



Great Habitat Expectations Genetic Structure of Northern Bluefish Populations Are Eels Climbing Back up the Slippery Slope? 144th Annual Meeting in Québec City Wrap Up Final Call for Papers: Portland 2015 Steve Berkeley's Marine Conservation Legacy



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The American Fisheries Society (AFS), founded in 1870, is the oldest and largest professional society representing fisheries scientists. The AFS promotes scientific research and enlightened management of aquatic resources for optimum use and enjoyment by the public. It also encourages comprehensive education of fisheries scientists and continuing on-the-job training.

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Note: This month's commentary is by Dan Isaak, who writes the most impressive, useful blog that I have read. He creatively visualizes concepts that he has synthesized and interpreted from the peer-reviewed literature on climate change and aquatics. Thanks to Dan for contributing to fisheries science in a way that truly benefits other fisheries professionals.

—Donna Parrish

Blogging Fish Science

Dan Isaak

Thank you, Donna, for inviting me into this space to offer a perspective on the role of blogging in science and our Society. I've written the Climate-Aquatics Blog the last several years as a means of rapidly and broadly distributing peer-reviewed research pertaining to climate change and its effects on aquatic ecosystems. My intent in doing so has been to raise awareness, stimulate healthy debates and information exchanges, and engage with those concerned about this global phenomenon across a diversity of backgrounds and aquatic science disciplines. So far, so good, as the blog mailing list continues to grow and I've enjoyed dialogues with people all over the world. Based on the feedback I receive, blogging is easily the most useful thing I do in terms of communicating and disseminating scientific information. And I suspect it will probably remain the most useful thing I ever do in those regards when I reflect someday back on my career.

Wikipedia estimates that more than 250,000,000 distinct blogs currently exist on popular platforms like Tumblr, WordPress, and Blogger. Within that universe of blogs-most properly referred to as the blogosphere-blogs are written on every conceivable topic and science blogs are increasingly popular among individual researchers and scientific societies (Amsen 2006; Fausto et al. 2012). Usually blogs are posted to a website and interested readers go to the website to read the content. But I've found a more active approach that involves sending blogs directly to those on my mailing list to be far more effective. Although it always makes me feel awkward to spam lots of people, I rationalize it based on the importance of a topic like climate change and I also try to be immediately responsive (and apologetic) to anyone who asks to be removed from the email list. I do my best in those inbox invasions to be respectful of people's time by having something useful to say and saying it succinctly, because we all suffer from information overload these days. So as not to wear out my welcome over time, I also try to use humor (with varying degrees of success-or none, based on my wife's assessments), which serves a secondary purpose of leavening the bread a bit when dealing with a topic like climate change.

In my opinion, a good science blog post is a sort of mental widget that connects seemingly disparate things in useful ways, encapsulates sets of related information, stimulates discussion, and forms synapses in a few brains other than that of the writer. The best ones get forwarded by the original recipients to others interested in a topic to create a sort of virtual echo chamber. To maximize efficiency and information content, I've learned to use lots of graphics because pictures really are worth a thousand words, and I embed hyperlinks to relevant information in the Internet equivalent of citations within a research paper. Although I sometimes forget this, the best ones are usually short. Not as short as a Twitter Tweet, but the most popular blog I've written consisted only

COLUMN President's Commentary



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of a few paragraphs. It pertained to the description of a new sculpin species and had a header graphic that conflated depictions of Lewis and Clark, an old map, and a sculpin floating in the sky to resemble a god-like deity in a scene obviously inspired by Ray Troll. (Blogs also provide a bit of a creative outlet for those otherwise constrained by standard scientific formats.) More than 8,000 people around the world were linked to that information for the first time when that blog dropped into their inbox.

I suspect most AFS members are part of the Society because they have been inspired by the natural world, and everyone relishes the new information about that world that AFS is so adept at producing. But it's also the case that we're all busy, and the exponential growth in scientific knowledge relative to an individual's fixed capacity to absorb it means we're all relatively more ignorant each day. It's also true that today's science is often so specialized, technically sophisticated, and competitive that researchers have difficulties communicating new wonders about the natural world back to the rest of us. Blogs, and blogging, help cut through all that. The most rewarding thing about blogging (and often the biggest challenge) is distilling complex scientific knowledge down to its essence, and then sharing that essence with people who appreciate it. If done effectively, this new medium can be a powerful tool for increasing the flow of information, strengthening AFS, and raising the profile of our science and issues we care about as a Society within society. And the more fishy information we can put out there, the more it will affect people's thinking and the actions they take with regards to fisheries.

