

Fisheries and Aquatics Bulletin

A publication of the U.S. Geological Survey,
Fisheries: Aquatic and Endangered Resources (FAER) Program
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[Edited by Robin M Schrock](#)

From the Assistant Program Coordinator's Desk

Highlight your Research! Here is a golden opportunity for wider distribution of information about your research activities to a broader audience and an opportunity to acknowledge our research partners. The USGS Fisheries: Aquatic and Endangered Resources Program will host a booth at the upcoming American Fisheries Society Annual Meeting in Anchorage, Alaska. The meeting theme "[Creating a Fisheries Mosaic: Connections Across Jurisdictions, Disciplines, and Cultures](#)" is a natural for USGS scientists. We hope to display many examples of interdisciplinary cooperative research on interjurisdictional aquatic resources, and to highlight projects developed with Tribal fisheries.



The meeting is scheduled for September 11-15, 2005, giving FAER Program scientists just 4 months to provide new fact sheets and other USGS science products for distribution. Printouts of project posters, Science Center fact sheets, relevant publication reprints, CDs, and promotional items such as bookmarks are all possibilities.

The bookmarks from the Florida Integrated Science Center were a big hit at the USGS Open House last year, so more informational products of this type are encouraged. Other handouts such as brochures or CDs are also welcome. If you are unable to attend the meeting, your 2004 and 2005 reprints would also be welcome. Check the Go to Great Links feature on page 8 for links to examples of fact sheets and other outreach materials.

Science Features:

Fish Passage - Fishways are Being Evaluated and Improved for Passage of American Shad in the Northeast



Photo: USGS

Shad migrate through Power Canal near Turner Falls

Researchers at the U.S Geological Survey's S.O. Conte Anadromous Fish Research Center in Turners Falls, Massachusetts, have been studying migration and passage of American shad in the Connecticut River for the past 13 years. Historic data indicate that about half the fish passed through the fish lift at Holyoke Dam reach the Turners Falls area, a distance of about 40 miles. During some annual spring migrations as many as 400,000 shad migrate and spawn between Holyoke and Turners Falls. Of the shad that migrate as far as Turners Falls and enter fishways there, on average less than 25 percent are successful in passing the fishways and the dam, indicating significant passage problems within the complex of three fishways. In addition, fish that ascend the lowermost fishway at Cabot

Station must also negotiate the 2½-mile long power canal before passing Turners Falls. Studies indicate that many shad do not find the upstream exit out of this canal and past the dam. To investigate these problems and improve fish passage at Turners Falls, Conte Center researchers are working with Northeast Utilities to design and evaluate modifications to the fishways that will improve shad passage, including increasing fishway flow, lighting the fishways at night, and modifying fishway hydraulics. In addition, a prototype of a new fishway entrance on the Turners Falls power canal is being evaluated which shows promise in guiding fish out of the canal and past the gatehouse and dam. Permanent improvements to the fishways and canal entrances may be made within the next several years.

Contact: Dr. Alexander Haro

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USGS S.O. Conte Anadromous Fish Research Center

Website: www.lsc.usgs.gov/CAFLindex.asp

Exotic Tapeworm Found in Endangered Desert Fishes

The Asian fish tapeworm (*Bothriocephalus acheilognathi*) was introduced into the US in the 1970s with the importation of grass carp (*Ctenopharyngodon idella*) and has become established in the endangered humpback chub (*Gila cypha*) population from the Colorado and Little Colorado Rivers in Grand Canyon, AZ. This parasite is known to cause disease and death primarily in hatchery raised carp, however, pathogenic effects have also been observed in other fish species. At the USGS National Wildlife Health Center in Madison, WI, a series of experimental trials were carried out using the closely related bonytail chub (*Gila elegans*), another endangered fish of the southwest US, to study the potential impacts of Asian fish tapeworm infections on survival, growth, and physiological condition of humpback chub. While older juvenile fish (10 months old and 83 mm long) revealed no negative effects associated with infections, subsequent experiments with younger and smaller fish (2.5 months and 22 mm long) demonstrated infected fish length was reduced as much as 9% on average

compared to control fish by the end of the 24-week study.



Photo: USGS

Infected bonytail chub (*Gila elegans*) showing distended abdomen (above) compared with uninfected control chub (below).



