



# THE Open Reading Frame

Newsletter of the Genetics Section of the American Fisheries Society

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Marlis Douglas

## President’s Message

Welcome to the December 2021 edition of the Genetics Section newsletter. As this second year under covid comes to close it seems appropriate to reflect on what we were able to accomplish in 2021.

One of the real positive events was the **AFS Annual Meeting in Baltimore**. Some of you were able to attend and present in-person, whereas others could participate virtually. Organizing such a hybrid meeting was an enormous task and AFS staff and the local committee worked very hard to make it a success. A meeting summary, including short snapshots of the symposia will be published in the January issue of Fisheries.

To facilitate student and postdoc attendance at the annual meeting and provide opportunities for networking and exposure of their research, our section provided additional funds for student travel awards and also awarded travel awards to postdocs.

The **Genetics Section Annual Business Meeting** in August happened virtually and it provided a great forum to highlight and honor our award recipients (see pages 2-6). The ExComm will organize **another virtual Section meeting in late January/early February** to update the membership on AFS activities. The AFS leadership is actively working with the Governing Board on defining the future of AFS. AFS is revising its strategic plan and has established committees and working groups to solicit feedback on what members value about AFS and how members envision the future of AFS. The new AFS logo is just one outcome of these efforts.



Dr. Marlis Douglas  
AFSGS President

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## President's Message, cont'd

On a more individual basis, most of us were able to resume lab and field work, albeit at a slower pace, in part due to lingering COVID restrictions and safety protocols that require alternate workflows. Another constraint that impacted progress and continues to do so are supply chain issues and competing demands on consumables we regularly use for our research (barrier tips). This might not change in the foreseeable future, but we learned to adapt and plan-ahead, finding alternate approaches and just being more patient.

This slower pace also translated to everything taking much more time to get accomplished, with the result that some of our planned activities did not materialize. Our Section did not generate materials for the AFS 150th Anniversary. But, the general idea was well received, and the ExComm will explore how to engage Section members to generate **virtual education materials**.

In 2022, our section will **elect new officers**. We will solicit nominations in early 2022. Please consider nominating a colleague or yourself! Serving on the ExComm is a great opportunity to expand your leadership skills.

As we move forward into another uncertain year, we hope we all will be energized after the holiday season to work together and shape the future of our Section.

Best wishes for the holiday season. We are looking forward to greeting all of you virtually during the early 2022 Section meeting.

On behalf of the executive committee (Andrew Whitley – Past President, Garrett McKinney – President-Elect, and Mary Peacock – Secretary/Treasurer), I extend our gratitude and appreciation to all of you for being part of the AFS Genetics Section.

- Marlis R Douglas President, AFS Genetics Section

## 2021 Stevan Phelps Memorial Award

*The Stevan Phelps Memorial Award was created in 2000 as a perpetual memorial to Steve who died prematurely from cancer in 1999. The award, honoring Steve's strong commitment to publication of applied genetic research in fisheries, is given annually for the best genetics paper published in an AFS journal the preceding year. This year's awardees are Robert Hunter, Edward Roseman, Nicholas Sard, Robin DeBruyne, Jinliang Wang, and Kim Scribner for their paper entitled "Genetic Family Reconstruction Characterizes Lake Sturgeon Use of Newly Constructed Spawning Habitat and Larval Dispersal." The manuscript, published in TAFS 148:442-463, is discussed below by the authors.*

Many fish species, including species of conservation concern such as Lake Sturgeon (*Acipenser fulvescens*) can exhibit considerable plasticity in reproductive behavior, that can help advance management efforts towards population and species recovery. As the authors (Hunter et al., 2020a; Trans. Amer. Fish. Soc. 149:266-283) discuss, assessments of degree of success of conservation efforts for threatened and endangered species are often constrained by aspects of a species ecology, abundance, and complexity of habitats occupied. Hunter et al. (2020a) use collections of eggs from mats that were deployed on newly constructed spawning reefs in the St. Clair-Detroit River System and genetic estimates of pedigree relationships to estimate the number of spawning adults. Collections of dispersing larvae were also made concurrently, and use of pedigree reconstruction jointly for eggs and larvae provided estimates of the distance of dispersal of larvae from spawning reefs. Recognition of the need to evaluate standard fisheries assessment and collection methods on population parameters estimated from genetic data (Hunter et al., 2020b; N. Amer. J. Fish. Manage 40:307-329), and empirical applications of newly developed 'pedigree accumulation' analyses to derive asymptotic estimates of the number of spawning adults based on pedigree estimates of the number of spawning (Sard et al. 2021; Meth. Ecol. and Evol. 12: 2388-2396) were also developed in this paper.