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COLUMN Policy



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Revisiting Hopes for Created and Restored Habitats

Thomas E. Bigford, AFS Policy Director

This column started with a singular focus on the ecological value of artificial or engineered spaces as surrogates for natural habitats. After some enlightening conversations at the AFS Annual Meeting in Québec City, my topic morphed into a broader policy arena. Besides habitats

we might create with sculpted sediments, nursery plantings, or mechanical assistance, I now found myself wondering about instant habitats such as artificial reefs constructed from materials as diverse as derelict subway cars, discarded appliances, and construction rubble. The grander discussion has a theme—each habitat has been created or restored, and each is accompanied by hopes it will serve an intended ecological purpose. That success, and how our experience is translated into management decisions and practice, is the subject of this policy column.

All fisheries policy is based, we hope, in science. For these habitat questions, one should frame an investigation of important management options, apply the same reasonable doubt as we do with all scientific hypotheses, and determine whether current practices are producing intended results. I wonder whether our track record affirms that we have the technical skills to create or restore functional fish habitat on a scale that can offset natural habitats we have degraded or lost. We need those scientific answers to inform policy and management decisions.

While approaching this question based on nearly 40 years of related work, my suspicions were that we need to revisit our current policies. I wonder if we might be putting too much hope in our ability to mimic or even approach natural systems. If monitoring and experience confirms we can design a fish ladder that passes fish, for example, then do our passage policies affirm that the art of habitat creation and restoration have advanced into a science?

I hope this column prompts the scrutiny we need to confirm we are serving our roles well as natural resource trustees. Habitat experts, and the permit regulators and fishery managers who benefit from their wisdoms, have assumed we can restore what has been degraded or even create what was destroyed or never existed. One application of this logic is when government resource agencies are entrusted with billions of dollars to restore fish habitats after spilled oil is recovered, Superfund sites are cleaned, a regulatory decision is rendered, or a hurricane decimates the coast.

These decisions are crucial to aquatic resources. With so many native species extirpated from their natural habitats, everyone from users to trustees is hoping for a saving grace. As one example, recreational fishers hope we can use various materials and designs to create artificial habitats that will help to rebuild a declining fish population. When we choose to swap one habitat for another, there is an implicit assumption that those new or improved habitats will be used to some extent by fish, preferably the same species that were displaced when the habitat was altered. If our actions to dam a river valley or create a wetland are expected to generate some ecological replacement value, we should measure whether the new habitat mimics the natural habitat (spatially or temporally) in its ability to attract the intended species. This is where science, management, and policy experts need to confirm that the "art" of habitat work is soundly based in "science." If our skills are lacking, then habitat-related decisions must be accompanied by a sliding scale or ratio that reflects our never-perfect role as creator. It usually takes years to create a salt marsh or stream riffle that mimics a natural habitat. Clearly, there are huge management implications from these habitat decisions.

With these questions swirling in my mind, it was timely to hear speakers in Québec City question these same tenets. On one morning, Matthew Acre wondered whether an artificial river-reservoir interface could replace the ecological values of a natural river floodplain, Jason Barnucz addressed the question of whether open-water habitat in Lake Erie cleared of invasive *Phragmites* could be expected to return to its ecological norm, and several other speakers focused on monitoring restoration efforts and judging success. The questions also apply to hydrological patterns from river water releases and reservoir levels, as I was reminded often in the special symposium on "Dam Impacts on Fishery Resources."

The artificial reef arena offers an interesting parallel to these questions. Will a new substrate provide suitable fish habitat? Will those benefits persist long enough to meet ecological and human expectations? If the answer is yes to these questions, how should that contribution be quantified so decision makers can balance benefits and costs, or create credits to be used as offsets later in a mitigation or conservation banking context?

In both the artificial reef and related designed-habitat worlds, another long-unresolved debate centers on whether engineered or artificial habitats support new biomass or instead simply re-locate individual fish to a new site. That question has sweeping implications throughout the habitat business. An artificial hard bottom or restored coral patch that concentrates



AFS ANNUAL MEETING 2015

145th Annual Meeting of the American Fisheries Society: Final Call for Papers 2015.fisheries.org

Start planning a trip to Portland from 16 to 20 August 2015 for the 145th Annual Meeting of the American Fisheries Society, cohosted by the Society, the Western Division, and the Oregon Chapter in downtown Portland at the convention center. The Program Committee has decided to go "theme-less" for the 2015 meeting, in hopes of encouraging a more diverse submission pool of symposia, contributed papers, and posters, with an aim to gather proposals covering multidisciplinary and interdisciplinary topics—including aquatic resources—as well as those interesting our international and regional audiences.