Photo: USGS

Additionally, when food ration was restricted, infected fish began dying 20 days earlier and at nearly twice the rate of control fish on low food ration (Figure 1). Infected fish were found to have significantly lower hematocrit levels and a reduced amount of visceral fat when compared with control fish.

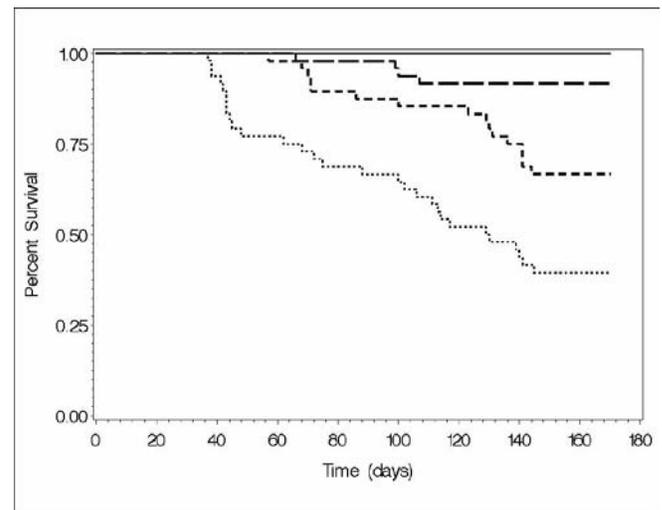


Figure 1. Kaplan-Meier survival curves for bonytail chub (*Gila elegans*) over 170 days illustrating treatment responses for control fish on high food ration (solid line), infected fish on high food ration (long dashed line), control fish on low food ration (short dashed line), and infected fish on low food ration (dotted line).

An experiment was also conducted to examine whether tapeworm infections exacerbate the effects of thermal shock that small chub undergo when being swept from the warm waters of the Little Colorado River (23.5 °C) into the cold waters of the Colorado River (9.5 °C) during monsoon flooding. Results from this experiment revealed no synergistic effects of cold shock and tapeworm infection, with control and infected fish exhibiting similar stress responses to the thermal extremes.



Photo: USGS

Intestine of bonytail chub (*Gila elegans*) infected with Asian fish tapeworm (*Bothriocephalus acheilognathi*).

A separate experiment demonstrated evidence for postcyclic infection of larger chub resulting from piscivory of infected small fish which is in contrast to the conventional infection route via the intermediate copepod host. Results from these experiments will be useful to resource managers and in ecological modeling efforts by providing information on potential implications of the parasite invader as well as ecological information related to parasite transmission. This information is not only useful in efforts to conserve humpback chub but can also provide insight into the potential implications should the Asian fish tapeworm invade other ecosystems and fish species.

For further information on parasites in fish in the Grand Canyon contact Dr. Rebecca Cole rebecca_cole@usgs.gov,
USGS National Wildlife Health Center
<http://www.nwhc.usgs.gov/>

USGS and US Fish and Wildlife Service biologists cooperate to develop methods to support aquaculture drug research

Researchers at the USGS Upper Midwest Environmental Sciences Center have teamed with USFWS fish health specialists from the La Crosse Fish Health Center to **develop consistent methods of disease exposure for fishes for applications in aquaculture drug testing**. This research was supported through a Multistate Conservation Grant awarded by the U.S. Fish and Wildlife Service and funded through the use of Sport Fish Restoration funds. The International Association of Fish and Wildlife Agencies (IAFWA) provides oversight, coordination, and guidance for the Multistate Conservation Grant Program as established by the Wildlife and Sport Fish Restoration Programs.

Columnaris disease, caused by the gram-negative



Photo: USGS

Figure 1. Necrotic gill tissue was observed on rainbow trout *Oncorhynchus mykiss* (bottom fish).

bacterium *Flavobacterium columnare*, is an acute to chronic bacterial infection that can cause mortality in nearly all cultured freshwater fish. Development of a successful therapy has thus far been constrained because of the lack of uniform infection models. Development of a disease infection model would provide clinical researchers with uniformly infected fish that are free of secondary pathogens to evaluate candidate therapies. This eliminates the confounding environmental variables often encountered during clinical efficacy trials.

