fisheries, Forestry, and Planning**, Chicago, IL. See www.informalearning.com/wildlife.

May 24-27—**Aquarama 2007: Tenth International Aquarium Fish and Accessories Exhibition and Conference**, Singapore, www.aquarama.com.sg.

May 28-Jun 1—**Human and Climate Forcing of Zooplankton Populations**, Hiroshima, Japan. See www.pices.int/meetings/international_symposia/2007_symposia/4th_Zooplankton/4th_Zoopla.aspx.

Jun 7-9—**15th International Conference on Environmental Bioindicators**, Kowloon, Hong Kong. See www.InformaLearning.com/EBI. Contact James Newman, jnewman@pandionsystems.com.

AFS Jun 6-9—**Fourth North American Reservoir Symposium**, Atlanta, GA. See www.sdafs.org.

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

Jun 17-23—**Seventh Symposium on Fish Immunology**, Stirling, Scotland. See www.noffi.org/sotland2007.

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

Jun 26-29—**ICES/PICES Conference for Early Career Scientists: New Frontiers in Marine Science**, Baltimore, MD. See www.pices.int/newfrontiers.aspx.

Jul 11-16—**American Society of Ichthyologists and Herpetologists Annual Conference**, St. Louis, Missouri.

AFS Sep 2-6—**American Fisheries Society 137th Annual Meeting**, San Francisco, CA. See www.fisheries.org.

Oct 9-12—**International Symposium: Wild Trout IX**, West Yellowstone, MT. www.wildtroutsymposium.com/. Contact Dirk Miller, Dirk.Miller@wgf.state.wy.us, 307/777-4556.

2008

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

AFS Aug 17-21—**American Fisheries Society 138th Annual Meeting**, Ottawa, Ontario.

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

2009

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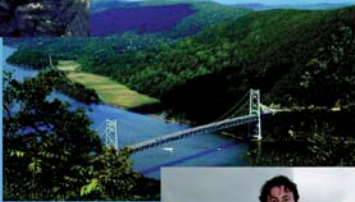
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REPORT: 2006 HUTTON JUNIOR FISHERIES BIOLOGY PROGRAM

Danielle Hawkins

Hawkins is the Hutton Program Coordinator and can be reached at hutton@fisheries.org or 301/897-8616 ext. 213.

Learn more about the Hutton Program at www.fisheries.org; click on Hutton Program.

PROGRAM DESCRIPTION

The Hutton Junior Fisheries Biology Program is a summer mentoring program for high school students sponsored by the American Fisheries Society (AFS). The principal goal of the program is to stimulate interest in careers in fisheries science and management among groups underrepresented in the fisheries professions, including minorities and women. Application to the program is open to all current sophomore, junior, and senior high school students regardless of race, creed, or gender. Because the program seeks to increase diversity within the fisheries professions, preference is given to qualified women and minority applicants.

Students selected for the program are matched with mentor professionals and enjoy an eight-week, hands-on fisheries science experience in a marine and/or freshwater setting. Assignments are made with participating organizations within reasonable commuting distance from the students. Each student receives a \$3,000 scholarship and a complimentary student membership in AFS.

2006 PROGRAM

Selection for the program is more competitive each year. From 266 eligible student applications, the Hutton Evaluation Panel selected 56 students for the Class of 2006. The students were matched with professional mentors in state and federal agencies, at universities, tribal facilities, and private organizations throughout 29 U.S. states and Canada.

At the end of the summer, students and mentors submit a final report to AFS evaluating their experience, their mentor or student, and the program. The students respond to questions about their future education and career plans. The immediate success of the program is defined by the number of students who make a positive statement in their final reports about their

experience and whether or not they plan to study or are considering the study of fisheries or a related field when they enter college. Of the 56 students in the Class of 2006:

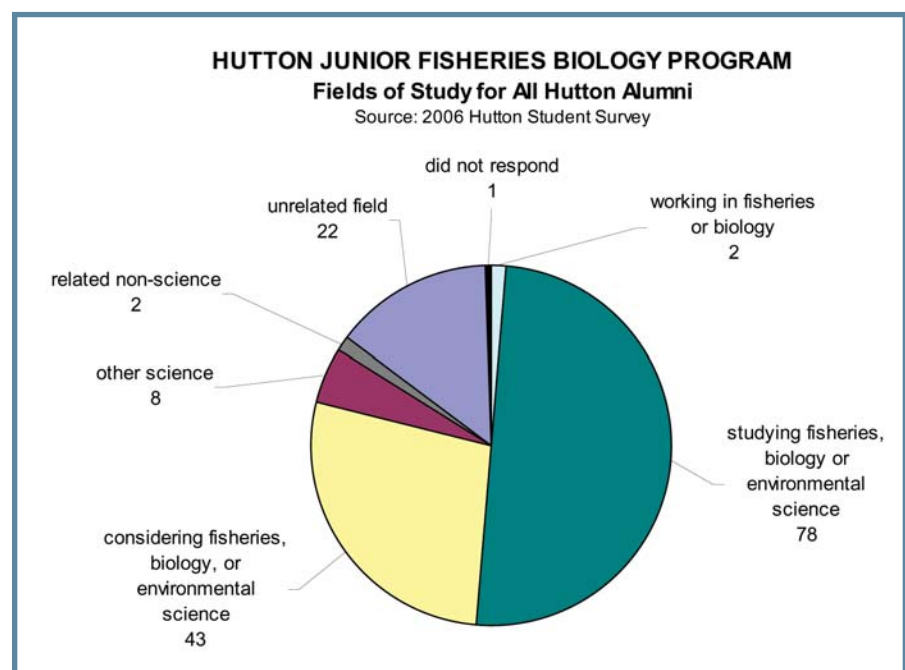
- 22 are currently enrolled in college, and of those students:
 - 15 are studying fisheries or biology;
 - 1 is studying environmental engineering
 - 2 are studying another science;
 - 2 are undecided on a major, but are considering fisheries or biology as an option;
 - 2 are studying a related non-science;
 - 0 are studying an unrelated field.
- 33 are still in high school, and of those students:
 - 15 plan to study fisheries or biology when they enter college;
 - 2 plan to study environmental science;
 - 1 plans to study another science;

- 14 are undecided on a major, but are considering fisheries or biology as an option;
- 0 plan to study an unrelated field;
- 1 did not respond to the question.

These reports verified that participation significantly benefits students in many ways. All of the students had the experience of working in a professional setting and learning what is required to be successful in that environment. They learned about fisheries issues in their local area and the importance of conservation to the future of the resource.

SURVEYS

AFS surveys the parents of the current class for their evaluation of the program and suggestions for improvement. A survey of the parents of the Class of 2006 received a good response with 31 completed surveys received to date. All of the responses were very positive and included evaluations of the program and the benefits it provides to



***Two summers ago,
I would have never considered
fisheries as a major and
now I leave for college in a week and
my major is wildlife ecology and fisheries.***

—Casey Slezniak
Class of 2005 and 2006

students. The most commonly repeated suggestion for improvement was to make the program more widely available with more publicity and increased funding.

The long-term results of the program will be monitored by an annual survey of Hutton alumni for a period of 10 years to determine how their experience has affected their educational plans and their ultimate career choice. As students are just beginning to graduate from college, the true success of the program will soon reveal itself. Ultimately, success will be measured by the number of minority and female Hutton participants who choose a career in fisheries science or natural resource management.

AFS spent several months conducting the 2006 survey of the 245 students who participated in the Hutton Program in the classes of 2001–2006. It was completed in October 2006 with 156 responses, generating a 64% response rate. According to the survey results:

121(78%) are studying or considering studying fisheries, biology, or environmental science,

- 2 (1%) are working in fisheries or biology,
- 2 (1%) are studying or planning to study related non-sciences,
- 8 (5%) are studying or planning to study other sciences, and
- 22 (14%) are studying, planning to study, or working in an unrelated field (see graph on facing page).