SYMPOSIA

- Proposals for Symposia must be submitted by 16 January 2015.
- The list of accepted Symposia proposals will be posted on 13 March 2015.
- If accepted, organizers must submit a complete list of confirmed presentations and titles by 6 March 2015.
- Abstracts for Symposium oral presentations must be submitted by 13 March 2015.

CONTRIBUTED PAPERS AND POSTERS

- Those who wish to present in Contributed Papers or Poster sessions at the 2015 AFS meeting are required to submit abstracts by 13 February 2015. This includes Student Presentations.
- Confirmation of acceptance or refusal of abstracts will be communicated by 17 April 2015. (Student presentations will be considered for a "best presentation" award if the student fills out additional application paperwork available at www.fisheries society.org/education/BSP.htm.)

FOR MORE INFORMATION: VISIT FISHERIES.ORG > ANNOUNCEMENTS

AFS does not waive registration fees for presenters at symposia, contributed paper sessions, or workshops. Registration forms will be available on the AFS website (fisheries.org/meetings) in May 2015; register early for cost savings.

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Paleoclimate Shaped Bluefish Structure in the Northern Hemisphere

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ABSTRACT: Bluefish (Pomatomus saltatrix), a highly migratory cosmopolitan predator, is the only extant representative of the family Pomatomidae. It has been the subject of many studies due to its commercial and recreational value, but much less research has been conducted on its global population structure. Here we investigate the population structure of this species and the effects of present and past oceanographic barriers to dispersal in its North Atlantic, Mediterranean, Marmara, and Black sea populations. We employed mitochondrial (cytochrome b and cytochrome oxidase subunit I genes) and nuclear (eight microsatellite loci) DNA as molecular markers. Three main genetic units of Bluefish were identified: American (West Atlantic waters), Spanish (East Atlantic-Western Mediterranean regions), and Turkish (Eastern Mediterranean, Marmara, and Black seas). Our results suggested that Bluefish is panmictic in the northwest Atlantic Ocean but not in the Mediterranean Sea. The common ancestor of the studied populations was traced back to the interglacial cycle Aftonian II, and the separation between clades was estimated to have occurred during glacial periods, likely due to migrations to refuges and the closure of the Mediterranean Sea. In conclusion, paleoclimate seems to have been fundamental for shaping the present genetic lineages of Pomatomus saltatrix.

INTRODUCTION

Ocean currents and the apparent lack of physical barriers in the marine realm seem to facilitate extensive gene flow among marine fish populations (Palumbi 1994). Pelagic and demersal fishes are expected to exhibit little intraspecific genetic structuring even over large geographic distances (Ward et al. 1994), and marine environments are often seen as open habitats in which isolation by distance is the main mechanism that may promote speciation (Palumbi 1994). However, several studies have demonstrated the existence of marine physical barriers that produce intraspecific genetic fragmentation in marine systems. Population structuring of highly migratory marine fish can be promoted by currents (Machado-Schiaffino et al. 2010), salinity gradients (Nielsen et al. 2004), temperature boundaries (Crow et al. 2007), convergence of distinct water masses (Borrero-Perez et al. 2011), behavior (Campos-Telles 2011), or

El paleoclima como determinante de la estructura poblacional del anjova en el hemisferio norte

RESUMEN: la anjova (Pomatomus saltatrix), un depredador cosmopolita y altamente migratorio, es el único representante vivo de la familia Pomatomidae. Ha sido sujeto de numerosos estudios dado su valor comercial y recreativo, pero poco se sabe acerca de su estructura poblacional a nivel mundial. En este trabajo se investiga la estructura poblacional de esta especie y los efectos que tienen las barreras oceanográficas pasadas y presentes en la dispersión de sus poblaciones hacia el Atlántico Norte, Mediterráneo, Mármara y Mar Negro. Se utilizó ADN mitocondrial (citocromo b y gen citocromo oxidasa subunidad I) y nuclear (ocho loci microsatélites) como marcadores moleculares. Se identificaron tres unidades genéticas principales en la anjova: americana (aguas del Atlántico oeste), española (regiones Atlántico este y Mediterráneo oeste) y turca (Mediterráneo este, Mármara y Mar Negro). Los resultados sugieren que la anjova es panmíctica en el noroeste del Atlántico pero no en el Mar Mediterráneo. El ancestro común de las poblaciones estudiadas se remonta al ciclo interglacial durante el Aftoniano II, y la separación entre clados se estima que ocurrió en periodos glaciales, muy posiblemente debido a las migraciones hacia refugios y al cierre del Mar Mediterráneo. En conclusión, el paleoclima parece haber sido un factor fundamental en cuanto a la determinación de las líneas genéticas actuales de Pomatomus saltatrix.