A *F. columnare* culture was isolated from a naturally occurring outbreak in channel catfish *Ictalurus punctatus* at the Rathbun State Fish Hatchery (Iowa Department of Natural Resources, Moravia, IA) and its identity confirmed by standard biochemical tests and polymerase-chain reaction (PCR) assay. The Rathbun isolate was subsequently used to infect rainbow trout *Oncorhynchus mykiss*, walleye *Sander vitreum*, and channel catfish at the US Geological Survey's Upper Midwest Environmental Sciences Center (La Crosse, WI). Anesthetized rainbow trout, walleye, and channel catfish were uniformly abraded along the left side by wiping (twice) cotton gauze from tail to head before immersion challenge. Static bacterial immersion challenges were administered at the following nominal bacteria concentration (colony-forming units [CFU]/mL) by duration combinations: 10⁴ CFU/mL for 8 h; 10⁶ CFU/mL for 4, 6, or 8 h; and 10⁸ CFU/mL for 30 min. Control fish were sham-challenged by similarly abrading and holding for 8 h in pathogen-free water. Following challenge, fish were transferred to observation tanks and held for 6 to 7 days and mortalities recorded and removed daily. Initial mortality occurred within 24 h of challenge at 10⁸ CFU/mL but was generally delayed to 48 or 72 h post challenge for other challenge combinations. Lesions observed included gill necrosis (Figure 1), frayed and/or eroded fins, discolored skin lesions generally along the left side, and the typical "saddleback" lesion anterior to the dorsal fin. Gill and/or fin wet mounts were prepared from affected fish and the characteristic haystack colonies of long, slender, motile, rod-shaped bacteria of *F. columnare* were observed. *Flavobacterium columnare* were also isolated from skin, fin and kidney tissues of infected experimental fish by inoculation of tissues into Hsu Shotts medium followed by PCR confirmation. Mortality increased and time to death decreased as challenge concentration and duration increased for all three species ($P < 0.01$; Table 1). Consistent challenge-related infection and mortality was induced by *F. columnare* immersion challenge of rainbow trout, walleye, and channel catfish following systematic abrasion. Clinical trials could be initiated using the abrasion and immersion challenge model described provided that therapy is initiated within 24 h of challenge. Given the pathogenicity of the Rathbun *F. columnare* strain

tested, delaying therapy to >24-h post challenge may result in infections so advanced that therapeutic intervention may not be successful.

Table 1. Cumulative percent mortality during Trials 1 and 2 and overall hazard ratio (relative to control) of rainbow trout *Oncorhynchus mykiss*, walleye *Sander vitreum*, and channel catfish *Ictalurus punctatus* following *Flavobacterium columnare* immersion challenge (bacteria concentration [colony forming units – CFU/mL] by duration). The hazard ratio is the expected number of events that should occur during a one-unit interval of time. For non-repeatable events such as mortality, the reciprocal of the hazard function gives an estimate of the expected length of time until an event occurs; the larger the ratio, the sooner an event is expected to occur. Hazard ratios with the same superscript letter are not significantly different ($P > 0.05$).

Species	Trial	°C	Control	Total percent mortality				
				10 ⁴ CFU/mL x 8 h	10 ⁶ CFU/mL x 4 h	10 ⁶ CFU/mL x 6 h	10 ⁶ CFU/mL x 8 h	10 ⁸ CFU/mL x 30 min
Rainbow trout	1	20	7	0	10	23	16	87
	2		0	3	10	20	34	70
Overall hazard ratio			NA ^{ab}	0.65 ^a	3.3 ^{bc}	8.1 ^c	8.3 ^c	66.6 ^d
Walleye	1	25	0	3	72	93	96	100
	2		3	3	50	37	86	100
Overall hazard ratio			NA ^a	3.2 ^a	76.1 ^b	118.6 ^b	187.2 ^c	574.3 ^d
Channel catfish	1	25	30	97	100	100	100	100
	2		0	100	100	100	100	100
Overall hazard ratio			NA ^a	28.9 ^b	74.9 ^c	132.1 ^d	308.7 ^e	571.0 ^f

NA – not applicable, the controls were assumed to represent the baseline hazard function.

