

Southern Division News



Southern Division of the American Fisheries Society



Announcements 12 **Chapter Updates 15** **Research Interests 22**

Read about graduate opportunities, award winners, and how to get involved in the Fisheries Management Section

See what Southern Division chapters and student subunits are up to, including chapter meetings, outreach, and awards.

Learn more about trends in non-native fishes and what it's like to be a high school intern in some of our contributed articles.

The President's Message: AFS Diversity

John Jackson, SDAFS President

It seems to me that just a few years ago I was a graduate student at Mississippi State University, at the "top of my game," full of energy,



*"Proof that I can catch a fish now and then."
- AFS President John Jackson*

and always ready for another after-work beer at Flo and Eddies, the local hangout for fisheries and wildlife graduate students. Well time does move along too quickly. That was 18 years ago. I am a product of the 1961 spawn,



- | | |
|----------------|---------------------|
| Alabama | Puerto Rico |
| Arkansas | South Carolina |
| Florida | Tennessee |
| Georgia | Texas |
| Kentucky | Virginia |
| Louisiana | Washington D.C. |
| Maryland | West Indian Islands |
| Mississippi | West Virginia |
| North Carolina | |
| Oklahoma | |

Questions/Comments:
Sasha S. Doss
SDAFS Newsletter Editor
doss@vt.edu



“Someone once told me going to a Southern Division meeting is like coming home, and I couldn’t agree more.”

A note from the editor...

It was my first day in the field as a grad student. It was freezing cold, the wind was howling, and all I could think about was “what in the world is this for?” I was standing beside the boat, and tied to it was a small foot-and-a-half stick. It wasn’t a special stick. The bark was worn away and overall it was a pretty unimpressive twig. Why on Earth had it been tied to the boat, I thought. My field mate picked up this mysterious stick, dunked it in the gas tank, and said, “We’re good to go.”

That is how we tell how much gas is in the tank. And that is what I love about fisheries—the people. They are innovators in their own right. They are quirky, smart, instinctive, and always fun to be around. Someone once told me going to a Southern Division meeting was like coming home, and I couldn’t agree more. I am so happy to contribute to this wonderful group, and I hope the newsletter portrays just how like home the division really is.

- Sasha S. Doss

which puts me at 53 years old. Today I don’t have to hit the F10 button and wait overnight to run a simple statistical test in SAS or hope the departmental secretary has finished typing my revised thesis. However, my flip phone with no camera still works just fine and I seem to survive and thrive without a smart phone despite what my daughters tell me. Today’s students and young professionals bring a new set of skills and new perspectives to fisheries. We need their refreshing approaches and increased diversity in AFS.

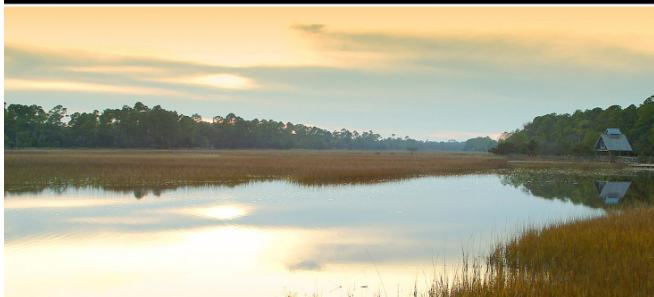
The American Fisheries Society should take great pride in the diversity of its membership. We come from a range of social, educational, and professional experiences with a shared mission that we express in many different ways. Our membership is temporally diverse. We are eager students, young professionals, seasoned mid- and late-career pros, and retired reflectors. We share our diversity of ideas and approaches during meetings, chapter activities, student subunits involvement, committee membership, continuing education opportunities, publications, and oral presentations. I encourage all of us to contribute to AFS diversity. Participate, join a committee, attend a meeting, present your research or management stories, and most important, develop life-long friendships. Take an active role and become a mentor to a student or young professional. You will not regret it.

See you in Savannah!



A father-daughter trout fishing trip on the White River, Arkansas

Meeting Announcements



Southern Division of the American Fisheries Society 2015 Spring Meeting in Savannah Georgia

The Georgia Chapter of the American Fisheries Society would like to invite you to Savannah, Georgia for the 2015 Southern Division AFS meeting from January 29 - February 1, 2015. The city of Savannah, located on the banks of the Savannah River, is one of the crown jewels of the South. Founded in 1733, there are a wealth of things to see and do in and around the city. The meeting will be held at the Hyatt Regency Savannah, which is situated in the heart of the city's historic district. The hotel is also centrally located on River Street, which is filled with shops, restaurants, and bars. No matter what your interests, we're certain that Savannah offers something for you to enjoy!

We have an excellent meeting planned for you, with numerous diverse workshops, symposia, and presentations. Social events during the meeting will provide opportunities to catch up with old friends and colleagues and to meet and interact with new ones. Our Saturday banquet will be held on the riverfront and promises to be memorable.

A special note about registration and the meeting program itself: we will be utilizing a smartphone or tablet mobile app for the 2015-meeting program. More details coming, but we're excited about the opportunity to provide real-time updates on meeting events and cut down on our use of printed programs at the meeting. On the online registration form, you'll notice a spot to indicate if you still prefer a printed meeting program. We will have a limited number of extra printed programs at the meeting, so please be sure to indicate your interest during registration. Also, more information about the meeting is added weekly, so check the meeting website at <http://sdafs.org/meeting2015/> for updates and follow us on social media through [Facebook](#) and [Twitter](#).

Finally, if you or the organization you represent are interested in helping support the meeting as a sponsor, or if you are interested in participating in the annual tradeshow, sponsorship information can be found at <http://sdafs.org/meeting2015/sponsors/>. Donations can be made by credit card online or by check. Our meeting sponsors are the key to helping keep registration costs low, and sponsorship provides a great marketing opportunity and a way to show your support for the hardworking men and women of the Southern Division. If you have any questions, feel free to contact any of the members of the organizing committee for additional information (<http://sdafs.org/meeting2015/contact-us/>). **We can't wait to see y'all in Savannah!**

2015 Pollution Committee Meeting SDAFS - Savannah, Georgia - January 29th

The Pollution Committee of the Southern Division American Fisheries Society will be meeting at the 2015 spring meeting in Savannah on Thursday, January 29 from 8:30 am – 5:00 pm. Check the onsite schedule for specific room information.

Major agenda items

- Work on an update to Special Publication #30 entitled, *Investigation and Monetary Values of Fish and Freshwater Mussel Kills*
- Share information on causes, results, and investigation techniques of aquatic life kills among Southern Division member agencies, organizations, and individuals; and discuss approaches towards case resolution.

Who we are:

- Each state game and fish agency within the Southern Division appoints a state representative to the Committee. Any interested Southern Division member may join, or be appointed as a member-at-large.

Major accomplishments:

- Publication of standardized and scientifically defensible protocols for conducting fish kill investigations and assessing monetary damages resulting from these incidents.
- Publications are used by various state agencies and other professionals in North America
- Publication dates: 1970, 1975, 1976, 1982, 1986, 1992*, 2003*† (*In cooperation with the socioeconomics section. †Incorporated freshwater mussel methods & values in cooperation with the Freshwater Mollusk Conservation Society)

Participants needed:

- Pollution committee state representatives
- Individuals experienced with investigating kills of aquatic life
- Individuals experienced with assessing monetary values & damages for kills of aquatic life
- Individuals with experience in natural resource damage assessments



Southeast Connectivity Assessment Project (SEACAP) Fish Passage Prioritization Workshop SDAFS – Savannah, Georgia – January 30th

The Southeast Connectivity Assessment Project (SEACAP) will demonstrate the tool to assess and prioritize barrier projects in the SALCC area. You can choose either the morning or afternoon workshop available on Friday Jan. 30, 2015. We are hoping to have WIFI in the room so bring your laptop as you may have a chance to work with the database and use the functions available for a custom analysis based upon your criteria.

Meeting details are on the web page <http://sdafs.org/meeting2015/> and registration for the workshop is in the lower half of the meeting registration form <http://sdafs.org/meeting2015/registration/>.

Fragmentation of river habitats by dams is one of the primary threats to aquatic species in the United States. Barriers limit the ability of sea-run fish species to reach preferred freshwater spawning habitats and prevent resident fish populations from moving among habitats critical to their life requirements. To help address this problem, The Nature Conservancy (TNC) and the Southeast Aquatic Resources Partnership (SARP) has completed an assessment of dams in the Southeast US. The project, funded by the South Atlantic Landscape Conservation Cooperative (SALCC), supports planners and managers in their efforts to target fish passage and other aquatic connectivity projects where they have the most benefit.

The Southeast Aquatic Connectivity Project identified opportunities to improve aquatic connectivity by prioritizing dams based on their potential ecological benefits if removed or bypassed within watersheds that intersect the SALCC area. The project area is ~ 250,000 sq. miles with over 350,000 miles of mapped streams. Approximately 16,000 dams were located in GIS and evaluated based on a suite of metrics: number of river miles opened by a passage project, number of downstream dams, presence of diadromous or resident fish species and metrics which assess watershed and stream ecological conditions. Metrics are combined to produce a relative prioritization and displayed in an interactive web map with a custom analysis tool for running user-defined scenarios. Attendees will learn how to run the interactive web map and filter data for custom analysis. They will be able to prioritize passage projects within their state or watershed of interest. **If you have, any questions contact John Kauffman at john@southeastaquatics.net.**



AMERICAN FISHERIES SOCIETY
PORTLAND, OREGON
145TH ANNUAL MEETING
AUGUST 16-20, 2015

The Oregon Chapter and Western Division of the American Fisheries Society cordially invite you to attend the 145th Annual Meeting that will be convened in Portland from 16 to 20 August 2015. A diverse program, unconstrained by a single theme, will feature the latest scientific knowledge, management applications, policy implications, and educational pursuits related to freshwater and marine resources.