In addition to fields of study, the survey also addressed publications, scholarships, and other honors, and fisheries-related work. A number of Hutton scholars reported that they have published material since their participation in the program. Even more alumni reported that they have received scholarships or have gone on to continue their work in the fisheries field, often working with their mentors' organizations.

OVERSIGHT AND EVALUATION

The Hutton Program Committee provides oversight and evaluation of the Hutton Junior Fisheries Biology Program.

BENEFITS TO MENTORS

Mentors and participating organizations receive many benefits including:

1. Complimentary membership in AFS,
2. Professional development quality points for certification,
3. Compliance with diversity initiatives,
4. Assistance with important summer projects,
5. Potential future employees, and
6. The opportunity to have a positive effect on the life of a high school student.

This is a special AFS committee composed of AFS members appointed by the Society's president.

PARTNERS

The 2006 Hutton Program would not have been possible without the financial support from the National Fish and Wildlife Foundation, NOAA Fisheries, USDA Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, Alaska Department of Fish and Wildlife/Sport Fish Division, North Carolina Wildlife Resources Commission, and the Wisconsin Department of Natural Resources. Many AFS Units also contributed to this year's program, including the North Central and Northeastern Divisions; the Michigan, Minnesota, New York, and North Carolina Chapters; and many AFS members.

LOOKING FORWARD

Some Hutton alumni have already completed undergraduate degrees. In the near future, we expect many of these Hutton alumni to not only begin filling positions that result from the projected retirement of nearly half of all fisheries biologists working in the United States within the next five years, but also to contribute to the diversity of a workforce traditionally underrepresented by minorities and women.

HOW TO SUPPORT THE HUTTON PROGRAM

You can help support the Hutton Program by:

1. Volunteering to be a Hutton Mentor (visit www.fisheries.org and click on "Mentors.")
2. Making a financial contribution (visit www.fisheries.org and click on "Donate.")
3. Offering to help find mentors for students in your area (email hutton@fisheries.org)
4. Advertising the program to students, mentors, and organizations (email hutton@fisheries.org)
5. Encouraging your AFS Section, Chapter, or Division to become involved in Hutton

Applications for the 2007 Hutton Program must be postmarked by 15 February 2007.

PHOTOS: JACK HOLLINGSWORTH, SAN FRANCISCO CONVENTION AND VISITORS BUREAU

FINAL CALL FOR PAPERS AND SYMPOSIA

CALL FOR WORKSHOPS INSTRUCTORS/PROFESSORS

Do you have an idea for a short continuing education course or workshop that could be offered at the 2007 AFS Annual Meeting in San Francisco, California? We are currently seeking proposals for short courses (4-16 hours of instruction) to be held on September 1st and 2nd, before the meeting starts. The AFS Annual Meeting can give your course exposure to a diverse pool of fisheries professionals at all stages in their careers, so take advantage of this opportunity to offer it through AFS! In order to best serve the profession, we are particularly interested in courses in the subjects that were assessed to be most needed by the AFS membership as well as the Northwest community:

- Statistics and Analysis
- Restoration and Enhancement
- Population Dynamics
- Multi-Species Interactions
- Technical Writing
- Computer Skills
- Leadership and Stakeholder Coordination Skills
- Distance Learning

Other ideas are also welcome! To propose a course, download a Course Approval Form from the Web at www.fisheries.org (click on "Education") or contact, Craig Woolcott (Craig.Woolcott@noaa.gov, 732/872-3069) or Gail Goldberg (GGoldberg@fisheries.org, 301/897-8616 ext. 201) to receive an application. All applications must be received by 19 January 2007.

The largest Dungeness crab ever caught was 10 inches in diameter.

We invite you to California as the American Fisheries Society (AFS) convenes its 137th Annual Meeting at the Marriott Hotel in downtown San Francisco September 2-6, 2007. The theme of the meeting is "Thinking Downstream and Downcurrent: Addressing Uncertainty and Unintended Consequences in Fish and Fisheries." At the interface between the Sacramento-San Joaquin River drainage and the Pacific Ocean, San Francisco provides an outstanding venue to think about managing whole ecosystems, advance your professional networking, and to keep current on emerging ideas in fisheries science and management.