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 USGS Upper Midwest Environmental Sciences
<http://www.umesc.usgs.gov/>

USGS Science Support Program: Providing US Fish and Wildlife Service managers with research support to meet science information needs

[USGS scientists evaluate dietary calcein as marking agent of scales and bony fish tissue](#)

Calcein chemically binds with calcium phosphate of bony fish tissue resulting in non-lethally detectable fluorescent marks when viewed at proper light wavelengths. Calcein (2,4-bis[N,N=di(carbomethyl)-amino-methyl]fluorescein) has recently received an investigative new animal drug (INAD) exemption for immersion marking of fish < 2 gram. Technology to mark fish has many management and stock enhancement application.

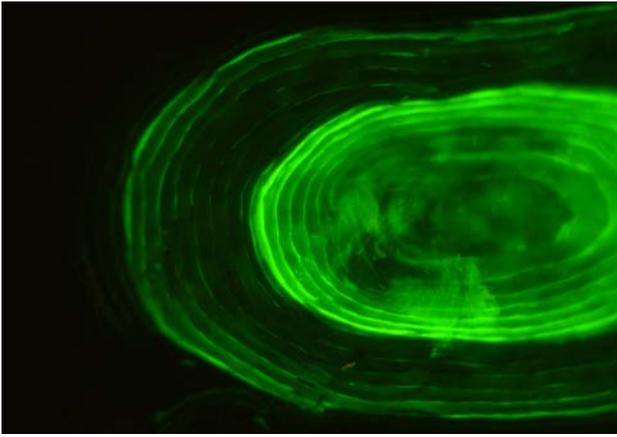


Photo: USGS

Brook trout scale marked with dietary calcein

Although tetracycline has been used extensively, there are practical reasons to replace it as a marking agent. Calcein appears to have many of the positive aspects of tetracycline but is not an antibiotic.

The project was recently funded through the Science Support Program (SSP,2005) to conduct cooperative studies with USFWS Bozeman and Lamar Fish Technology Centers. In addition to the development of a dietary marking technique, this work would support the current calcein INAD (INAD #10-987) approved for immersion administration in fish less than 2 g. Many techniques (coded wire, elastomer, Carlin, Floy, and pit tags) require individual handling of fish for application whereas dietary calcein would minimize or eliminate fish handling during marking. Also there are times when marking larger fish or use of an alternate means of mass marking fish is desirable. Preliminary work at the U.S. Geological Survey's Northern Appalachian Research Laboratory and the U.S. Fish & Wildlife Service's Lamar FTC has demonstrated that induction of calcein marks in scales and bony structures via administration of dietary calcein is feasible, but not without caveats. Both single and multiple marks have been induced via feed in brook trout, Atlantic and coho salmon, and yellow perch. Two calcein marks can be seen as a result of administering calcein twice. However, there appears to be some species differences as well as apparent non-specific binding of calcein to feed components. Use of a marking technique employing feed, would offer a more cost-effective method for mass marking of small fish, as well as larger fish. Questions and potential limitations of this technique must be addressed before the FWS AADAP program will

request a new INAD exemption from FDA (the first step in obtain FDA approval). The research objectives of the study are to determine appropriate feed application formulations and dose levels for calcein for marking representative trust species; determine useful length of time calcein mark remains as the fish grow and determine mark resistance to ultra violet light degradation.

Contact: Dale C. Honey field honeyfie@usgs.gov
USGS Northern Appalachian Research Laboratory
<http://www.lsc.usgs.gov/NARLindex.asp>

[USGS scientists develop strategies to culture endangered mussels with the US Fish and Wildlife Service](#)

The USGS and U.S. Fish and Wildlife Service have partnered to evaluate the safety of five common water-borne aquaculture drugs to freshwater mussels under the USGS Science Support Program. Many mussel species are threatened or endangered and the propagation of mussels to restore depleted populations is a national priority. Preliminary results on three drugs indicate that they could be safely used to prevent disease on host fish in mussel culture operations without harming the larvae.

Contact: Jeff Rich jrach@usgs.gov
USGS Upper Midwest Environmental Sciences Center
<http://www.umesc.usgs.gov/>

New Publications

[Molecular geneticists release two new primer notes:](#)

King, Tim L., Cackles, Michael S., and Benjamin H. Letcher. 2005. **Micro satellite DNA markers for the study of Atlantic salmon (*Salmon salar*) kinship, population structure, and mixed-fishery analyses.**

Molecular Ecology Notes (2005)5:130-132.