The city of Portland is blessed with an abundance of diversity and an appealing laid-back and relaxed pace. The downtown area of Portland offers unique experiences and endless activities from wine bars in historic buildings to art galleries housed in modern buildings. The city is repeatedly ranked as one of the best walking cities in the United States. It is this walkability that will allow you to easily visit the countless restaurants, food carts, microbreweries, distilleries, and coffee shops that have led to Portland being recognized for its outstanding culinary and beverage scene. Portland and the surrounding Pacific Coast-Wine Country-Cascades-Columbia River Gorge landscapes provide endless opportunities for sightseeing, outdoor adventure, and fishing. The city of Portland and surrounding areas have something for everyone to enjoy in August 2015!

Save the Date

2015

*For the Southeastern Association of Fish and
Wildlife Agencies 69th Annual Conference.*

November 1-4, 2015

*Renaissance Asheville Hotel
Asheville, North Carolina*

seafwa.org • ncwildlife.org



EXPLOREASHEVILLE.COM

Meeting Announcements



Protecting Rivers and Lakes in the Face of Uncertainty

Don't miss out on your chance to attend one of the most dynamic and informative workshops ever offered by the Instream Flow Council.

Flow 2015 features:

- A powerful line-up of presenters from around the globe
- A suite of pre-workshop technical training sessions led by recognized experts
- Professionally facilitated discussion sessions to draw on experiences and views of attendees
- Abundant networking opportunities to form valuable professional and personal contacts

Multidisciplinary and interjurisdictional:

The workshop is specifically organized to provide skills and understanding for scientists, policy makers, engineers, lawyers, municipalities, and industry to participate more effectively in flow and water level projects. Sessions will focus on laws, policies, and methods used to manage uncertainties faced by:

- Federal regulatory agencies in the U.S. and Canada
- State and provincial fish and wildlife agencies as well as
- Nongovernmental organizations, industry, and municipalities

At the leading edge:

Attend a special session focused on new and evolving methods for quantifying flow and lake level needs such as probability models and holistic ecosystem assessments.

Location, location, location! FLOW 2015 will be held in the beautiful city of Portland, Oregon on April 28-30, 2015. Our host hotel is the [Red Lion on the River, at Jantzen Beach](#), where special room rates are available. Registration and rooms are limited and will fill up fast, so book your room now at [Red Lion on the River lodging for FLOW 2015](#). Check out the program and register at the [Instream Flow Council](#) webpage by navigating to the FLOW 2015 workshop webpage (www.instreamflowcouncil.org/flow-2015). You can also learn about [poster presentation opportunities](#) and options for [sponsoring or exhibiting](#) at the event.

Register by midnight (EST), February 20 and take advantage of the reduced early registration price!

Committee Updates

Resolutions Committee
Warmwater Streams Committee
Catfish Committee

The Resolutions Committee: Resolution on the Use of Off-Highway Vehicles in Streams

The Resolutions Committee has developed the resolution printed below on the use of off-highway vehicles in streams, which will be voted upon at the SDAFS Business Meeting in Savannah, GA on January 30, 2015. This resolution has been revised based on comments received and has also been posted on the SDAFS website at <http://sdafs.org/resolutions/>.

WHEREAS, off-highway vehicles (OHVs) and off-road vehicles (ORVs) are popularly defined as all-terrain vehicles, commonly known as ATV's, motor cycles designed for off-highway use, 4-wheel drive jeeps, automobiles or sport utility vehicles and other vehicles specially designed for off-road use (Stokowski and LaPointe 2000; Cordell et al. 2005); and

WHEREAS, according to industry and government reports, (cited in Cordell et al. 2005), the number of off-highway motorcycles and ATV's in the United States reached 8 million in 2003, with ATV's accounting for 70% of that number; and

WHEREAS, surveys in 1999-2004 documented that between 18-24% of Americans or 39-51 million people 16 years of age and older participated in OHV recreation one or more times within a year of the survey date (Cordell et al. 2005) and there were 15.6 million residents of states in the Southern Division-AFS geographical area who indicated they were OHV recreational users in those surveys (data from Cordell et al. 2005); and

WHEREAS, these OHV users are two times more likely to participate in fishing and three times more likely to participate in hunting than the general public participation rate (Cordell et al. 2005); and

WHEREAS, we recognize and affirm that OHVs are needed to cross streams by those working in --- but not limited to --- agriculture, ranching, livestock production, mining, oil, gas and mineral exploration and extraction, electric power, water and wastewater transmission, pipeline construction, and telecommunication cable services. All these activities share a common purpose which allows OHV use when necessary but not solely for recreational pursuits; and

WHEREAS, we recognize and support the rights of of private property owners to secure and protect their land and water resources from unsolicited, unwanted or unlawful use by others; and

WHEREAS, ORVs can traverse small streams which are found in abundance throughout the United States. The scientific findings regarding the negative effects of these vehicles across a broad expanse of North American streams have been well documented (Stokowski and LaPointe 2000; Ouren et al. 2007); In general, the impact of ORV use in streams is one of habitat degradation, which largely determines the structure and persistence of aquatic communities. In many streams, degradation has a simplifying effect upon the aquatic biota, reducing species diversity, and trophic interactions. Some species are unable to adapt and disappear from the modified environment; and

WHEREAS, in a study of impacted and unimpacted sections of the Nueces River, Texas, Garrett (2001) found obvious impacts to the physical habitat at the site used by ORVs, including a heavily scoured appearance and lack of aquatic vegetation at the impacted site. They found significant differences in the fish communities between the two sites. The impacted site had less than half of the number of fishes found at the unimpacted site, and the species compositions were significantly different. Pollution tolerant species dominated the fish community, species requiring edge habitats were missing, environmentally sensitive species were in greatly reduced abundances and sport fishes were not abundant at the impacted site; and

WHEREAS, ORVs damage streams by breaking down stream banks and damaging riparian vegetation along and in the stream course. This results in erosion, siltation and the prevention of bank stabilization, which increases the potential for other water pollution impacts (Harrison 1980; Wilshire 1983, Edwards and Burns 1986, Allan 1995); and

WHEREAS, damage to stream beds and banks and increased siltation from ORVs may further impact fishes by changing the local temperatures of streams, causing extreme temperatures to increase. Many fishes rely on certain temperature changes for reproduction, and the increased temperature variability can lead to population decreases (U.S. Department of the Interior and U.S. Department of Agriculture 1999). Other changes resulting from disturbances from ORVs include changes in stream benthic communities and community organization (Peterson 1994; Buzby 1998, Covich et al. 1999); and

WHEREAS, when ORVs are driven near streams, they can cause damage to riparian vegetation. Payne et al. (1983) recorded a direct relationship between the number of trips over an area and the amount of damage to vegetation; up to 99% vegetation loss

resulted after 32 passes with an all-terrain vehicle. Vegetation loss was found to carry over into subsequent years and, after one year, up to 85% of all-terrain vehicle tracks were still visible. Some tracks were still evident two years after the last passage of an ORV; and

WHEREAS, during low water conditions, some recreational ORV users use the stream course as a trail, travelling along the stream bed, instead of merely crossing the stream; and

WHEREAS, the conservation group, Tread Lightly!, recommends that ORV users “avoid sensitive areas such as meadows, lakeshores, wetlands, and streams” and ORV advocacy groups, such as the All Terrain Vehicle Association, recommend only crossing streams at designated fording points and at 90° angles to lessen environmental impacts; and

WHEREAS, because of prior evidence of damage from ORVs, their unregulated use on federal lands has now been restricted. Executive Orders 11644 and 11989 (signed by Presidents Nixon in 1972 and Carter in 1977, respectively) were issued to "ensure that the use of off-road vehicles on public lands will be controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands; and

WHEREAS, ORV impacts on aquatic ecosystems and stream dynamics are so significant that the states of Georgia, Louisiana, Mississippi, Missouri, and Texas, have either banned or severely restricted the recreational use of ORVs in stream beds; and

WHEREAS, the Texas and Louisiana Chapters of the AFS have adopted policy statements on the use of ORVs in streams in 2002 and 2013, respectively; and

WHEREAS, it seems prudent that similar concerns be expressed for the impact of OHVs/ORVs on all streams

within the geographical boundaries of the Southern Division, American Fisheries Society, therefore be it;

RESOLVED, that the members of the Southern Division, American Fisheries Society, assembled at their annual meeting on this 30th day of January in the year 2015 at Savannah, Georgia strongly recommend that state fish and wildlife agencies and state environmental permitting agencies --- while respecting existing private property rights -- hereby promulgate and enact state laws and state regulations as they deem appropriate to prohibit the recreational use of OHVs along stream courses and to severely restrict stream crossings by recreational OHV users in order to protect and conserve the integrity of these waterway habitats and the flora and fauna inhabiting them.