historical past events (Shen et al. 2011). Some barriers to gene flow are well defined by coastal shapes and features. Examples are the Gibraltar Strait for some Sparidae species (Bargelloni et al. 2003), the Siculo-Tunisian Strait for Sea Bass (Bahri-Sfar et al. 2000), the Florida Keys for gobies (Avise 1992), and the hydrographic isolation of the Aegean and Ionian and Adriatic seas for numerous species (Patarnello et al. 2007; Perez-Losada et al. 2007). On the other hand, behavioral traits such as homing can also account for population differentiation in some species (e.g., Castillo et al. 2005). Finally, though the genetic variability and population genetic structure of a species are shaped by both present and historical marine barriers, they are also affected by paleoecological history (Patarnello et al. 2007; Perez-Losada et al. 2007). Hence, to better understand speciation mechanisms in the marine environment, it is important to characterize not only population dynamics and structure but also life history strategies, environmental factors from past and present, and physical barriers to dispersal (Zardoya et al. 2004).

Bluefish (Pomatomus saltatrix) is a cosmopolitan, migratory, pelagic predator distributed over continental shelves and in estuaries of temperate waters of the Atlantic, Indian, and Pacific oceans and adjacent seas, including the Mediterranean, Aegean, and Black seas (Briggs 1960; Tortonese 1986; Pottern et al. 1989; Juanes et al. 1996). As a consequence of its broad distribution and the existence of potential oceanographic barriers, the species may be composed of multiple different populations, but there is limited information available (Goodbred and Graves 1996; Turan et al. 2006; Pardiñas et al. 2010). Bluefish is one of the most important recreational and commercial species along the east coast of the United States (Robillard et al. 2008) and is the target species of an important artisanal fishery in all Turkish seas: Marmara, Aegean, and Black (Ceyhan et al. 2007). Failure to detect and recognize population units can lead to local overfishing and ultimately to severe declines of fisheries (Hutchings 2000; Knutsen et al. 2009); thus, an accurate definition of Bluefish population structure is particularly important and necessary for fisheries management (Utter 1991; Wilson 2003).

The contemporary distribution of Bluefish is coincident with sea surface temperatures of 18–27°C (Juanes et al. 1996), and it has been suggested that shifts in its ranges and contacts between populations have resulted from historical changes in water temperature (Goodbred and Graves 1996). The sensitive behavioral response of Bluefish to temperature variations may provide new insights into the evolutionary consequences of the glacier–interglacier cycles and migrations into refuges for marine migratory species.

The objective of this study was to document the present population structure of Bluefish in its northern distribution across the North Atlantic ocean and Mediterranean, Marmara, and Black seas; identify possible ocean barriers to dispersal; and reconstruct the phylogeography of Bluefish to understand the role of climate for determining historical and present barriers to gene flow along the Atlantic and Mediterranean basins.

MATERIAL AND METHODS

Sampling

A total of 120 samples of *Pomatomus saltatrix* collected from eight different locations (Figure 1) between 2004 and

2009 were analyzed. These samples represent at most two consecutive generations because the maturity age is 2.4 in males and 1.9 in females (Dhieb et al. 2006). Four locations were in the northwest (NW) Atlantic Ocean, on the U.S. coast—New Jersey, Maryland, North Carolina, and Florida—and four locations were in the East Atlantic and in the Mediterranean basin—Cadiz (Atlantic Spanish coast) and Barcelona (West Mediterranean, Spanish coast) and Canakkale and Istanbul (Marmara and Black seas, Turkish coast).