SYMPOSIUM PROPOSALS

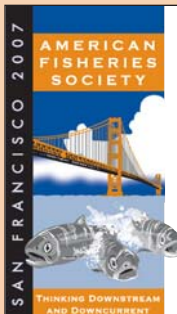
The Program Committee invites proposals for symposia from individuals or groups. Symposia may be presented as oral presentations, posters, or both. Topics should be related to the meeting theme (these will receive priority) or be of general interest to AFS members. Symposium organizers are responsible for recruiting speakers, soliciting their abstracts, and directing them to submit their

abstracts through the AFS online abstract submission form. Each symposium should last at least a half-day (about 10 oral presentations) and may span a maximum of two days (about 40 oral presentations). There is no limitation for the number of posters submitted for symposia.

Symposium proposals must be submitted by 12 January 2007 via e-mail to Eric Wagner (ericwagner@utah.gov) with the proposal attached in the correct format in MS Word or WordPerfect; please contact Eric Wagner (address and phone below) if you do not receive confirmation by January 19. The Program Committee will review all symposium proposals and notify organizers of acceptance or refusal by 2 February 2007. If accepted, organizers must submit a complete list of all confirmed speakers and titles by 23 February 2007. Symposium abstracts (in the same format as contributed abstracts; see below) are due by 2 March 2007.

Format for symposium proposals:

- 1) **SYMPOSIUM TITLE:** Brief but descriptive.
- 2) **ORGANIZER(S):** Provide names, addresses, telephone and fax numbers, and e-mail addresses for all organiz-



CONTACTS

Questions regarding symposia should be addressed to:
Eric Wagner
1465 W. 200 North
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435/752-1066 x22
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ericwagner@utah.gov

Questions regarding contributed papers should be addressed to:
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khieb@dfg.ca.gov

Questions regarding meeting logistics and planning should be addressed to:
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dmanning@scwa.ca.gov

Anyone who wishes to organize a continuing education course or workshop should contact:
Craig Woolcott
J J Howard Marine Science Lab
74 Magruder Rd
Highlands, NJ 07732
craig.woolcot@noaa.gov

ers. Indicate by an asterisk the name of the main contact person.

- 3) **DESCRIPTION:** In 300 words or less, describe the topic addressed by the proposed symposium, the objective of the symposium, and the value of the symposium to AFS members and participants.
- 4) **FORMAT:** Indicate format and length of the proposed symposium (for example: a full-day session with 20 speakers, a full-day session with 15 speakers followed by a 2-hour panel discussion, half-day session with 10 speakers; in general, allow 10 time slots per half-day session).
- 5) **MODERATOR:** Identify who will moderate the symposium. If there is more than one moderator please supply all names.
- 6) **PRESENTATION REQUIREMENTS:** We encourage speakers to use PowerPoint for presentations. Presentations in other software programs need to be approved prior to acceptance.
- 7) **AUDIOVISUAL REQUIREMENTS:** Symposia chairs will need to provide a PC-interface laptop computer for their sessions. LCD projectors will be available in every room. Other audiovisual equipment needed for the symposium will be considered, but computer projection is strongly encouraged. We encourage/request that all Mac-based presentations be converted to PC format prior to the meeting.
- 8) **SPECIAL SEATING REQUESTS:** Standard rooms will be arranged theatre-style. Please indicate special seating requests (for example, "after the break, a panel discussion with seating for 10 panel members will be needed").
- 9) **SPEAKERS AND TOPICS:** Provide each speaker's name, tentative title of presentation, and the speaker's confirmation status in the following format:

Speaker	Title/Topic	Confirmed
1. _____	_____	(yes/no)
2. _____	_____	(yes/no)
- 10) **SPONSORS:** If applicable, indicate sponsorship. A sponsor is not required.