Warmwater Streams Technical Committee

J. Brian Alford, Chair

The Warmwater Streams Technical Committee had a very productive 2014. During the Spring meeting of the Southern Division of AFS in Charleston, SC the Committee hosted a workshop titled *Instream Flow Science To Support Warmwater Stream Management*. This workshop was designed to introduce methods for assessing in-stream flow and to provide attendees practical information on how to conduct their own assessments. The Committee organized another training workshop at the Southern Division AFS 2015 meeting in Savannah, GA titled *Standardization and Management of Fish Data for Rivers and Streams of the Southern U.S.* The workshop disseminated information and recommendations for standardizing fishery-independent data collection and reporting from monitoring programs, which will allow researchers the opportunity assess condition of stream biota and carry out scientific studies at broad spatial scales. The Committee organized a

symposium at the 2015 Southern Division AFS meeting titled *Meeting our Data Needs with Limited Resources: Recent Advances in Stream Sampling Techniques*. The Keynote speaker was Dr. Mary Freeman from the University of Georgia. Topics included addressing uncertainty in sampling of warmwater stream biota and habitat, data quality, in-stream flow techniques, classification schemes for warmwater streams, sampling techniques for rare fishes (e.g., eDNA), new aerial, side-scan sonar, and video techniques for assessing stream fish, angling effort and habitat. There were also talks on crayfish sampling techniques and trawling techniques for assessing fish assemblages and invasive Asian Carp. The Committee created a new website this year to make it fresher and more user-friendly, and it contains annual round table discussions of research and management issues relevant to all the southeastern U.S. states, as well as digital copies of past symposia at the following web address <http://sdafs.org/wwstreams/management-and-research-activities/>. The Facebook page for the Warmwater Streams Committee, provides up to date, interesting, and fun tidbits of information (including videos) regarding current management and conservation issues for warmwater stream resources in the southeastern U.S. You can “like” us at www.facebook.com/WarmwaterStreams. Finally, the Committee would like to announce the 2015 winner of the Jimmie Pigg Memorial Outstanding Student Achievement Award. This year’s winner is Mr. Tomas Ivasauska from North Carolina State University. Tomas is working towards a PhD under the direction of Dr. Tom Kwak, and he is researching the habitat utilization and early life stage swimming performance of the rare Sicklefin Redhorse (*Moxostoma* sp.).

Catfish Management Technical Committee

The Catfish Management Technical Committee (CMTC)'s mission is to provide a forum for data and technology exchange to enhance the management, conservation, and awareness of catfishes and their habitats. The CMTC continues to be a very active and engaged group of students and professionals with several activities occurring in the past year.

In conjunction with the 2014 Southern Division meeting in Charleston, South Carolina, a catfish age and growth techniques workshop was held on January, in which 22 students and professionals attended. Chair at the time (Bob Greenlee-Virginia Department of Game and Inland Fisheries), (Scott Lamprecht-South Carolina Department of Natural Resources) and Dave Buckmeier-Texas Park and Wildlife) did an excellent job of helping host and teach the workshop. Several other state representatives on the catfish committee panel gave presentations and shared their expertise in an ever-growing field. Participants at the workshop learned various techniques with hands-on extracting and preparing of catfish structures (both otoliths and spines). Guidance on the appropriate use of aging structures (otoliths v. spines) and training in reading aging structures was also provided.

Also, South Carolina Department of Natural Resources (DNR) Fisheries Chief, Ross Self invited Georgia DNR Fisheries Biologist, Tim Bonvechio to lead a low frequency electrofishing workshop, as well as assist with age and growth collection of flathead catfish in South Carolina. The 3 day-workshop was held from June 23rd to 25th, 2014 at the Gresham wildlife management area in Gresham, South Carolina, involved both a classroom and field

application. On the first day, Tim gave a presentation on the successful use of modified low frequency electrofishing equipment targeting the invasive flathead catfish on the Satilla River in Southeast Georgia. On the second and third days of the workshop, Tim and several South Carolina DNR fisheries professionals unleashed several catfish electrofishing boats on the Little Pee Dee River in an effort to collect an age and growth sample from the well-established, non-native flathead catfish population. The results of this endeavor will be discussed at this year's Catfish management technical committee meeting in Savannah, Georgia. This particular workshop for these 2 state agencies was originally spawned as a result of discussion in the catfish management technical committee meeting 2 years before in Nashville, Tennessee.



Pictured are fisheries biologist Jason Marsik (left) and Tim Bonvechio (right) with a few of the flathead catfish captured from the Little Pee Dee River, South Carolina.

Announcements



Fred Harris Receives Prestigious Award

Fred Harris, former interim executive director of the N.C. Wildlife Resources Commission, recently received the Clarence W. Watson Award in recognition for his contributions and service to fish and wildlife conservation in North Carolina.

Harris received the 2014 Clarence W. Watson Award at the Southeastern Association of Fish and Wildlife Agencies' annual meeting in Destin, Fla., in October. The award is the association's most prestigious honor, recognizing the career individual who has made the greatest contribution to wildlife or fish conservation in areas of wildlife management, fisheries

management, research, law enforcement, administration, or information and education. SEAFWA presented Harris the award jointly with the Southern Division of the American Fisheries Society and the Southeastern Section of the Wildlife Society.

Harris, of Fuquay-Varina, worked for the Wildlife Commission for 36 years before retiring in 2008. He began his career with the agency in 1972 as a district fisheries biologist, working his way up through the ranks to become chief of the Division of Inland Fisheries in 1986. Because of his reputation and skills as a leader in conservation, Harris was promoted to Assistant Director of the Commission in 2004 and

Interim Executive Director in 2007, where he focused on integrating wildlife diversity, climate change effects and priority habitat conservation into daily fish and wildlife management decisions.

Throughout his career, Harris advocated aquatic resource conservation. He directed and supported projects that promoted the wise stewardship of fisheries and aquatic resources and projects that were based on good science.

"Fred always demanded good science from his biologists and he encouraged staff to present and publish conceptual papers that stimulate critical thinking and expand the boundaries of

fish and wildlife science,” said Bob Curry, chief of the Division of Inland Fisheries, who, along with Dr. David Cobb, chief of the Division of Wildlife Management, nominated Harris for the award. “Fred has the ability to quietly size up a problem or issue, identify potential solutions and then set about working tirelessly to bring resolution to a situation.

On any given day, Fred was known best for picking up the phone, calling his staff members for their opinions, and more times than not, implementing solutions that include the recommendations of his staff.”

While his accomplishments in the conservation field are many, it is his leadership style for which Harris is best known. Harris is recognized in conservation circles throughout the nation as a leader committed to ensuring the use of good science and professional development to empower staff and motivate employees to perform at maximum capacity.

“It would be difficult to find anyone in a natural resource management agency who has coached and inspired more upcoming resource managers than has Fred Harris,” Cobb

said. “Fred’s reputation as a life-long leader and an innovator in state, regional, national and international resource conservation is known far and wide.”

A certified fisheries scientist, Harris is a past President and a life member of the American Fisheries Society, the world’s oldest and largest organization dedicated to strengthening the fisheries profession, advancing fisheries science, and conserving fisheries resources. He received the AFS Southern Division’s Outstanding Achievement Award in 1992 and the AFS Distinguished Service Award in 1998.

Graduate Position Available

Title:
Graduate Assistantship in Coastal Sciences offered by the University of Southern Mississippi’s Department of Coastal Sciences at the Gulf Coast Research Laboratory.

Location:
Gulf Coast Research Laboratory, Ocean Springs, Mississippi

Salary:
\$19,200 stipend plus tuition

End Date:
Until Filled

Description:

The Department of Coastal Sciences is pleased to announce the availability of two, one-year student research assistantships to prospective students seeking a Master’s or PhD degree. The department seeks candidates with an interest, expertise and experience in one of the four research areas represented at the laboratory: Coastal Ecology & Ecosystem Processes, Environmental & Organismal Health, Fisheries & Fisheries Oceanography and Aquaculture.

The intention of this announcement is to recruit highly competitive students to the University of Southern Mississippi’s Department of Coastal Sciences at the Gulf Coast Research Laboratory. Qualified applicants are strongly encouraged to contact one or more of the faculty members in the department (<http://www.usm.edu/gcrl/contacts/>) to discuss their research and educational interests prior to completing their applications for admission.

Academic requirements: Minimum GPA of 3.0, GRE verbal and quantitative percentiles of a minimum of 50%, and a 4.5 analytical writing score. Foreign students: minimum TOEFL percentile of 50%.



**FISHERIES MANAGEMENT
SECTION**

American Fisheries Society

<http://www.sdafs.org/fmsafs/>

My name is Jason Olive and I am the current Southern Division representative for the AFS Fisheries Management Section (FMS). For those who are not familiar with the FMS, the following description was taken from the section's webpage

(<http://www.sdafs.org/fmsafs/>):

The Section is composed of people who wish to develop, apply, and evaluate effective management concepts or techniques as well as programs in education and information to solve fisheries management challenges. The Section promotes the exchange of fisheries management information and the results of applied research among professionals, students, user groups, resource management agencies, and the general public

who share interest in fish and the habitats supporting them. The Section sponsors workshops, symposia, topical sessions at professional meetings, and special projects to examine fishery management challenges. Section membership provides a credible voice for a wide range of fisheries management issues. The Section continues active involvement with legislative initiatives as well as governmental and private-sector activities, which affect the quality and extent of all fisheries. Selection of activities for Section involvement results from individual member initiative.