"Juvenile Lake Sturgeon" by U.S. Fish and Wildlife Service - Midwest Region; CC BY 2.0

## James E. Wright Award Winners

*The James E. Wright Graduate Award is given in the memory of Jim Wright, one of the founders of fish genetics research and education in North America. This award is presented annually to recognize excellence in graduate-level work in fisheries genetics, as well as assist graduate students with travel to the national meeting. For 2021, the number of awardees was expanded to seven, and also included postdoctoral scholars. A selection of recipients are featured below.*

### Anna Rix, University of Alaska, Fairbanks

As a PhD student at the University of Alaska, Fairbanks, my research focuses on understanding the genetics of fishes that live in high latitude environments. My research subjects include population genetics in lake trout in Alaska and molecular evolution in Antarctic notothenioid fishes. Antarctic notothenioids have evolved for millions of years in a cold, oxygen-rich environment, which may have resulted in loss or reduced performance of genes required for dealing with low oxygen levels. Diminished oxygen carrying capacity is especially apparent in white-blooded notothenioids, but may extend into red-blood species as well. I investigated the protein sequence and functionality of the Hypoxia Inducible Factor-1 (HIF-1) finding an insert that may affect protein function. Lake trout populations in Alaska may similarly be ill prepared to deal with warming temperatures and low oxygen concentrations. I investigated the origins of lake trout in Alaska by examining mitochondrial DNA sequence variation, which revealed two haplotypes with overlapping distribution in Alaska's Arctic drainages. Additionally, I use population genetics to determine the influence a very large proglacial lake in southcentral Alaska on the modern distribution of lake trout. My work shows that gene flow does not occur between the populations despite them living in close geographic proximity. In the final piece of the lake trout story, I will explore local adaptation and diversity of genes known to affect the fitness of other teleost fishes. My long-term research interest is discovering the genotypic basis for physiological and phenotypic differences.



The James E. Wright Award allowed me to attend the national AFS meeting virtually. Attending the meeting was a great opportunity for gathering ideas for future analyses of my data sets, establishing connections with researchers with a fisheries perspective, and learning more about current fish research.

### Nathan Backenstose, University at Buffalo

As a PhD candidate in the Department of Biological Sciences at the University at Buffalo, my research is centered on applying the most advanced genomic techniques to investigate the North American *Coregonus* species complex. I am interested in developing genomic resources for the North American clade of *Coregonus* species to help understand the evolution of the complex and inform conservation and management actions. Through the sequencing and assembly of a reference genome as well as resequencing efforts we have begun to examine the demographic history within the complex following the deglaciation of the Great Lakes region. From these data I wish to gain insight into the processes of adaptive evolution and selection and how they attribute to rapid speciation in this evolutionarily fascinating group. The goal of my current project is to use whole genome resequencing to discover genetic architecture and genome features across members of *Coregonus* species that could be the mechanistic underpinnings linked to specific morphological, physiological, and behavioral traits. Elucidating the population structure and underlying genome features that describe variation will be paramount for making informed decisions in the future of fisheries management and conservation.



I am tremendously grateful to be a recipient of the James E. Wright Award this year with the funds supporting my attendance of the AFS annual meeting in Baltimore. At the meeting I was able to present my current research on low-coverage whole genome resequencing of the *Coregonus* complex. In doing so I was able to meet and receive feedback from fellow fish geneticists and gain valuable insights from the multitude of genetics forward presentations. I am thankful for the support of the AFS Genetics Section that provided me this unique opportunity to advance my career in the field of fish genetics and genomics.