DNA Extraction, Amplification, and Sequencing

DNA was extracted with Chelex (Bio-Rad, Berkeley, CA) following Estoup et al. (1996). Two mitochondrial genes and eight microsatellite loci were amplified. The mitochondrial cytochrome b (cyt b) gene sequences were obtained following the protocol described by Kocher et al. (1989), with the primers H151 and L148 described therein. The cytochrome oxidase subunit I (COI) gene was amplified with primers designed for Pomatomus saltatrix-COI-R-Pom: 5'-AAGAATGGGGTCTCCTCCAC-3' and COI-F-Pom: 5'-TTGGTGCATGAGCTGGTATG-3'-with the software PRIMER3 (Rozen and Skaletsky 2000). Several potential primer sets were generated; we selected one set of primers that covered the maximum number of base pairs. The polymerase chain reactions (PCRs) to obtain the COI sequences were performed using the GeneAmp PCR system 2700 (Life Technologies, Waltham, MA). Total reaction volume was 40 µL and the reaction mix contained approximately 50 ng of DNA, 20 pmol of each primers 10 mM Tris-HCL pH 8.8, 250 µM of each dNTP, 5 U µL-1 of DNA Taq polymerase (Promega, Madison, WI), and 2.5 mM MgCl₂. The PCR conditions were as follows: initial denaturing at 95°C for 5 min, 35 cycles of denaturing at 95°C for 30 s, annealing at 58°C for 30 s, an extension of 72°C for 30 s, and a final extension at 72°C for 20 min. PCR products were visualized in 2% agarose gels with 10 mg/mL of ethidium bromide. Stained bands were excised from the gel and DNA fragments were purified with an Eppendorf Perfect-Prep Gel CleanUp kit (Hamburg, Germany). Then, purified DNA was precipitated using standard 2-propanol precipitation and resuspended in formamide prior to sequencing. Sequencing was performed in an ABI PRISM 3100 Genetic Analyzer (Life Technologies), with a BigDye 3.1 Terminator system, in the Unit of Genetic Analysis of the Scientific-Technical Services of the University of Oviedo (Spain).



Figure 1. Sampling locations. Geographical distribution of sampling points in the Atlantic Ocean and the Mediterranean, Marmara, and Black Seas. NJ: New Jersey (USA); MD: Maryland (USA); NC: North Carolina (USA); F: Florida (USA); C: Cadiz (Spain); B: Barcelona (Spain); TC: Canakkale (Turkey); TI: Istanbul (Turkey).

Eight tetranucleotide microsatellites were assayed: elf 17, elf 19, elf 37, elf 39, elf 44, elf 46, elf 49, and elf 50 (Dos Santos et al. 2008). Reactions and conditions were modified from those described by the authors. PCRs consisted of the following: 95°C for 5 min, 35 cycles of 95°C for 30 s, the annealing temperature (Table 1) for 30s, 72°C for 30s, followed by 72°C for 20 min. PCRs were performed in a total volume of 20 μ L in individual PCR reactions for each locus with the GeneAmp PCR system 2700 and 2720 Thermal Cycler (Applied Biosystems). Products were visualized in 50 mL 2% agarose gels with 2.5 μ L of ethidium bromide (10 mg/mL) for verification and genotyped using an ABI PRISM 3100 Genetic Analyzer (Applied Biosystems), with GS500 LIZ 3130 size standard, in the Unit of Genetic Analysis of the Scientific-Technical Services of the University of Oviedo (Spain).

Genetic Diversity

Sequences of each mitochondrial gene (cyt b and COI) were aligned using ClustalW (Thompson et al. 1994) from the BioEdit Sequence Alignment Editor (Hall 1999) and were visually inspected to avoid base-calling errors. The incongruence length difference tests (Farris et al. 1995) were performed in PAUP* 4.0 (Swofford 1999) with 1,000 replicates and a *p*-value of 0.05. The two mtDNA gene sequences were concatenated and haplotypes defined with DNAsp v.4.50.3 (Rozas et al. 2003). MtDNA haplotype (H) and nucleotide diversity (pi) were calculated for each location using the software Arlequin version 3.0 (Excoffier et al. 2005).

Microsatellite allele sizes were estimated using the GeneMapper Software Version 4.0 (Applied Biosystems). Loci with scoring errors, large allele dropout, and null alleles were discarded employing the program MICROCHECKER (Van Oosterhout et al. 2004). Conformity to Hardy-Weinberg equilibrium was calculated using the exact probability test with GENEPOP software (Raymond and Rousset 1995). Microsatellite variation (number of alleles per locus, allelic richness, and observed and expected heterozygosity) was calculated with the programs GENETIX Version 4.03 (Belkhir et al. 2004) and FSTAT Version 2.9.3.2 (Goudet 2001).

Population Differentiation and Structure

A median-joining (Bandelt et al. 1999) haplotype network was constructed using the concatenated mtDNA genes to visualize the intraspecific relationships of the different haplotypes and their relative frequencies in the sampled populations with the program Network 4.5.1.6 (fluxus-engineering.com) with default settings. Network software reconstructed all possible, shortest, least complex, phylogenetic trees (maximum parsimony) from a data set under different algorithms.