Some of the FMS's priorities for the coming year are to complete the Virtual Hall of Excellence, to support the International Standard Sampling Symposium at the 2015 AFS Annual Meeting in Portland, and to engage young professionals in the Section. The FMS publishes a newsletter twice each year, and is always looking for content that is relevant to fisheries managers. So if you have completed a research project or have developed innovative management techniques that you think would

be of interest to fisheries managers across North America, please send those to me (jaolive@agfc.ar.gov) and I will submit them to the FMS newsletter editor. Another item of interest is that AFS has hired a Continuing Education Coordinator, Beverly Pike, and units have been encouraged to submit ideas or content to her for potential webinars. So if you have any fisheries management related ideas for webinars, please send those to Beverly.



Chapter Updates

Arkansas Chapter

The Arkansas Chapter of the American Fisheries Society is happy to announce their 29th annual meeting to be held in Benton, Arkansas the 25th – 27th of February, 2015. The meeting will take place at the Benton Events Center located at 17322 I-30 in North Benton, AR 72019 (www.bentoneventcenter.com) with hotel rooms available at the adjacent Fairfield Inn and Suites (501-722-6330). More information will be available on the Chapter website as it comes available (<http://sdafs.org/arkafs/AFS/>).

Florida Chapter

The Florida Chapter held its 34th annual meeting February 18 – 20th, 2014 at the Florida 4H-Camp in

Ocala National Forest. There were 106 Chapter members in attendance, including 28 students from five different universities. Fifteen of the students applied for and received travel grants from the Chapter, which covered their meals and lodging at the meeting. We had 53 total presentations (36 oral, 17 poster) with students presenting 19 of those.

The symposium was titled ‘Research and Management: Tag Team Titans’ and provided us with talks about how researchers and managers are working together to get the best data possible. Luiz Barbieri (FWC) and Jason Dotson (FWC) started off with a tag team keynote followed by eight more tag team talks and six solo

symposium talks. At the end of the day there were a lot of comments about the quality of the talks, and hopefully this symposium opened up doors for more communication and collaboration and gave those who attended some useful information to use in the future. Thanks to all the symposium presenters for taking the time to make the symposium a success.

As usual, the highlights of our business meeting were the awards presentations. Each year, the Chapter gives two students a

plaque and \$500 check through the Roger Rottmann Memorial Scholarship. This scholarship was established to recognize outstanding students enrolled in a Florida university or college, who are working toward a graduate degree related to fisheries sciences. The scholarship is in memory of Roger Rottman, one of the first fisheries biologists hired by the State of Florida University System. Recipients of this year's Rottmann Scholarship included Ross E. Boucek (PhD Candidate, Florida International University) and Nicholas W. Cole (Masters Student, University of Florida).

Bob Wattendorf (FWC) received the Rich Cailteux Award, which recognizes individuals for their career contributions to the fisheries profession, mentoring or young fisheries professionals, and involvement and leadership with the Florida Chapter. Bob has devoted his career to freshwater fisheries management & promoting freshwater fishing in Florida. He joined the Florida Game and Freshwater Fish Commission in 1979 and spent his first years working on non-native fish, eventually becoming involved in projects involving Triploid Grass Carp. He adapted the Coulter Counter System for the first rapid and practical certification of Triploid Grass Carp. He was the

Assistant Division Director of the Florida Game and Freshwater Fish Commission Fisheries Division from 1985 to 1996 and has spent many years as the freshwater Federal Aid in Sportfish Restoration coordinator. Bob has stayed busy promoting freshwater fishing through marketing and special projects with FWC and was a key figure in developing the five-year fishing license, an incentive program which has successfully increased license sales. Bob has been instrumental in the promotion of the Big Catch and Trophy Catch statewide angler recognition programs. He has served as both facilitator and Chairman with Get Outdoors Florida, and is the coalition's current secretary. Bob is also the current President of the Florida outdoor Writers Association. It was the honor and privilege of the chapter to name Bob as the 4th recipient of the Rich Cailteux Award.

The Jack Dequine Best Student Paper Award went to Ed Camp (UF). Ed is a PhD student and gave an excellent presentation titled 'Evaluation of potential stock enhancement of Florida's red drum recreational fishery: an integrated modeling approach'. Ed received a plaque and a \$100 check through the award. The award for the best professional

paper went to Nick Trippel (FWC/FWRI) titled 'Impacts of angling for nesting Florida Bass, *Micropterus floridanus*, on nest success and recruitment'.

Our student subunit has received the AFS Outstanding Student Subunit Award for 2014. They submitted an application detailing their many activities: a collaborative research paper, a blog called "From Reefs to Rivers" (<http://floridafisheriesscience.blogspot.com/>), creating science videos, outreach to schools, and much more. The EXCOM and I are so very proud of all that they had accomplished. The sub-unit received the award at the Quebec City Annual Meeting in August.

The Florida Chapter will hold its 35th annual meeting February 17 – 19th, 2014 at the Florida 4H-Camp in Ocala National Forest. This year's symposium is titled 'Fisheries-dependent vs. fisheries-independent: common ground, dissimilarities and insights gained' and will focus on how fisheries-dependent and fisheries-independent data are used to tackle important ecological and management questions. More information about our 35th annual meeting can be found at our website <http://www.sdafs.org/flafs/> or our newsletter 'The ShellCracker'.



North Carolina State University Student Subunit - By Tomas J. Ivasauskas

Do you know what television show featured Blinky the One-Eyed Fish? Do you know the difference between a placoid and ganoid scale? Can you identify a Spotted Bass *Micropterus punctulatus*? Members of the North Carolina State University Student Fisheries Society (NCSU SFS) demonstrated their knowledge of these and other topics during the fisheries-themed trivia game that was hosted at the first meeting of the spring 2014 semester.

During each of the 8 monthly meetings held this year, the SFS discussed subunit activities, recent events, and chapter news. In addition to fisheries-themed trivia, meetings featured speakers and events to inspire interest in fisheries research. Professionals discussed important water quality and habitat issues threatening local waterways, as well as current research. Through hands-on experience with vouchered specimens, a professional astacologist taught us how to identify crayfish. Brena Jones, the current president of the NCAFS, presented her 'State of the Union of Fisheries,' which detailed the history of AFS and NCAFS, current issues, and the benefits of being a member. All of our members also had the opportunity to formally introduce themselves through a series of 'about me' presentations.

In 2014 we strived to uphold the level of commitment SFS has always shown to our community and remained willing and ready to take on new outreach events. We participated in two events aimed at introducing children, many from the inner-city, to the pleasures of fishing. SFS maintained an educational booth at the grand opening event of Field and Stream, and engaged store patrons in a



friendly and knowledgeable manner. Two days were spent removing trash from Rocky Branch Creek, our adopted stream that flows through campus. Additionally, we participated in the 'NC Big Sweep,' cleaning litter from Umstead State Park.

When SFS was contracted by the Country Club of the Carolinas to reduce pickerel populations in their community fishing pond, members gained experience using boat electrofishing and interacting professionally with the public. Although many of us are skeptical about the long-term ecological effects of this removal, country club residents were delighted to see that management actions were being taken on their pond. Furthermore, it provided an opportunity to educate curious residents about the pond's fish assemblage and ecology. The gracious donation made in exchange for our services will be used to fund club activities.

In collaboration with the NC Museum of Natural Sciences' Shad-in-the-Classroom program, we conducted dissection-based comparative anatomy labs with 7 classes at 5 schools. Fish used in these dissections were those removed from the (aforementioned) community fishing pond. We really enjoyed assisting with this educational

program and hope to continue to do so in future years. During a dissection-lesson at Broughton High School in Raleigh, a class of juniors and seniors dissected 12 fish belonging to 2 species; despite the shrieks of horror when the slimy specimens were presented and several subsequent fish beheadings, all 20 students gained an understanding of the internal and external anatomies of fish and learned to appreciate the adaptations that make fish interesting!

Another important part of the SFS experience is attending conferences and disseminating the results of our members' research. During this past year, our members prepared and delivered over 20 oral presentations and posters. We attended and presented at a number of official conferences, including the Annual Meeting of the AFS (Quebec, Canada), the Spring Meeting of the SDAFS (Charleston, SC), and the 25th Annual Meeting of NCAFS (Durham, NC). Members were actively engaged in the conservation and recovery of endangered species: we shared and discussed research with the Robust Redhorse Conservation Committee and the Sicklefin Redhorse Species Status Assessment. We also presented our research directly to

stakeholders, at Trout Unlimited and Musky Angler Club meetings. Many of our members received funding for travel from grants offered through our club, NCAFS, SDAFS, and the Parent Society; we are very grateful for the generosity of individuals and organizations that make such support available.

We are looking forward to 2015! The incoming executive committee is excited about carrying on SFS's tradition of excellence and making the club even better. We have scheduled a fish identification workshop with two of the triangle's best fish taxonomists (Gabriella Hogue and Brynn Tracey), and we are working on a collaboration with Duke University's fisheries club to host author Paul Greenburg. Because we understand the importance of public education and outreach, we established an ad-hoc committee that will go into effect in 2015 and will be devoted to actively seeking out such opportunities. Meetings are held the second Tuesday of every month at NCSU; if you are in the area, please feel free to stop by and learn about what we are up to!