## James Wright Award Winners

### Ricky Flamio, Southern Illinois University

I am currently a fifth-year doctoral student in the SIUC Conservation Genomics Laboratory of Dr. Edward Heist. As part of my dissertation research, I have been developing genomic resources for the federally endangered Pallid Sturgeon (*Scaphirhynchus albus*). The species hybridizes with the sympatric Shovelnose Sturgeon (*S. platyrhynchus*).



Current conservation priorities of the Pallid Sturgeon require stocking of the species, and stocked specimens must have no Shovelnose Sturgeon admixture. Prior to my Ph.D. research, the lab was using 19 microsatellite loci to differentiate between Pallid and Shovelnose Sturgeon. This microsatellite panel did not have enough resolution to detect multigenerational backcrosses. I identified 11,000 haplotyped SNP loci that substantially increased the resolution in species discrimination. My current research involves making a linkage map based on experimentally-produced *Scaphirhynchus* haploids (the use of haploids simplifies the procedure for detecting paralogs in the polyploid Sturgeon genome) to find unlinked markers. Further applications of the linkage map could include synteny mapping with the Sterlet (*Acipenser ruthenus*) and estimating effective population size of the Pallid Sturgeon.

I am honored to receive the James E. Wright Award for my current sturgeon genomic work. The award is given each year in honor of Jim Wright, a geneticist whose one of many accomplishments was advancement of salmonid genomics. Salmonids and sturgeons are evolutionary polyploids and I hope to advance sturgeon genomics in an appreciable manner as Jim Wright did with salmonids. I am grateful

to have received the award as it contributed to my ability to attend this year's national AFS meeting in Baltimore, Maryland. At the conference, I was able to present my current linkage map work in the Genetics Section symposium. I benefitted from receiving feedback from colleagues and enjoyed conversing with section members as well as other fisheries professionals.

### Morgan Sparks, Purdue University

I want to thank the AFS Genetics Section and the award committee for their support to present my dissertation research at the recent national meeting. As a PhD student at Purdue University, I study contemporary evolution of pink salmon in the Great Lakes. Pink salmon in the Great Lakes are a unique introduction story because they were founded during a single event—an accidental introduction in the 1950s—but spread rapidly throughout all five lakes. Moreover, in their native range pink salmon are obligately anadromous and have fixed two-year, semelparous life histories that have led to the establishment of temporal lineages. Odd-spawning year fish across their native range are more related to other odd-year fish and vice-versa, including those that may spawn in the same river. In the Great Lakes, novel age at maturity life histories have also emerged where fish spawn at 2-, 3-, and even 4-years old and has led to populations spawning in both odd and even years, despite the progenitor being an odd-year stock.



For my dissertation, I am using whole-genome sequencing to assess genetic adaptation to the Great Lakes, especially to features such as the wholly freshwater environment of the Great Lakes or the potential genetic basis of the novel life histories. At the meeting this year, I presented on initial data that indicate a genome-wide reduction in diversity consistent with a founder effect, as well as several putative outlier regions that may be associated with adaptation. One site in particular, on chromosome 20, is the gene *SLC12A2*, which is related to passive ion transport and maintaining osmotic balance. Without the support of the James E. Wright award I likely would have not been able to share these data at the meeting this year. So, thanks again to the Genetics Section for the support!

## James Wright Award Winners

### Spencer Weinstein, Waterloo University

I am a PhD student at the University of Waterloo researching the diversity of chars (*Salvelinus* spp.) in the central Canadian Arctic. Arctic char and Dolly Varden are both important subsistence fishes, but have historically been thought to occupy discrete ranges; Dolly Varden have been thought to exist only in the western Arctic, while anadromous Arctic char occupy systems in the central and eastern Arctic. However, limited previous research and observations by subsistence fishers in Nunavut have suggested that both Arctic char and Dolly Varden are present in the central Canadian Arctic.



I am using the recently released 87K Arctic char SNP genotyping assay and reference samples from across the North American Arctic to assess whether Arctic char and/or Dolly Varden are present in two rivers in the central Canadian Arctic that support subsistence char fishing. I will combine this genomic data with mtDNA haplotype data to assess patterns of post-glacial recolonization, and morphometric and meristic analyses to address concerns by fishers that the fish have 'looked different' in recent years. I am also interviewing fishers and elders to understand how their fishery has changed in recent decades. This research is unique in that it directly addresses community questions about their fish and fishery, and my work will contribute to a broader project that aims to identify and restore critical char habitats, with the overarching goal of protecting a subsistence fishery.