CONTRIBUTED ORAL AND POSTER ABSTRACTS

The Program Committee for the 137th AFS Annual Meeting invites abstracts for contributed oral presentations and posters. Poster submissions are strongly encouraged because of the limited space available in the program for oral presentations. The meeting schedule will include a special poster session to encourage discussion between poster authors and attendees.

Both contributed oral presentation abstracts and contributed poster abstracts must be received by 9 February 2007. All submissions must be made by using the AFS online abstract submission form, which is available on the AFS website (www.fisheries.org).

Only one oral presentation (symposium or contributed) will be accepted for each senior author; additional posters are allowed.

Submitting via the AFS website is required, and formatting is automatically done for you. On the "Session Topic" lines of the abstract form, please indicate which two general topics best fit the concept in your abstract. Use a brief but descriptive title, avoiding acronyms or scientific names in the title unless the common name is not

widely known. List all authors, their affiliations, addresses, telephone numbers, and e-mail addresses. Abstracts are restricted to 200 words and should be a summary of your findings. All presenters will receive an immediate email confirmation of their abstract submission and will be notified of formal acceptance and the designated time and place of their presentation in April.

General topics for contributed papers and posters include: Bioengineering, Communities and Ecosystems, Contaminants and Toxicology, Education, Fish Culture, Fish Health, Fish Conservation, Freshwater Fish Ecology, Freshwater Fisheries Management, Genetics, Habitat and Water Quality, Human Dimensions, Marine Fish Ecology, Marine Fisheries Management, Native Fishes, Physiology, Policy, Population Dynamics, Statistics and Modeling, Species Specific (specify), and Other (specify).

Indicate your preference for the presentation format using one of the following:

- 1) Oral presentation only
- 2) Poster presentation only
- 3) Oral presentation preferred, but poster presentation acceptable.

Late submissions will not be accepted. Please note that AFS does not waive registration fees for symposium, workshop, or contributed session participants. All presenters and meeting attendees must pay registration fees. Registration forms will be available on the AFS website (www.fisheries.org) in April 2007; register early for cost savings!



The San Francisco Museum of Modern Art, or SFMOMA, has been a landmark of the South of Market, or SoMa, district since it opened in 1995. Designed by noted architect Mario Botte, it houses one of the most eclectic art collections in the world.

EMPLOYERS: To list a job opening on the AFS Online Job Center submit a position description, job title, agency/company, city, state, responsibilities, qualifications, salary, closing date, and contact information (maximum 150 words) to jobs@fisheries.org. Online job announcements will be billed at \$350 for 150 word increments. Please send billing information. Listings are free for Associate, Official, and Sustaining organizations, and for Individual members hiring personal assistants. If space is available, jobs may also be printed in *Fisheries* magazine, free of additional charge.

See more job listings at www.fisheries.org; click on Jobs.

Ph.D. Graduate Research Assistant,

School of Environment and Natural Resources, Ohio State University, Columbus.

Posted: 10/10/06.

Closing: 12/31/06.

Responsibilities: Conduct research related to monitoring the impacts of various stream restoration practices in Ohio. Research supported by ODNR, Division of Wildlife.

Qualifications: M.S. in biology, ecology, fisheries, or related field. Experience sampling and identifying fishes and macroinvertebrates. Experience with watershed models preferred.

Salary: \$1,500 per month plus tuition waiver.

Closing date: Prefer 12/31/06

Target start date: 7/1/07

Contact: Send letter of interest, CV, GRE scores, and contact information of 3 references to: Dr. Lance Williams, School of Environment and Natural Resources, The Ohio State University, 2021 Coffey Road, Columbus, Ohio 43210. 614/292-7739. E-mail applications preferred: williams.2323@osu.edu.

Ph.D. Graduate Research Assistant in Environmental Toxicology, Fisheries and Illinois Aquaculture Center and Department of Zoology at Southern Illinois University, Carbondale.

Posted: 8/29/06.

Closing: 12/29/06.

Responsibilities: Work with active environmental toxicology group. Potential research topics include: joint toxicity of multiple stressors, fate and effects of pesticides in aquatic systems, and bioavailability issues in sediments.