Oklahoma Chapter

The Oklahoma Chapter has set the date and location for its annual meeting to be held joint with the Oklahoma Chapter of The Wildlife Society February 11-13, 2014. The Meeting will be held at the Hyatt Regency in downtown Tulsa. Abstracts and registration are due January 15. More information may be found at <http://sdafs.org/okafs/upcoming-meetings/>

Oklahoma Student Subunit

The Oklahoma State University (OSU) AFS student subunit has been extremely productive over the past semester. Myself and my fellow officers wanted to focus on three main goals this year: expanding our membership's education and skillsets in fisheries, performing outreach activities to educate the public about fisheries and aquatic ecology, and fostering camaraderie within our group. Our meetings this semester have been well-attended by graduate and undergraduate students with a diverse background of study disciplines.

In terms of expanding our education in fisheries, we were fortunate to host two excellent guest speakers this semester. A Ph.D. student at OSU, Robert Mollenhauer informed us about his research that incorporates the

use of fish traits into a sampling efficiency study of Ozark stream fishes. Dr. Michael Tringali, a research scientist with the Florida Fish and Wildlife Research Institute, educated us on the use of genetics to address the taxonomy and conservation of black bass species. To improve the fisheries-related skillsets of our membership, our group has functioned as a mediator to connect undergraduates and others seeking field experience to get involved in the ongoing research efforts of our graduate students. To close out the semester, we also held a screening and discussion of a fisheries-related documentary.

The subunit's involvement in outreach activities has expanded, as we have been involved with kids fishing events, nature expos, and departmental outreach events. Members assisted the local Sierra Club Nature Camp, taking children fishing and teaching them the importance of our aquatic resources. We also created an extensive educational display for the Oklahoma Department of Wildlife Conservation's annual Wildlife Expo. Our members created several posters highlighting the diversity of fishes occurring in several ecoregions of the state. Accompanying these posters were

aquaria featuring fishes and crayfishes from each ecoregion. To assist in departmental student recruiting efforts, we contributed an aquaria with native sportfishes to the department's wildlife display. In addition to these outreach activities, we have also attempted to give back to our parent chapter, the Oklahoma AFS Chapter. We created an improved template for the chapter's Lateral Line Newsletter, complete with a marked increase in relevant content. Our members also designed and created a new digital logo for the state chapter.

Last but not least, camaraderie within our group is also very strong. Our group, along with several other student clubs, hosted an annual departmental cookout and all had great fun. We also created a Facebook group for our members to interact and share fisheries-related content. We are planning a float-and-fish trip when warmer weather returns, and cannot wait for our first meeting of the Spring 2015 semester!

University of Tennessee Knoxville Student Chapter

Last spring The University of Tennessee at Knoxville's Wildlife and Fisheries Society welcomed a new advisor, Dr. Brian Alford. We have been working closely with him to improve our fisheries activity through volunteer work and campus research. This semester we have volunteered with the Tennessee Valley Authority as they have conducted Biotic Integrity sampling, which gave some of our members valuable experience with field techniques such as backpack electroshocking, seining and data collection.

A new project we have set up on campus is a lake sturgeon care project, which involves a team of students active in the chapter feeding and looking after two eight year old sturgeons. We have set this up in a classroom on our campus, which will provide us with experience caring for an endangered aquatic species as well as an education project for years to come.

Our chapter held its first annual Fall Fish Fry on November 1st for its members and their families in order to fundraise for future fisheries projects within the society. This provides a time for students and faculty to come together and enjoy a good meal while supporting our undergraduate work opportunities. We will be hosting our Annual Wild Game Dinner on February 7th 2014.

Due to our hard work and many accomplishments this year, our chapter was recently awarded Student Chapter of the Year at the Southeastern Association of Fish and Wildlife Agencies.



Caylor Romines (President) and Nathan Wilhite (Vice President) accepting Southeastern Chapter Of the Year Award

Members volunteering with TVA at Lenoir City High School educated students about native darters and sampled Town Creek. Left is sampling equipment used to conduct an Index of Biotic Integrity, and the endangered flame chub, Hemitrema flammea.



Tidewater Chapter

The 29th Annual Meeting of the Tidewater Chapter of AFS will be held March 5-7, 2015, in Pine Knoll Shores, NC. The meeting will kick off on Thursday afternoon with a poster reception in the “Freshwater Gallery” of the Pine Knoll Shores Aquarium. Oral presentations will be held all day on Friday, with the dinner banquet being held that evening in the “Saltwater Gallery” of the aquarium. Oral presentations will continue Saturday morning, and the meeting will conclude at noon.

More information on the meeting can be found on the Tidewater Chapter website at:

Website at:
http://www.sdafs.org/tidewater/AFSTidewater/Annual_Meeting.html. We anticipate early registration and abstract submission will open in mid-December 2014. The Tidewater Chapter especially encourages abstract submissions from students, who are eligible for Best Student Poster and Best Student Oral Presentation awards given out at the meeting.

North Carolina Chapter

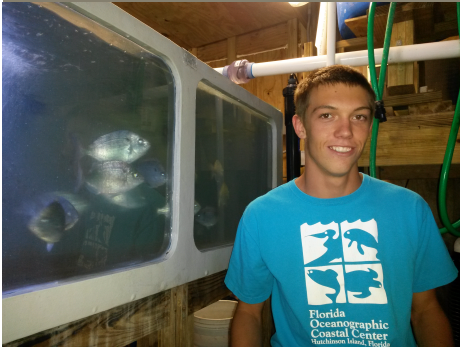
Our annual Chapter meeting is coming up on the 24-25th of February, 2015 in Carolina Beach, NC. Details & registration can be

found here:

<http://nc.fisheries.org/2015-ncafs-meeting/>

Additionally, all of our past newsletters are archived on the new site & most recent chapter updates, including our 2014 Student Travel Award winners, and NC research updates, can be found in our Fall 2014 issue: <http://nc.fisheries.org/newsletters/> (full Fall 2014 issue: <http://nc.fisheries.org/2014/11/10/fall-2014-newsletter/>)

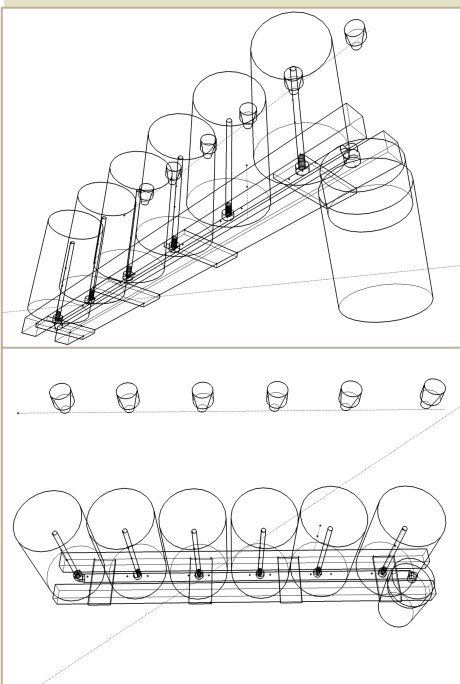
Contributed Articles



“Not in my wildest dreams did I expect to find myself as both a researcher and engineer in aquaculture or to get a chance to work in the subject area that I am so passionate about.”

- Ben Wisenhaupt

Ben Wisenhaupt is a senior high school student who interned at Live Advantage Bait, LLC. Here, he describes his experience as an intern. Below are a couple of sketches of his engineering invention.



An Unexpected Summer – Swimming with Rotifers

Ben Wisenhaupt

When most people think of a fun and interesting summer, they would imagine pristine beaches, gorgeous vistas, and endless adventures. Ask a typical high school student to describe their perfect summer, and words to that effect are bound to come up. And if you would've asked me that same question less than a year ago, my answer would've included many of those social norms. Yet, I found myself spending the summer before my senior year of high school in an advanced research environment learning more than I could have ever imagined, both from the incredible people I worked with and from the marine animals themselves. If you were to ask me that question again today, there's nowhere I'd rather be than in that same little building, engineering new and more efficient ways of managing different species.

As the rotifer researcher for Live Advantage Bait LLC (and Team OCEAN Intern with Florida Oceanographic), I was asked to first stabilize the densities, second increase the consistent density,

and third automate as the process. For a 17 year old with no true aquaculture experience, the task should have been quite daunting. Luckily, a combination of growing up in the water, a lifetime of tackling challenges, and an amazing mentor, provided more than enough confidence to step up to the plate. Over the course of the next several months, all of those goals were surpassed. I found a way to vent my passion for the water into a worthwhile cause, and the results spoke for themselves.

After a long series of attempts and failures, the rotifers were consistently in very high densities. Steps one and two had been successfully completed. Not unexpectedly, step three proved to be the most difficult and time consuming. For construction, I had only wood scraps, various PVC pipes, and some pool cleaning style barrels/materials. It went surprisingly well. With only a few minor hiccups, the design was up and running, and the process automated. As for the design itself, it has many convenient perks.

One definite benefit would be that the system requires very little electricity, with the air pumps being the only part needing it; the rest is run by gravity. Five barrels

were placed shoulder to shoulder, all feeding into one drain, which subsequently ran into a barrel with a series of filters that first catches any waste/unwanted particles and then harvests the rotifers. The amount of water feeding into the drain for each barrel is dependent on the rate by which water is being added to each individual barrel; for this reason, rates can be monitored on a barrel by barrel basis. This allows for the growing of different types of rotifers in each bucket (or anything else that'll be harvested by the size filters installed in the harvesting bucket), so that feeds can be optimized for its individual purpose with great consistency while still being automated.