Receiving the James E. Wright Award made it possible for me to participate in the national AFS meeting, and I am deeply grateful to the AFS Genetics Section for the recognition. It is always a pleasure to learn about the genetics and genomics research that members of the section are engaged in, and I was able to learn from so many researchers during this year's meeting and expand on my own research ideas.

## 2021 Genetic Section Hall of Excellence Inductee - Dr. Eric Hallerman

Dr. Eric Hallerman received his Ph.D. in 1984 from Auburn University, studying dynamics of genetic markers in selected strains of channel catfish. Eric has been a Professor of Fisheries Science at Virginia Tech since 1989, where he served as Department Head from 2007 to 2013, taught eight different university courses, advised or co-advised dozens of graduate and undergraduate students, and mentored many other students in his genetics laboratory. Hundreds of students have learned about fisheries genetics through one or more of his four genetics-oriented courses, which range from principles of genetics to aquaculture genetics to applied conservation genetics. Eric edited a textbook that AFS published in 2003 entitled *Population Genetics: Principles and Applications for Fisheries Scientists*. This book brought together the scientific knowledge of the time in an accessible format for students, and is still AFS's standard population genetic text. In addition to his work as an educator, Eric and his students have made important scientific contributions to genetic improvement of aquaculture species such as tilapia, Rainbow Trout, oysters, and numerous finfish and shellfish species, genetically-informed management of sport and commercial species, including Walleye, Brook Trout, and horseshoe crabs, and conservation genetics and phylogenetics of imperiled freshwater fishes and mussels. His research on fishes and mussels has fundamentally shaped our understanding of southeastern aquatic species, helping agency biologists delineate appropriate taxonomic and management units, design appropriate propagation programs, and prioritize populations for restoration activities. For decades, Eric has served as a technical expert and international ambassador on fish biotechnology, guiding policy on genetic improvement of aquaculture organisms and the assessment and management of risks from the genetic engineering of such organisms.



Dr. Eric Hallerman

## 2021 Early Career Award Winner - Dr. Trevor Krabbenhoft

*The Genetics Section Early Career Award is given annually and recognizes the contribution of early-career researchers to the field of fisheries genetics. The goal of this award is to promote innovative and particularly applicable genetics research, increase interest in fisheries genetics careers, and enhance professional connections among fisheries geneticists. The award is presented at the Genetics Section meeting during the AFS Annual Meeting. A candidate's genetics work should be applicable to the Society's mission to "improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science".*



Dr. Trevor Krabbenhoft

I am an Assistant Professor of Biological Sciences and member of the RENEW Institute at the University at Buffalo, New York. I am broadly interested in the ecology and evolution of fishes. Work in my lab (and with collaborators) is focused on fisheries management/restoration and conservation of native biodiversity, with particular focus on the impacts of climate change.

Much of our work is focused on the biology and restoration of ciscoes (*Coregonus* spp.) in the Laurentian Great Lakes. Ciscoes are a species complex that has experienced dramatic reductions and loss of species/sub-species during the 20th century. Our current work, supported in part by the Great Lakes Fishery Commission, aims to understand the extant and historic diversity of ciscoes using genetic tools, with the aim of providing actionable information to fisheries managers. The overarching goal of this work is to support sustainable, resilient stocks of ciscoes throughout the Great Lakes basin and conserve legacy biodiversity that persisted after population crashes and extirpations during the past century. This work directly supports cultural, ecological, and economic benefits of Great Lakes coregonines.

There is a long list of threats to native fishes and freshwater ecosystems. However, the creative and engaged people I've met in AFS and the broader community make me hopeful for what comes next. This is an exciting time for seeing fruits of restoration and conservation activities and an avenue I am excited about contributing to moving forward.

I want to thank the AFS Genetics Section for continually championing fisheries genetic work and the individuals who donate time and energy to this society, including the awards committee for reviewing these nominations.