Callahan, Colleen R., Henderson, Anne P., Cackles, Michael S., and Tim L. King. 2005. **Micro satellite DNA markers for the study of population structure and dynamics in nutria (*Mycastor coypus*).**

Molecular Ecology Notes (2005)5:124-126.

A new Pacific lamprey publication:

Meeuwig, Michael H. and Jennifer M. Bayer. 2005. **Morphology and Aging Precision of Statoliths from Larvae of Columbia River Basin Lampreys.** North American Journal of Fisheries Management 25: 38-48.



Egg incubation apparatus used for examining the effects of temperature on survival and development of embryonic and larval lampreys.

New USGS and USFWS publication on whirling disease:

Ryce, Eileen K. N., Zale, Alexander V., MacConnell, Elizabeth and Mark Nelson. 2005. **Effects of fish age versus size on the development of whirling disease in rainbow trout.** Diseases of Aquatic Organisms 63: 69-76.

Researchers at the USGS Montana Cooperative Research Unit and the USFWS Bozeman Fish Health Laboratory cooperated on the study. The researchers have been conducting Whirling Disease research since 1998, and reports and publications can be found in the [Whirling Disease Bibliography](http://whirlingdisease.montana.edu/biblio/default.htm) <http://whirlingdisease.montana.edu/biblio/default.htm> on the Whirling Disease Initiative website. Contact Alexander Zale zale@usgs.gov of the Montana Cooperative Fishery Research Unit for more information this whirling disease research and other related publications.

New Funding Opportunity

New National Science Foundation Opportunity Announced for Innovative Outreach Among Scientists

The National Science Foundation recently announced a new funding opportunity to further interactions among scientists from different disciplinary, institutional, organizational and geographic areas to create new research directions: **Research Coordination Networks in Biological Sciences.** The program encourages innovative ideas for implementing novel networking strategies among groups of investigators. A broad research focus, specific groups of organisms, or particular technologies or scientific approaches is possible themes. The funding will support groups of investigators to communicate and coordinate research, training and educational activities across organizational, institutional, and geographical boundaries. For more information on this unique opportunity, view the NSF website: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05569

Biological Resources Staff Updates

Dr. Russ Mason fills new position as Science and Research Liaison at IAFWA

Dr. Russ Mason is the Science and Research Liaison between the International Association of Fish and Wildlife Agencies, the USGS, and the US Fish and Wildlife Service. Russ comes to this position after a long and successful career as a scientist, field station leader, and research program manager with USDA APHIS Wildlife Services National Wildlife Research Center. The author of numerous publications and patents, Russ has held senior academic positions at the University of Pennsylvania, Rutgers University, Utah State University, and the University of Wyoming. Russ remains an Adjunct Professor of Biology and Psychology at Utah State University, an Adjunct Associate Professor of Physiology and Zoology at the University of Wyoming and an Affiliated

Scientist of the Monell Chemical Senses Center, University of Pennsylvania. Throughout his research career, Russ focused on the development and application of taxon selective attractants, repellents, and toxicants for a variety of species, including amphibians, snakes, passerine birds, waterfowl, deer, and various predators. His goal as the Science and Research Liaison is to foster creative and productive partnerships among the federal and state fish and wildlife agencies on science and research topics of mutual interest. At present, his efforts are focused on cooperative monitoring, invasive species, the National Fish Habitat Initiative, sage brush and western grasslands concerns, and the development of wind power strategies that holistically consider wildlife impacts. Contact Russ at: rmason@iafwa.org

Andrea Ostroff joins IAFWA staff to support National Fish Habitat Initiative information needs

The USGS is supporting a new position at the International Association of Fish and Wildlife Agencies. The position will provide data support for development of the National Fish Habitat Initiative, a multi-agency effort to develop a National Fish Habitat Plan. Andrea, a GIS specialist with the New Jersey Division of Fish and Wildlife, will develop an interactive atlas of past and present fish habitat restoration projects from across the United States. In her new position as USGS-IAFWA Fish Habitat Restoration Project Coordinator, Andrea will work with the Science and Data Working Groups to assess the key elements of habitat restoration projects, and work with them to develop a system to share information about historic, ongoing, and future restoration projects. The purpose is to provide the back ground information on the objectives and attributes of successful projects in different aquatic habitat types to formulate national approaches for essential habitat for different fish species. The informational database will describe habitat attributes previously selected for restoration, and identify successful partnerships and founding approaches. This one year project will form one of the data building blocks for the science information system that will support the National Fish Habitat Plan.