Genetic divergence between populations was estimated using population pairwise $F_{\rm ST}$ values calculated using nuclear and mtDNA data with the program Arlequin version 3.0 (Excoffier et al. 2005). The statistical significance of $F_{\rm ST}$ values between samples was calculated with 1,000 permutations and 10,000 steps in a Markov chain. This software was also employed for analysis of molecular variance (locus by locus and standard AMOVAs) using 1,000 permutations.

Fu's F_s test (Fu 1997) for selective neutrality was calculated in Arlequin v.3.0. For neutral markers, this test can be employed to detect changes in population size. Significant and negative F_s values can be interpreted as signatures of population expansion (Dodson et al. 2007). Mismatch analysis was also used to explore the spatial and demographic evolution of the studied Bluefish populations with the raggedness index (Harpending 1994) and the sum of squared deviations (SSD; Schneider and Excoffier 1999). Both demographic and spatial mismatch analysis were calculated with Arlequin v.3.0 and were based on the null hypothesis of expansion; thus, nonsignificant values reveal population expansion.

Population structure across the study area was assessed using the program STRUCTURE 2.3.1 (Pritchard et al. 2000) by using microsatellite loci data. This software estimates the minimum number of population units with genetic identity in the data set under a Bayesian framework. This data set was analyzed under the "Admixture model," which assumes that individuals may have mixed ancestry. The parameter set consisted of a burn-in period of 30,000 steps followed by 300,000

Table 1. Diversity indices for mitochondrial DNA and microsatellite loci of Pomatomus saltatrix samples.										
Localities	Acronym	N	н	(π)	Nh	NA	AR	He	Ho	FIS
UNITED STATES		65			33 (33/21)	18.28				
New Jersey	NJ	23	0.9264 ± 0.0388	0.0045 ± 0.0026	14 (5/5)	13.9	33.405	0.8856	0.7018	0.1938
Maryland	MD	20	0.9692 ± 0.0209	0.0051 ± 0.0029	19 (11/10)	13.1	32.644	0.8714	0.7576	0.1531
North Carolina	NC	11	0.9273 ± 0.0665	0.0051 ± 0.0030	8 (2/2)	16.4	31.952	0.8399	0.7549	0.1269
Florida	F	11	0.9636 ± 0.0510	0.0056 ± 0.0033	9 (4/4)	10.1	32.921	0.8593	0.6598	0.2321
SPAIN		41			14 (10/8)	14 (10/8)				
Cadix	С	35	0.8414 ± 0.0441	0.0025 ± 0.0016	12 (6/6)	12 (6/6)	31.130	0.8014	0.7170	0.1207
Barcelona	В	6	1.0000 ± 0.0962	0.0031 ± 0.0021	6 (1/1)	6 (1/1)	29.848	0.7143	0.7619	0.0243
TURKEY		14			4 (2/3)	9.14				
Canakkale	TC	7	0.0000 ± 0.0000	0.0000 ± 0.0000	1()	6.7	28.666	0.7194	0.8299	-0.0662
Istanbul	TI	7	0.5238 ± 0.2086	0.0006 ± 0.0006	3 (2/2)	6	28.611	0.7211	0.6922	0.1577
TOTAL		120			55 (-/34)	23.28	33.352	0.839	0.741	

^aDiversity indices of the concatenated Cytb-COI genes as H, Haplotype diversity; (π), Nucleotide diversity; Nh, Number of haplotypes (private/singletons as exclusive of a locality / one single copy respectively) and for microsatellite loci asNA, average number of alleles per locus. AR, allelic richness. He and Ho, heterozygosity observed and expected respectively and FIS values. N, sample size. (-), none

Markov chain Monte Carlo (MCMC) iterations and seven runs for each K (number of genetic units estimated); the number of K was estimated following Evanno et al. (2005).

Mantel tests of association between genetic differentiation values (pairwise F_{sT} values) and geographical Euclidean distances (linear distances between sampling locations) were calculated with Arlequin version 3.0 (Excoffier et al. 2005). Mantel tests were done to determine whether the considered populations follow an isolation-by-distance model. To determine possible geographical barriers to dispersal, we employed the software BARRIER v.2.2 (Manni et al. 2004), which can identify geographically continuous and discontinuous assemblages of samples from a spatial landscape. Geographical coordinates of each sampling area were mapped into a matrix connected by Delauney triangulation (Brassel and Reif 1979). Barriers in the triangulation were identified using mitochondrial and nuclear pairwise $F_{\rm ST}$ distances. The analysis employed was based on Monmonier's maximum distance algorithm (Manni et al. 2004) to identify regions with sharp genetic change or discontinuity.