I appreciate having had the opportunity to work with some very fine people: collaborators, agency partners, and students/trainees. I have benefitted immensely from excellent mentors over the years, most of whom were members of the AFS Genetics Section. Thank you especially to Drs. Thomas Dowling (Wayne State University) and Thomas Turner (University of New Mexico) for their continued mentoring and support long after I left their labs.

## Special Issue – Conservation Genetics of Sturgeon

**This Special Issue is an interesting opportunity to present case studies, research findings, and synthesis papers about any of the following topics:**

- i) Genetic structure of natural and/or cultured populations;
- ii) Identification of species, hybrids, and introgression events among species;
- iii) Population dynamics in habitat with anthropogenic impact
- iv) In situ monitoring supported by genetic analysis;
- v) In situ and ex situ management activities to prevent populations/stocks from biodiversity losing;
- vi) Forensic methods for trade control; or any other genetic topics relevant for conservation of endangered sturgeon species;
- vii) Effects of environmental and biotic features on reproductive success and recruitment; advances in genomic techniques for sturgeon research, monitoring and conservation; and
- viii) Population assignment and mixture analyses to characterize movements and occupancy areas during non-spawning periods; or any other genetic topics relevant for conservation of endangered sturgeon species.

More info: [mdpi.com/journal/diversity/special\\_issues/Conservation\\_Sturgeons](https://mdpi.com/journal/diversity/special_issues/Conservation_Sturgeons)  
 Deadline for manuscript submissions: 30 October 2022. Submission portal is open

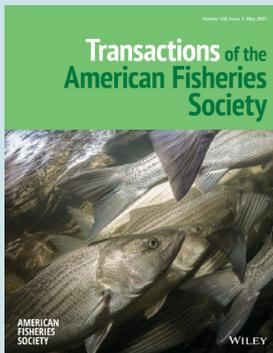


*diversity*

# In case you missed it...

## Recent genetics papers from AFS journals and beyond

Editor's note: Click citations for link to papers



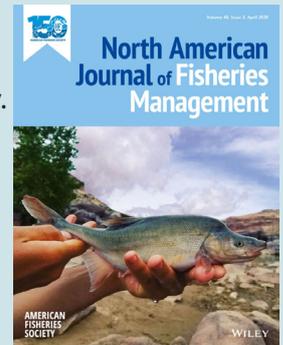
Erdman, B., et al. Broadscale Population Structure and Hatchery Introgression of Midwestern Brook Trout. *Transactions of the American Fisheries Society*.

Kazyak, D.C., et al, Population genetics of Brook Trout (*Salvelinus fontinalis*) in the southern Appalachian Mountains. *Transactions of the American Fisheries Society*.

Olsen, J.B., et al. Genetic divergence and diversity reflect a predominant freshwater resident life history in Rainbow Trout from southwestern Alaska. *Transactions of the American Fisheries Society*.

Bohling, J., et al. Developing a Standardized Single Nucleotide Polymorphism Panel for Rangewide Genetic Monitoring of Bull Trout. *North American Journal of Fisheries Management*.

Delomas, T.A. and M. Campbell. Grandparent inference from genetic data: The potential for parentage-based tagging programs to identify offspring of hatchery strays. *North American Journal of Fisheries Management*.



Haenel, Q., et al. The maintenance of standing genetic variation: Gene flow vs. selective neutrality in Atlantic stickleback fish. *Molecular Ecology*.

Mayne, B., et al. Nonlethal age estimation of three threatened fish species using DNA methylation: Australian lungfish, Murray cod and Mary River cod. *Molecular Ecology Resources*.

Yang, L., et al. Genomic and functional evidence reveals convergent evolution in fishes on the Tibetan Plateau. *Molecular Ecology*.

Ackiss, A.S. et al. Genomic and environmental influences on resilience in a cold-water fish near the edge of its range. *Evolutionary Applications*.

Smith, S.R., et al. A chromosome-anchored genome assembly for Lake Trout (*Salvelinus namaycush*). *Molecular Ecology Resources*.