The water is added to the system by starting a siphon from the incoming water pump or reservoir to a container above each bucket (one per bucket). The water flow is regulated by plastic regulators available at most hardware stores. Each bucket has a tube running from the bottom of the bucket (make a hole in bottom of the bucket and attach the tubing there) to each barrel (make sure to run the tubing to the height of the water level wanted on the bucket first, or the bucket will simply drain out). After the OmniFeed™ is mixed, it was

poured into the bucket, and the system ran on like normal, except that food was present in the water added to the bucket. This results in a relatively slow feed over time, which has proven to be better for rotifer production and to reduce the amount of waste in the barrel.

Another perk to this system is that it allows for the harvesting of rotifers from any section of the water column. Since the basic system is simply a PVC pipe running straight up the center of the barrel as an overflow pipe feeding into the drain, another PVC pipe with a cutout that matches up the desired section of water column may be placed around the overflow PVC pipe and secured to the bottom of the barrel.

Around this time last year, my summer plans included relaxing, fishing, and surfing, especially after working long hours the entire previous summer. Not in my wildest dreams did I expect to find myself as both a researcher and engineer in aquaculture or to get a chance to work in the subject area that I am so passionate about. As I begin college applications and decisions, I am now entering with a much clearer understanding of what I want to do both during and after college. It is simply amazing how

heavily a simple opportunity can influence someone's perspective on what they would like to do in their lifetime.

Temporal trends in non-native fishes established in the continental United States

Gary C. Matlock
National Oceanic and Atmospheric Administration, Oceanic and Atmospheric Research, 1315 East West Highway, Silver Spring, Maryland 20910, USAE-mail: Gary.c.matlock@noaa.gov

Abstract

Management of non-native fish species is informed by monitoring their temporal and spatial distribution. There are few published analyses of temporal patterns of established non-native fish species. The objective of this study was to examine the utility of the American Fisheries Society's (AFS) lists of fish names for quantifying trends in the number of established non-native fishes as a first step in determining trends in the number of invasive fish species in the continental United States. As of the 2013 AFS list, there were 66 non-native species listed as established in the continental U.S., a 2.5-fold linear increase from 1970. All of the species, except two, established before 2013 persisted in 2013. The number of species added to each subsequent list increased

throughout the period. Eight species were added from 1970 to 1980, 14 from 1980 to 1991, 18 from 1991 to 2004, and 5 from 2004 to 2013. The number of listed non-native families increased linearly from 8 to 19 during the same period. Cichlids, cyprinids, and poeciliids were the most represented families (about 73% of the established species listed in 1970, 1980, and 1991, and about 56% on the 2004 and 2013 lists). Converting the trend in the number of non-native species into the number of invasive species is difficult because of lack of available impact information and the dependency on human perception and value.

Introduction

Humans affect aquatic ecosystems through intentional and unintentional introductions of species beyond their native range. When human-introduced, non-native species become established they change the ecology of their non-native range (Lockwood et al. 2013). Humans then impose value judgments (e.g., benign, undesirable, harmful, or beneficial) on the impacts of those changes to guide potential management responses. For example, impacts like reduced natural biodiversity, habitat modification, increased disease, and decreased human economies

and health are considered harmful (Olden and Poff 2005; Dudgeon et al. 2006; Rahel 2007; Pfeiffer and Voeks 2008). The United States government defines invasive species as non-native to a particular ecosystem (complex of a community of organisms and its environment) capable of propagation whose introduction by humans does or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council 2014). This definition recognizes that society does not pre-judge a non-native species as necessarily invasive. Beneficial impacts like increased food production, new or improved sport fisheries, biological control of other invasive species, enhanced ornamental industry, or increased species richness may also occur (Clarkson et al. 2005; Sagoff 2005; Galil 2007; Gozlan 2008). These non-native species may or may not be considered invasive.

Lockwood et al. (2003) provided a useful five-stage model for studying the process by which non-native species may be considered invasive. A non-native species is transported and introduced by humans beyond its native range, becomes established, spreads, and has human-perceived negative impacts. UNEP (2008) suggested that "trends in invasive alien

species” is a promising indicator of threats to ecosystems, and “number of invasive alien species in each country” may be a measure of the indicator. At the very least, these data might quantify the success of efforts to impede invasions by “keeping them out” (Simberloff et al. 2005). It is useful, therefore, to monitor the global distribution and impacts of non-native species to minimize harmful risks and capitalize on benefits of future introductions (Crossman 1991; Olden and Poff 2005). But, there are few published analyses of temporal patterns in established non-native fish species (Cohen and Carlton 1998; Lockwood et al. 2013).

Although there are some temporal data on non-native fish introduced into the U.S. (e.g., Nico and Fuller 1999; Fuller et al. 1999; Fuller 2003 for freshwater species), the number of invasive (i.e., harmful) fish species established in the U.S. is unknown. The rate of increase of established non-native fish species in the U.S., a necessary first step in determining trends in the number of invasive species in the U.S., has not been quantified. Courtenay and Hensley (1980) reported an exponential trend in the number of established non-native fish species (not restricted to invasive species) in North America from 1 in 1680 to 35 in 1980. Although they did not provide data for the U.S. separate from Canada, Welcome (1988) reported that 70 non-native fish species had been introduced into the continental U.S. by 1985, and 45 species had become established by 1989 (Crossman 1991). However, Nico and Fuller (1999) reported that 38 foreign freshwater species had become established in U.S. open waters by 1998 (an apparent decrease of 7 species in 10 years).

Data contained in the American Fisheries Society (AFS) lists of fish names may be useful in addressing this inadequacy. AFS has periodically published lists of non-native fishes established in the continental U.S. since the 1940s after forming the Committee on Common and Scientific Names of Fishes in 1948 (American Fisheries Society 1948). The Committee developed a list of common names of fishes occurring in the continental U.S. and Canada corresponding to accepted scientific names to achieve nomenclature uniformity. The only non-native species included in the first list were “Introduced Carps” (goldfish *Carassius auratus* (Linnaeus, 1758), carp *Cyprinus carpio* Linnaeus, 1758, and tench *Tinca tinca* (Linnaeus, 1758)). The Second Edition (American Fisheries Society 1960) included all native and successfully introduced species without distinguishing between the two groups. Since 1960, the lists have been updated five times (about every 10 years) and have identified separately native and non-native fish species established in each of the continental U.S. and Canada. The objective of this study was to use the AFS lists to quantify temporal trends in the number of established non-native fish species in the continental U.S.

Methods

The AFS editions of “Common and Scientific Names of Fishes from the United States and Canada” (Bailey et al. 1970; Robins et al. 1980, 1991; Nelson et al. 2004; Page et al. 2013) were used to tabulate, by year, all species listed as “Introduced” (species not native to the U.S. that are established within the geographic areas to which each list applied) into the continental U.S.. The AFS definition of “introduced” includes those species which are “established.” Therefore, I use the term “established” instead of “introduced” (i.e., species introduced but not established are not included). The 1970 and 1980 lists did not specify whether introduced fish were introduced into the U.S. or Canada or both, but later editions did. Information in the later editions was used to infer whether or not earlier introductions were applicable to the U.S. The number of species and families listed in each AFS edition were counted, and temporal trends of species and families were determined by fitting regressions using standard linear regression techniques (Draper and Smith 1966).

Results

There were 66 non-native fish species, representing 19 families, listed by AFS in 2013 as established in the continental U.S., about 2.5 times more than were listed in 1970 (Table 1). The number of species of non-native fishes increased linearly during the period 1970 through 2013, from 26 to 66 (Figure 1). The temporal trend is expressed as:

$$Y = -1938 + 0.997X$$

where Y = number of species and X = year. The regression explained 97.7% of the variation in the data (adjusted R²). The correlation between species and time was very high because all but five species included on any AFS list remained on all subsequent lists. Banded cichlid *Cichlosoma severum* (Heckel, 1840), was included on all lists except the 1991 list. Two species (*Bairdiella bairdiella* (Jordan and Gilbert, 1882) and orangemouth corvina *Cynoscion xanthulus* (Jordan and Gilbert, 1882)) listed before 2013 were extirpated in about 2006 from the Salton Sea, California, by increasing salinity and not included on the 2013 list (Page et al. 2013). Two unidentified species of Locariidae listed in 1991 were apparently re-identified as *Pterygoplichthys* spp. in 2004 (Nelson et al. 2004).

The number of new species added to each list, compared to the previous list, increased throughout the study period except for the 2013 list (compared to the 2004 list). Five new species were added from 2004 to 2013. In contrast, eight species were added from 1970 to 1980, 14 from 1980 to 1991, and 18 from 1991 to 2004 (Table 1).

Almost all non-native fish species were established in fresh water. Three species (chameleon goby *Tridentiger trignocephalus* (Gill, 1858), red lionfish *Pterois volitans* Linnaeus, 1758, and devil firefish *P. miles* (Bennett, 1828)) were not. The chameleon goby occurs in estuaries, and both *Pterois* spp. occur in the Atlantic Ocean and Gulf of Mexico.

The diversity of the families represented in the non-native fish community also increased about 2.5 times from 1970 through 2013 (Figure 1). The temporal trend is expressed as: $Y = -554 + 0.285X$, where Y = number of families and X = year. The regression explained 94.4% of the variation in the data (adjusted R²). Cichlids, cyprinids, and poeciliids were the most represented families during the 43-year record (Table 1). These three families accounted for 73% of the established species listed in 1970, 1980, and 1991, and about 56% of the species on the 2004 and 2013 lists. The family with the most species was cichlidae. They accounted for the most species on each list, increasing from 7 species in 1970 to 20 in 2013.