Phylogeny and Evolutionary History of *Pomatomus saltatrix*

Population divergence time estimations were done under a Bayesian MCMC framework using the two mtDNA genes with the software BEAST version 1.6.1 (Drummond and Rambaut 2007). Following a burn-in of 3 million cycles, rates were sampled once every 1,000 cycles from 30 million MCMC steps for an extended Bayesian skyline tree prior with a stepwise model for mitochondrial DNA and strict clock model. Bayesian intraspecific phylogenies are based on coalescent theory (Kingman 1982) and allow the inference of past population dynamics and parameters from contemporary gene sequences. The best evolutionary model of both sequences (COI and cyt b) and their priors (kappa, gamma-shape, proportion of invariant sites, etc.) were inferred by using jModelTest software version 0.11 (Posada 2008) and its implementation of the Akaike information criterion (Akaike 1974). The mutation rates employed were 2% per million years (MY) for cyt b (Brown et al. 1979) and 1.2% per MY for COI (Bermingham et al. 1997). Tracer version 1.5 (Rambaut and Drummond 2007) was used to check that chains had converged to a stationary distribution. The analysis was repeated with longer runs (50 million MCMC steps) when data sets did not accomplish this condition.

RESULTS

Genetic Diversity

A total of 46 haplotypes for the concatenated COI–cyt b genes were detected among the studied samples. Most (68.75%) were observed solely among U.S. samples (Northwest Atlantic Ocean) and the rest were from the eastern area (Table 1; GenBank ID: JQ039400-JQ039435 for COI and JQ039436-JQ039465 for cyt b haplotypes). High haplotype diversity and low nucleotide diversity were found in general for all regions,

but differences between localities revealed a gradient from west to east across the studied area. U.S. samples exhibited higher diversities than European ones, and western Mediterranean samples were more diverse than those from the eastern Mediterranean (Table 1). The highest number of haplotypes and haplotype and nucleotide diversities corresponded to northwest Atlantic samples.

The eight microsatellite loci considered were amplified for the same 120 individuals across the sampling area. MICRO-CHECKER did not detect dropouts or scoring errors, but null alleles were found for one loci (elf 44) in different populations. Therefore, elf 44 was excluded from the data set. High genetic variability was found at the seven loci. The number of alleles per locus ranged from 18 (elf 17) to 29 (elf 37). All sampling areas were in Hardy-Weinberg equilibrium and there were no significant differences between expected and observed heterozygosities in any location (Table 1).

Population Differentiation and Population Structure

Differentiation between the two sides of the Atlantic Ocean was observed in the haplotype network (Figure 2), where the main separation between mitochondrial lineages corresponded clearly to the geographical differentiation between the two sides of the Atlantic Ocean, giving separate U.S. and European clades, with further internal division. The presence of unique haplotypes may be caused by recent differentiation, and geological or demographic factors and mutations would explain the haplotype structure (Verheyen et al. 2003).

The population structure of Bluefish based on both mitochondrial and nuclear DNA was consistent with three different genetic units in the sampling area: northwest Atlantic and west and east Mediterranean. $F_{\rm ST}$ population pairwise comparisons revealed significant differences between northwest Atlantic and other locations and also between east and west Mediterranean samples (Table 2) for both types of markers. The northwest Atlantic group consisted of all of the North American localities: Florida, Maryland, North Carolina, and New Jersey. The west Mediterranean cluster included Cadiz (from the Atlantic Ocean) and Barcelona (west Mediterranean), and the east Mediterranean group was composed of the two Turkish localities, Istanbul and Canakkale.

Bayesian analysis confirmed that Bluefish from this study belonged to three different genetic units (K = 3), corresponding to the same three clusters detected with the genetic distances but with a moderate level of admixture between them (Figure 3). There is also a secondary maximum at K = 8, supported by much lower likelihood than K = 3, suggesting a hierarchical island model (Evanno et al. 2005) of eight different populations clustered in three main sets. The AMOVA confirmed these three genetic units. Both AMOVAs, standard (for mtDNA) and locus by locus (for microsatellite loci; Table 3), showed significant differences among the three groups and within populations but not among populations within the three previously defined groups.



Figure 2. Haplotypes network.Median-joining network with the relationships among the 48 haplotypes defined by concatenated cyt b and COI mitochondrial genes. Circle sizes are proportional to the frequency of each haplotype. Different locations are represented in different colors. Branches are proportional to mutations between haplotypes.

In the standard AMOVA, the highest percentage of variation was observed between groups (71%; P < 0.001), whereas the highest percentage of variation in the locus by locus AMOVA was within populations (93.72%; P < 0.001). These results were consistent with STRUCTURE and mitochondrial and nuclear $F_{\rm ST}$ results.