Qualifications: M.S. in zoology, biochemistry, chemistry, toxicology, or related field. Experience with toxicological bioassays, culturing of aquatic organisms, and analytical equipment (GC/HPLC).

Salary: Research assistantships will include a competitive salary (~\$16,000), full tuition waiver, health benefits, and support for the proposed research.

Closing date: 12/31/2006.

Starting dates: Fall 2006-spring 2007.

Contact: Send letter of intent describing



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Life (*Fisheries* only, 2 installments, payable over 2 years) \$1,200
Life (*Fisheries* only, 2 installments, payable over 1 year) \$1,000

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All memberships are for a calendar year. New member applications received January 1 through August 31 are processed for full membership that calendar year (back issues are sent). Those received September 1 or later are processed for full membership beginning January 1 of the following year. *Fisheries*, December 2006

research interest and goals, a resume, transcripts and three letters of reference to: Dr. Michael Lydy, Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901, 618/453-4091, cell 618/201-1681, mlydy@siu.edu.

**Assistant/Associate Professor
Crustacean and Molluscan Biology,**

Department of Fisheries and Allied Aquaculture, Auburn University.

Posted: 11/10/06.

Closing/review: 12/15/06

Start date: 8/16/07.

Responsibilities, qualifications, application instructions, and other information: www.ag.auburn.edu/fish/.

Contact: Dr. Allen Davis, Chair, Search Committee, Department of Fisheries and Allied Aquacultures, 203 Swingle Hall, Auburn University, AL 36849; 334/844-9312; or fax 334/844-9208, davis@auburn.edu. AA/EOE.

Fishery Biologist GS-482-11/12, Bureau of Reclamation; Klamath Falls, OR.

Posted: 11/8/06.

Closing: 12/8/06

Responsibilities: Conduct ecological investigations for listed suckers, salmonids, and other fish species in the Klamath Basin. Negotiate agreements with other agencies and private development interests associated with operation of the

Klamath Irrigation Project.

Qualifications: Experience with western sucker and salmonid species in a eutrophic lacustrine and riverine environment, experience developing study designs to evaluate limiting factors affecting listed species, research studies and contracts, and experience with water delivery or irrigation projects.

Salary: \$51,972-80,975

Closing: 12/8/06.

Contact: Cindy Williams at 541/883-6935, cwilliams@mp.usbr.gov. Human Resources Office, 916/978-5471, jobs@mp.usbr.gov. BR-MP-2006-325 is open to U.S. citizens. BR-MP-2006-324 is open to U.S. citizens with

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.seagrants.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.seagrants.org/SGDirectors.html
- any participating NMFS facility—www.nmfs.noaa.gov/science.htm



federal status. Apply online at www.usbr.gov/pmts/hr/hireme.html

Scientists—Theoretical Aquatic Ecology, Modelling and/or (Statistical) Data Analysis (two two-year positions), Potsdam University, near Berlin, Germany.

Review begins: 1/9/06
Closing: Until filled.
Start: 1/12/06 and 1/7/08.

Responsibilities: Work within the EU Marie Curie Transfer of Knowledge Project FEMMES (FEedback Mechanisms in Models for Ecological forecastS) to develop innovative models that forecast how environmental change affects ecological systems at different hierarchical levels (e.g., populations and communities) which may be linked by feedback mechanisms. FEMMES will last for 4 years, comprised in total of five positions, and is hosted by the Department of Vegetation Science and Nature Conservation, and the Department Ecology and Ecosystem Modelling, focusing on pelagic ecosystems. Details of the research to be conducted at Potsdam are open to

discussion and should be linked to previous experiences and current research interests of the applicant and to ongoing research of the host (e.g., food web theory, metabolic basis of ecology, ecological stoichiometry, size spectra; for details see www.bio.uni-potsdam.de/oeksys/index.htm). The analyses may be based on temporally and taxonomically highly resolved measurements of plankton biomass and production in Lake Constance (20-year timeseries), and on long-term micro- and mesocosm experiments. The unusually comprehensive L. Constance data set has already provided the basis for numerous (model) studies which resulted in seasonally resolved size spectra and quantitative food web models in units of carbon and nutrients which may be further analyzed. Another focus of the host is on improving the capability of dynamic simulation models to account for the potential of individual populations to adapt to altered conditions, and for (species) shifts in community composition which change average community properties. Other topics are also

welcomed as is teaching of post-graduate students.