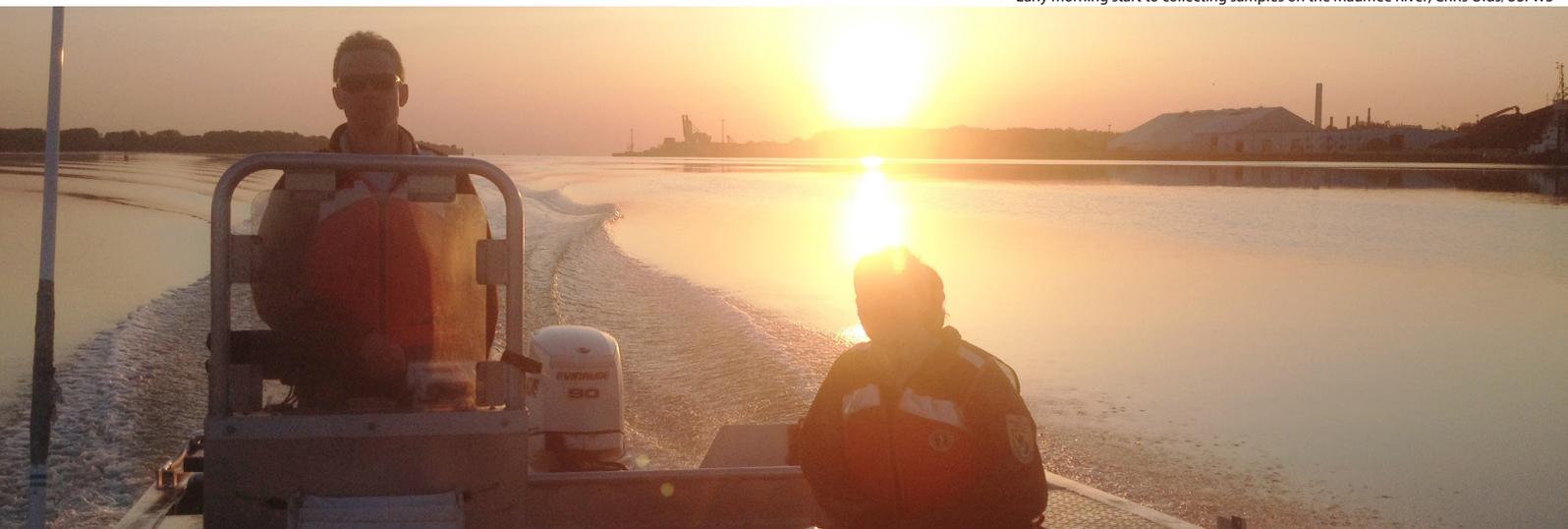
Saha, A., et al. Whole-genome resequencing confirms reproductive isolation between sympatric demes of brown trout (*Salmo trutta*) detected with allozymes. *Molecular Ecology*.

Kess, T., et al. Genomic basis of deep-water adaptation in Arctic Charr (*Salvelinus alpinus*) morphs. *Molecular Ecology*.

Gold, Z., et al. Improving metabarcoding taxonomic assignment: A case study of fishes in a large marine ecosystem. *Molecular Ecology Resources*.

Galla et al. The relevance of pedigrees in the conservation genomics era. *Molecular Ecology*.

Early morning start to collecting samples on the Maumee River; Chris Olds/USFWS



# Calendar

## **February 2022**

13<sup>th</sup>-16<sup>th</sup>: 82nd Midwest Fish and Wildlife Conference. Des Moines, Iowa.

24<sup>th</sup>-27<sup>th</sup>: Canadian Conference for Fisheries Research and Society of Canadian Limnologists, Vancouver, British Columbia.

27<sup>th</sup>- March 4<sup>th</sup>: Ocean Sciences Meeting 2022, Honolulu, Hawaii.

## **March 2022**

14<sup>th</sup>-18<sup>th</sup>: North American Wildlife and Natural Resources Conference, Spokane, Washington.

## **April 2022**

4<sup>th</sup>-8<sup>th</sup>: 46th Annual Easter Fish Health Workshop, Atlantic Beach, North Carolina.