Discussion

The AFS lists of common and scientific names of fishes provide a baseline of data necessary to monitor quantitatively the number of non-native fish species established in the continental U.S. (about 10 species per decade). Incorporating temporal trends presented in this paper into future AFS editions would be an efficient way to monitor retrospective temporal trends in the number of non-native fish species in the continental U.S. Since the lists are updated about every 10 years, they do not inform intra-decadal changes and they do not provide real-time monitoring of newly established species. For example, the lists do not include species that might have become established and then extirpated during the years between consecutively published lists. Data collected continuously by the U.S. Fish and Wildlife Service, especially for freshwater fish, (Nico and Fuller 1999; Fuller 2003) may be useful for refining and improving precision of estimates in this study.

Table 1. List of fishes established in the continental United States (X) as of each of five reporting years (from American Fisheries Society lists of Accepted Common and Scientific Names).

Family	Scientific name	Common name	1970	1980	1991	2004	2013
Callichthyidae	<i>Hoplosternum littorale</i> (Hancock, 1828)	Brown hoplo				X	X
Channidae	<i>Channa marulius</i> (Hamilton, 1822)	Bullseye Snakehead				X	X
Channidae	<i>Channas argus</i> (Cantor, 1842)	Northern Snakehead					X
Cichlidae	<i>Amphilphus citrinellus</i> (Gunter, 1867)	Midas Cichlid			X	X	X
Cichlidae	<i>Astronotus ocellatus</i> (Agassiz, 1831)	Oscar	X	X	X	X	X
Cichlidae	<i>Cichla ocellaris</i> Bloch & Schneider, 1801	Butterfly Peacock Bass			X	X	X
Cichlidae	<i>Cichlasoma bimaculatum</i> (Linnaeus, 1758)	Black Acara	X	X	X	X	X
Cichlidae	<i>Cichlasoma nigrofasciatum</i> (Gunter, 1867)	Convict Cichlid	X	X	X	X	X
Cichlidae	<i>Cichlasoma severum</i> (Heckel, 1840)	Banded Cichlid	X	X		X	X
Cichlidae	<i>Cichlasoma urophthalmus</i> (Gunter, 1862)	Mayan Cichlid			X	X	X
Cichlidae	<i>Geophagus surinamensis</i> (Bloch, 1791)	Redstriped Eartheater			X	X	X
Cichlidae	<i>Hemichromis letourneuxi</i> Sauvage, 1880	African Jewelfish	X	X	X	X	X
Cichlidae	<i>Oreochromis aureus</i> (Steindachner, 1864)	Blue Tilapia		X	X	X	X
Cichlidae	<i>Oreochromis mossambicus</i> (Peters, 1852)	Mozambique Tilapia	X	X	X	X	X
Cichlidae	<i>Oreochromis niloticus</i> (Linnaeus, 1758)	Nile Tilapia				X	X
Cichlidae	<i>Oreochromis urolepis</i> (Norman, 1922)	Wami Tilapia			X	X	X
Cichlidae	<i>Parachromis managuensis</i> (Gunter, 1867)	Jaguar Guapote			X	X	X
Cichlidae	<i>Parachromis salvini</i> (Gunter, 1862)	Yellowbelly Cichlid				X	X
Cichlidae	<i>Rosio octofasciatum</i> (Regan, 1903)	Jack Dempsey		X	X	X	X
Cichlidae	<i>Sarotherodon melanotheron</i> Ruppell, 1852	Blackchin Tilapia	X	X	X	X	X
Cichlidae	<i>Thorichthys meeki</i> Brind, 1918	Firemouth Cichlid ^b			X	X	X
Cichlidae	<i>Tilapia mariae</i> (Boulenger, 1899)	Spotted Tilapia		X	X	X	X
Cichlidae	<i>Tilapia zilli</i> (Gervais, 1848)	Redbelly Tilapia		X	X	X	X
Clariidae	<i>Clarias batrachus</i> (Linnaeus, 1758)	Walking Catfish	X	X	X	X	X
Cobitidae	<i>Misgurnus anguillicaudatus</i> (Cantor, 1842)	Oriental Weatherfish	X	X	X	X	X
Cyprinidae	<i>Carassius auratus</i> (Linnaeus, 1758)	Goldfish	X	X	X	X	X
Cyprinidae	<i>Ctenopharyngodon idella</i> (Cuvier & Valenciennes, 1844)	Grass Carp		X	X	X	X
Cyprinidae	<i>Cyprinus carpio</i> Linnaeus, 1758	Common Carp	X	X	X	X	X
Cyprinidae	<i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844)	Silver Carp				X	X
Cyprinidae	<i>Hypophthalmichthys nobilis</i> (J. Richardson, 1845)	Bighead Carp			X	X	X
Cyprinidae	<i>Leuciscus idus</i> (Linnaeus, 1758)	Ide	X	X	X	X	X
Cyprinidae	<i>Mylopharyngodon piceus</i> (Richardson, 1846)	Black Carp					X
Cyprinidae	<i>Rhodeus sericeus</i> (Pallas, 1776)	Bitterling	X	X	X	X	X
Cyprinidae	<i>Scardinius erythrophthalmus</i> (Linnaeus, 1758)	Rudd	X	X	X	X	X
Cyprinidae	<i>Tinca tinca</i> (Linnaeus, 1758)	Tench	X	X	X	X	X
Cyprinodontidae	<i>Rivulus hartii</i> (Boulenger, 1890)	Giant Rivulus			X	X	X
Doradidae	<i>Platydoras armatulus</i> (Valenciennes, 1840)	Southern Striped Raphael				X	X
Gobiidae	<i>Acanthogobius flavimanus</i> (Temminck and Schlegel, 1845)	Yellowfin Goby	X	X	X	X	X
Gobiidae	<i>Neogobius melanostomus</i> (Pallas, 1814)	Round Goby				X	X
Gobiidae	<i>Proterorhinus marmoratus</i> (Pallas, 1814)	Tube-nose Goby				X	X
Gobiidae	<i>Tridentiger barbatus</i> (Gunter, 1861)	Shokihaze Goby				X	X
Gobiidae	<i>Tridentiger bifasciatus</i> Steindachner, 1881	Shimofuri Goby				X	X
Gobiidae	<i>Tridentiger trigonocephalus</i> (Gill, 1858)	Chameleon Goby	X	X	X	X	X
Loricariidae	<i>Hypostomus plecostomus</i> (Linnaeus, 1758)	Suckermouth Catfish		X	X	X	X
Loricariidae	<i>Hypostomus</i> sp. (1)a	Suckermouth Catfish			X		
Loricariidae	<i>Hypostomus</i> sp. (2)a	Suckermouth Catfish			X		
Loricariidae	<i>Pterygoplichthys anisitsi</i> Eigenmann & Kennedy, 1903	Southern Sailfin Catfish				X	X
Loricariidae	<i>Pterygoplichthys disjunctivus</i> (Weber, 1991)	Vermiculated Sailfin Catfish				X	X
Loricariidae	<i>Pterygoplichthys multiradiatus</i> (Hancock, 1828)	Orinoco Sailfin Catfish			X	X	X
Loricariidae	<i>Pterygoplichthys pardalis</i> (Castelnau, 1855)	Amazon Sailfin Catfish				X	X
Mastacembelidae	<i>Macragnathus siamensis</i> (Gunter, 1861)	Spotfin Spiny Eel					X
Notopteridae	<i>Chitala ornata</i> (Gray, 1831)	Clown Knifefish				X	X
Osmeridae	<i>Hypomesus nipponensis</i> McAllister, 1963	Wakasagi		X	X	X	X
Osphronemidae	<i>Trichopsis vitata</i> (Cuvier, 1831)	Croaking Gouramy			X	X	X
Percidae	<i>Gymnocephalus cernuus</i> (Linnaeus, 1758)	Ruffe			X	X	X
Percidae	<i>Sander lucioperca</i> (Linnaeus, 1758)	Zander					X

Table 1 (continued).

Family	Scientific name	Common name	1970	1980	1991	2004	2013
Poeciliidae	<i>Belonesox belizanus</i> (Kner, 1860)	Pike Killifish	X	X	X	X	X
Poeciliidae	<i>Poecilia mexicana</i> Steindachner, 1863	Shortfin Molly	X	X	X	X	X
Poeciliidae	<i>Poecilia reticulata</i> Peters, 1859	Guppy	X	X	X	X	X
Poeciliidae	<i>Poecilia sphenops</i> Valenciennes, 1846	Mexican Molly				X	X
Poeciliidae	<i>Poeciliopsis gracilis</i> Valenciennes, 1846	Porthole Livebearer		X	X	X	X
Poeciliidae	<i>Xiphophorus helleri</i> Heckel, 1848	Green Swordtail	X	X	X	X	X
Poeciliidae	<i>Xiphophorus maculatus</i> (Gunther, 1866)	Southern Platyfish	X	X	X	X	X
Poeciliidae	<i>Xiphophorus variatus</i> (Meek, 1904)	Variable Platyfish	X	X	X	X	X
Salmonidae	<i>Salmo trutta</i> Linnaeus, 1758	Brown Trout	X	X	X	X	X
Sciaenidae	<i>Bairdiella icistia</i> (Jordan and Gilbert, 1882)	Bairdiella	X	X	X	X	
Sciaenidae	<i>Cynoscion xanthurus</i> (Jordan and Gilbert, 1882)	Orangemouth Corvina	X	X	X	X	
Scorpaenidae	<i>Pteros miles</i> (Bennett, 1828)	Devil Firefish					X
Scorpaenidae	<i>Pteros volitans</i> Linnaeus, 1758	Red Lionfish				X	X
Synbranchidae	<i>Monopterus albus</i> (Zuiew, 1793)	Asian Swamp Eel				X	X
Total number of families			8	10	13	19	19
Total number of species			26	34	47	63	66

^a*Hypostomus* sp. 1 and 2 re-identified as *Pterygoplichthys* spp.