Salary: Includes mobility allowance and depends on the scientific experience.

Qualifications: Fluent in speaking and writing English. Knowledge of German is not essential but helpful.

Formal requirements of the EU: See <http://cordis.europa.eu/mariecurie-actions/tok/apply.htm> (1) Non-German citizen of the EU or an associated country (e.g., Norway, Switzerland, Rumania, Turkey, etc) who has not stayed in Germany for > 1 year during the past 3 years, or non-Germans who stayed in the EU or an associated country for at least 4 out of the past 5 years, but not > 1 year in Germany, or Germans who worked outside the EU or associated countries during at least 4 of the past 5 years. (2) at least Ph.D.

Contact: Send application, research proposal, and publication list to Gaedke@uni-potsdam.de or: Professor Dr. Ursula Gaedke, Universität Potsdam, Maulbeerallee 2, D-14469 Potsdam, Germany. (The previous 3 fellows acquired funding to continue their stay in Potsdam.)



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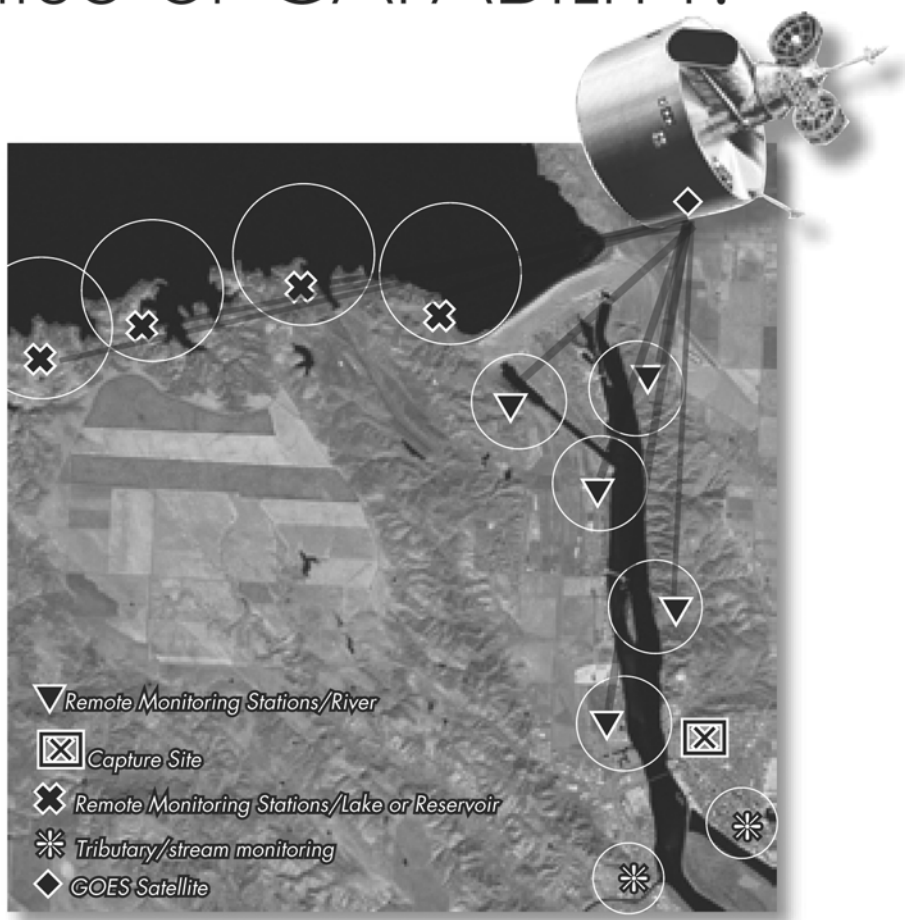
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