18<sup>th</sup>-22<sup>nd</sup>: 22nd International Conference on Aquatic Invasive Species, Oostende, Belgium

## **May 2022**

9<sup>th</sup>-12<sup>th</sup>: Fourth ICES PICES Early Career Scientist Conference, St. John's Newfoundland

14<sup>th</sup>-19<sup>th</sup>: Joint Aquatic Sciences Meeting, Grand Rapids, Michigan.

## **June 2022**

18<sup>th</sup>-July 1<sup>st</sup>: 14th International Congress on the Biology of Fish, Montpellier, France

## **August 2022**

14<sup>th</sup>-19<sup>th</sup>: Ecological Society of American 107th Annual Meeting, Montreal, Quebec

21<sup>st</sup>-25<sup>th</sup>: 152nd Annual Meeting of the American Fisheries Society, Spokane, Washington.

**To find dates and information for AFS chapter meetings, visit [fisheries.org/about/units/chapters/](https://fisheries.org/about/units/chapters/)**

# Job Postings

## **Research Associate - Baton Rouge, Louisiana**

A Research Associate position is available in the laboratory of Robb Brumfield at Louisiana State University. This is a one year position, with the possibility of re-appointment. Duties involve preparation and enrichment of genomic libraries. Apply at: [https://lsu.wd1.myworkdayjobs.com/LSU/job/B0009-MJ-Foster-Hall/Research-Associate-2\\_R00062465](https://lsu.wd1.myworkdayjobs.com/LSU/job/B0009-MJ-Foster-Hall/Research-Associate-2_R00062465)

## **Two Tenure-Track Assistant Professor Positions - Florida State University in Computational Genomics.**

The Department of Biological Science at Florida State University (<https://www.bio.fsu.edu>) invites outstanding applications for a tenure-track Assistant Professor in the broadly defined area of Computational Genomics. Questions about the position should be directed to Prof. Hengli Tang: [micro@bio.fsu.edu](mailto:micro@bio.fsu.edu). How to Apply: Submit your application at <http://www.jobs.fsu.edu> (Job ID 50256).

## **Assistant Teaching Professor University of Notre Dame, Department of Biological Sciences.**

The Department of Biological Sciences at the University of Notre Dame seeks a broadly trained and innovative biology educator at the Assistant Teaching Professor level to contribute to our Introductory Biology sequence, and to teach specialized, upper-level courses in any area of biology, including ecology, evolution, physiology, and cellular or molecular biology. This renewable, non-tenure track position is available starting fall semester 2022, and is expected to be a long-term, continuing position with opportunities for promotion. To apply online, visit <https://apply.interfolio.com/97419>.

## **Assistant Professor of Ecology - Louisiana State University.**

The Department of Biological Sciences at Louisiana State University invites applications for a tenure-track position in Ecology at the level of Assistant Professor. We seek a broadly trained ecologist who addresses questions in any of a variety of sub-disciplines of ecology including but not limited to animal behavior, population demography and regulation, community structure and interactions, or the maintenance and function of biodiversity. [https://lsu.wd1.myworkdayjobs.com/LSU/job/0202-Life-Sciences-Building/Assistant-Professor\\_R00061771](https://lsu.wd1.myworkdayjobs.com/LSU/job/0202-Life-Sciences-Building/Assistant-Professor_R00061771)

## **Field and Hatchery Technicians- Michigan State University.**

The Black River Streamside Research Facility operated through the Department of Fisheries and Wildlife at Michigan State University is hiring four technicians for the 2022 field season. Technicians will assist in ongoing field and experimental lake sturgeon evolutionary ecology research. Field work will include collection of adult biological and behavioral data and annual census information on the Upper Black River. Technicians will collect physical stream data, conduct larval lake sturgeon and macroinvertebrate drift collections, juvenile lake sturgeon census, and assist with experimental assessment of factors affecting larval mortality and adult reproductive success. Hatchery work will include rearing lake sturgeon from egg, larval, and juvenile life stages using standard aquaculture methodology. Technicians will be also be responsible for maintaining adult and larval biological data, hatchery, and water quality data. Technicians may work during daylight and night hours and in inclement weather. Opportunities exist to conduct individual research projects and assist with projects of graduate students and faculty. More details at: <https://jobs.fisheries.org/job/field-and-hatchery-technician-cheboygan-michigan-0567>



Marlis Douglas

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