Meetings

USGS scientists, in collaboration with partner agencies, are organizing several of the symposia with other agencies at the **American Fisheries Society 135th Annual Meeting** in Anchorage, Alaska, September 11-15, 2005. Information about all the symposia can be accessed at: <http://www.wdafs.org/Anchorage2005/symposia.htm>
The symposia with USGS organizers include:

Advances in Telemetry: Opportunities and Challenges for Fisheries and Aquatic Ecology organized by David Smith david_r_smith@usgs.gov of the USGS Eastern Region with Mike Millard mike_millard@fws.gov of the USFWS.

From the Laboratory to the Field: Practical Applications of Physiological and Performance Indicators in Fish with Matt Mesa matt_mesa@usgs.gov of the USGS Columbia River Research Laboratory and Brian Beckman brian.beckman@noaa.gov of NOAA-Fisheries as organizers.

Invasive Species in Large River Systems is a USGS team effort by Jill Hardiman jhardiman@usgs.gov and Tim Counihan tim_counihan@usgs.gov of the USGS Columbia River Research Laboratory and Ian Waite iwaite@usgs.gov of the USGS Oregon Water Science Center.

The **Conservation and Recovery of North America's Imperiled Freshwater Fauna & Ecosystems** symposium is a transboundary team effort by Shawn Staton statons@dfo-mpo.gc.ca and Becky Cudmore cudmoreb@dfo-mpo.gc.ca with Noel Burkhead noel_burkhead@usgs.gov of the USGS Florida Integrated Science Center

Carol Ann Woody carol_woody@usgs.gov of the USGS Alaska Science Center is organizing the **Sockeye Salmon Ecology, Evolution, Life History, and Management -- A Special Poster Symposium**

The USGS and US Fish and Wildlife Service will host a reception and meeting for their scientists who attend the 2005 AFS Annual Meeting (Wednesday, September 14. 5:30-7:30 PM).

The **2006 VII International Congress on the Biology of Fishes** website is now up and running: www.mun.ca/biology/icbf7/index.html

Go to Great Links

USGS Information Transfer

Many media are available to get your scientific results out to the public, as well as your professional colleagues. Science Center websites offer a great opportunity to access or transmit information on scientific research results using many different approaches. Fact sheets are a convenient and easily distributed product. Posters are often provided on a website in a format appropriate for printing on common copier paper sizes. The following website links will guide you to information outreach product ideas of USGS scientists. Many examples are available to help produce similar media products that highlight your work.

The following are links to some current USGS information outreach products. If research keeps you too busy to develop a creative new product, cover plates from online publications can be enhanced with contact information and the web link to be used as a fact sheet.

Bookmarks

Florida Integrated Science Center
<http://fl.water.usgs.gov/Educ/Bookmarks.html>

Fact Sheets

Great Lakes Science
http://www.glsc.usgs.gov/main.php?content=products_publications_factsheets&title=Publication_s0&menu=products

Leetown Science Center
<http://www.lsc.usgs.gov/facts.asp>

Western Fisheries Research Center Fact Sheets
http://wfrc.usgs.gov/pubs/fact_sheet.htm

Printable Posters

Florida Integrated Science Center Posters
<http://cars.er.usgs.gov/posters/index.html>

Animations

Fort Collins Science Center
<http://www.fort.usgs.gov/products/presentations/presentations.asp>

Photos and other Images

Florida Integrated Science Center Posters
http://cars.er.usgs.gov/Center_Publications/Image_Archive/image_archive.html



Photo: USGS Florida Integrated Science Center

Gulf sturgeon *Acipenser oxyrinchus desotoi*

Share Your Expertise through the Fisheries and Aquatics Bulletin

Communicate your fisheries and aquatic resources items of interest to gain national exposure. Thanks to all those who contributed material to this issue of the FAB. Send articles and photographs with credits and captions to:

Robin Schrock robin_schrock@usgs.gov
FAER Asst. Program Coordinator

or *Jim Preacher*, *FAER Program Coordinator at*
jpreacher@usgs.gov.

<http://biology.usgs.gov/farp/index.htm>