^bInformation received after the 1980 list was in press indicated firemouth cichlid was established in Florida.

For example, data in the U.S. Geological Survey Nonindigenous Aquatic Species database indicated about eight 8 new non-native fish species reportedly established per decade (P. Fuller, U.S. Geological Survey, personal communication) as compared to the estimated 10 species/decade from this study.

The lists provide limited information on the distribution of non-native fishes within the continental U.S. Hawaii, Alaska, or U.S. Territories were not included (except that the 1991 edition provided a list of exotic fishes established in Hawaiian fresh and marine waters—but these data were not used in this analysis). The 2013 list included information separately for Mexico and Canada. These data could be the foundation for providing temporal trends beyond the continental U.S., and consideration should be given to including additional trend information in future lists.

This study assumes the AFS lists are accurate and complete. Their periodic revision by a committee of subject matter experts using the latest taxonomic information maximizes the likelihood that the assumption is valid. As such, they are reliable sources of information for management of non-native fish, including species identification and verification, risk assessments, prevention and response strategies, surveillance plans, and evaluation of management

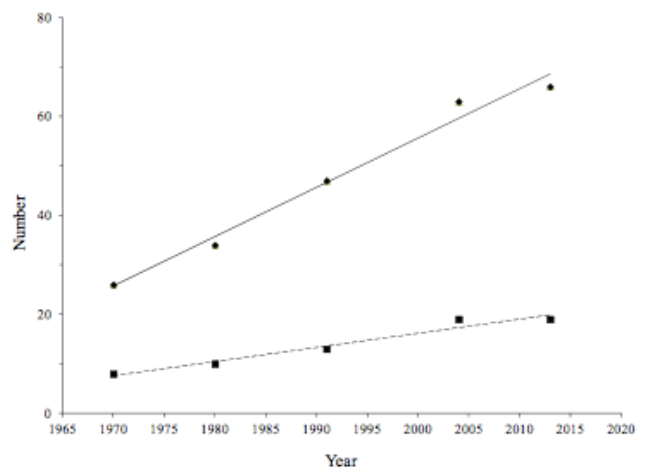


Figure 1. Number of non-native fish species (◆) and families (■) included on AFS lists of established fishes in the continental United States from 1970 through 2013.

actions.

AFS also produces lists of names for crustacea, cnidaria/ctenophora, and mollusks. Publications for each of these taxa are only on the second edition, with the first editions published less than 20 years ago. As these lists are updated, they might prove as useful as the lists of fish names in monitoring trends in established populations of non-native species in the U.S. The increasing trend in the number of known established non-native fishes in the continental U.S. will probably continue into the foreseeable future

(DeSilva et al. 2006; Gozlan 2008; Gozlan et al. 2010). The underlying factors most often cited as contributing to geographic spread (i.e., more people in more places with greater demands for natural resources) are not likely to decrease (Miller-Reed and Czech 2005). Expansion of aquaculture and use of non-native species for food and as ornamental fish appears inevitable (Rahel 2007). Further, increased transport, introduction, and establishment of non-native fish are likely as we continue to modify our environment, globalize the economy, and respond to changing climate (Rahel 2000; Dudgeon et al. 2006). It also seems likely that the number of documented established non-native species may also increase as an artifact of increased sampling effort as attention to the impacts of invasive species increases (Lockwood et al. 2013).

The future rate of increase in newly established non-native fishes in the U.S. may, however, decrease. Fewer new species were established in the continental U.S. between 2004 and 2013 than during any previous consecutive period. This decline might reflect the decreasing support for the use of non-native fish in the U.S., a decrease in the construction of new habitats (i.e., reservoirs), increased management efforts to prevent introductions, or other factors. For example, none of the newly established fish resulted from the intentional stocking to create or maintain any sport fishery, as was done with butterfly peacock bass, orangemouth, or baidiella (Fuller et al. 1999). Only one cyprinid (black carp) was added to the 2013 list, unlike in previous years when several cyprinids were used to control non-native aquatic plants. No new cichlids were included on the 2013 list, possibly indicating improvements in the availability, transport, and distribution of fish used in the fish-hobbyist industry. Additional research is warranted.

Converting trends in non-native fish species into trends in invasive (i.e., harmful) species is difficult (Parker et al. 1999; Lockwood et al. 2013). The effects of many non-native species on individuals, populations, communities and ecosystems have not been studied (Fuller et al. 1999; LePrieur et al. 2009; Cucherousset and Olden 2011). But, even if the effects are known, the nature of the effects with respect to human perception and valuation is a topic of debate (Sagoff 2005; Simberloff 2005; Gozlan et al. 2010; Vitule et al. 2009). Brown and Sax (2007) concluded that although invading species are often accused of damaging the ecosystem structure and function, there is usually little scientific evidence of such negative impacts. Gozlan (2008) estimated that the probability of an ecological impact resulting from freshwater fish introduction is relatively low (around 6%). On the other hand, Sorte et al. (2010) stated that introduced species are recognized as one of the main anthropogenic threats to biological systems. Wilcove et al. (1998) stated that the spread of alien species (not restricted to fish) is the second greatest threat to biodiversity in the U.S.

Natural biodiversity can enhance ecosystem resiliency and productivity (Lapointe et al. 2014). Most studies examining impacts of non-native fish species on non-human components of ecosystems have focused on natural biodiversity (Raffaelli 2004; Clarkson et al. 2005; Worm et al. 2006; Cucherousset and Olden 2011). The evidence that non-native species are a direct cause of native population decline is not without question (Gozlan et al. 2010). For example, Wilcove et al. (1998) concluded that non-native species are the cause of endangerment for 48% of the species listed under the U.S. Endangered Species Act. But, Brown and Sax (2007) concluded that alien species have undoubtedly contributed to the extinction of some native species, but the ultimate cause of extinction is often ambiguous because other human activities have had substantial environmental impacts. Regardless of the extent to which non-native species may be causing native species extinction, there is little doubt that biotic homogenization (establishment of exotic species coupled with loss of native species) is accelerating (Rahel 2000, 2007; Elvidge and Ricciardi 2007). Fundamental to

understanding the impacts of homogenization is an effective non-native species monitoring program, and this study has demonstrated that AFS lists can provide estimates of retrospective inter-decadal trends of established non-native species within the U.S. and potentially Canada and Mexico.

Acknowledgements

Thanks are extended to Michelle Harmon for her help in developing the idea of using the AFS lists of common and scientific names as a potential source of data for monitoring non-native fishes in the U.S. I am also grateful to Pam Fuller for reviewing an earlier version of the manuscript. The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author and do not necessarily reflect the views of any reviewers, NOAA, or the Department of Commerce.

Temporal changes in taxonomic and functional diversity of fish assemblages downstream from mountaintop mining

Nathaniel P. Hitt and Douglas B. Chambers

Abstract: Mountaintop mining (MTM) affects chemical, physical, and hydrological properties of receiving streams, but the long-term consequences for fish-assemblage structure and function are poorly understood. We sampled stream fish assemblages using electrofishing techniques in MTM exposure sites and reference sites within the Guyandotte River basin, USA, during 2010–2011. We calculated indices of taxonomic diversity (species richness, abundance, Shannon diversity) and functional diversity (functional richness, functional evenness, functional divergence) to compare exposure and reference assemblages between seasons (spring and autumn) and across years (1999–2011). We based temporal comparisons on 2 sites that were sampled during 1999–2001 by Stauffer and Ferreri (2002). Exposure assemblages had lower taxonomic and functional diversity than reference assemblages or simulated assemblages that accounted for random variation. Differences in taxonomic composition between reference and exposure assemblages were associated with conductivity and aqueous Se concentrations. Exposure assemblages had fewer species, lower abundances, and less biomass than reference assemblages across years and seasons. Green Sunfish (*Lepomis cyanellus*) and Creek Chub (*Semotilus atromaculatus*) became numerically dominant in exposure assemblages over time because of their persistence and losses of other taxa. In contrast, species richness increased over time in reference assemblages, a result that may indicate recovery from drought. Mean individual biomass increased as fish density decreased and most obligate invertivores were apparently extirpated at MTM exposure sites. Effects of MTM were not related to physical-habitat conditions but were associated with water-quality variables, which may limit quality and availability of benthic macroinvertebrate prey. Simulations revealed effects of MTM that could not be attributed to random variation in fish assemblage structure.

Key words: fish community, species richness, functional diversity, simulation, mining

Read the entire article at:

<http://www.jstor.org/stable/pdfplus/10.1086/676997.pdf?acceptTC=true&jpdConfirm=true>