Demographic analyses indicated that all of the populations except Canakkale were in expansion (Table 4). In the Mantel test, a high and significant correlation was detected between genetic and Euclidean distances between samples (r = 0.734; P < 0.001), suggesting a pattern of isolation by distance for *Po*matomus saltatrix. The software BARRIER (Manni et al. 2004) identified two main boundaries coincident with the two longer geographical distances between samples. The two detected barriers were supported with both types of molecular markers (Figure 4). However, all of the previous population structure results (STRUCTURE, mitochondrial, and nuclear $F_{\rm ST}$ and AMOVAs) suggested some permeability across the three genetic units. The Gibraltar Strait was not a barrier to gene flow for Pomatomus saltatrix because the Spanish samples on the two sides of the strait (Cadiz and Barcelona) were not significantly different.

Phylogeny and Evolutionary History of *Pomatomus saltatrix*

The time to the most recent common ancestor (TMRCA) of the sampled Bluefish was estimated to be 480,000 years ago (95% highest posterior density [HPD] = 0.28-0.72 MY), and the TMRCA for the NW Atlantic Ocean was dated as 252,000 years (95% HPD = 0.13-0.39 MY) and 148,300 years (95% HPD = 0.05-0.27 MY) for the Mediterranean samples. The population growth rate estimated with the extended Bayesian skyline model for the U.S. samples reached its maximum approximately 40,100 years ago, whereas for the European clade the maximum occurred 23,420 years ago (Figure 5). Both estimates suggest that the northwest Atlantic clade is more ancient than the Mediterranean. The Bayesian tree obtained for the northwest Atlantic Ocean suggested that there are two separate American lineages that are composed of a mixture of all localities. The TMRCA of the two American lineages was estimated to be approximately 175,000 and 131,000 years. The substructure detected with the Bayesian methods and not with $F_{\rm ST}$ is likely due to the more sophisticated approaches of Bayesian inference. $F_{\rm sr}$ -based approaches are well understood, widely used, and easily applied, but Bayesian-based analyses allow

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Localities	NJ	MD	NC	F	C	В	TC	ті
NJ	-	0.01008	0.00367	0.00498	0.02203	0.03900	0.06407	0.06734
MD	0.02436	—	0.01153	0.00240	0.01930	0.03542	0.08319	0.07287
NC	0.04170	-0.02772	-	0.01777	0.01969	0.02785	0.07205	0.06623
F	0.05955	-0.02595	-0.05941	—	0.01357	0.04297	0.06358	0.04482
C	0.75687	0.74427	0.75280	0.74692	_	0.00572	0.07385	0.07825
В	0.70537	0.68326	0.67787	0.65902	-0.06545	-	0.05565	0.04119
TC	0.74745	0.73286	0.74596	0.73079	0.19134	0.18157	-	0.01869
т	0 75434	0 74041	0 75938	0 74326	0 23288	0 17656	0.00001	_

Table 2. Populations pairwise F_{st} differences.

Pairwise F_{st} estimates between Bluefish samples based on mtDNA (below diagonal) and nuclear DNA based on microsatellite loci (above diagonal). Significant P-values are in bold. Locality acronyms as described in Table 1.

 $\Delta \mathbf{K} = \mathbf{m} \left(|\mathbf{L}^{\prime\prime}\mathbf{K}| \right) / \mathbf{s} \left[\mathbf{L}(\mathbf{K}) \right]$



nuclear DNA with STRUCTURE 2.3.1 (Pritchard et al. 2000) following Evanno et al. (2005). (B) Percentage of individual membership detected with STRUCTURE 2.3.1. Each genetic unit is represented by one color (U.S. samples in blue, Spanish in green, and Turkish in red). Each vertical bar represents one individual. Acronyms of sampling localities are below the plot and described in Figure 1 and Table 1.

more precise estimates (see Pearse and Crandall [2004] for a review).

DISCUSSION

This study provides a genetic analysis of North Atlantic and Mediterranean Bluefish populations. Three clear genetic units were identified and may follow a hierarchical island model. The North American samples were clustered together, without any significant difference between sampling sites, suggesting that Bluefish is panmictic in the northwest Atlantic Ocean. Many studies based on distribution and morphological characteristics had investigated the number of stocks in the East Coast of the United States. In previous studies, the number of stocks identified ranged from six to two (Lund 1961; Lassiter 1962; Lund and Maltezos 1970), but other investigations concluded that either two distinct spawning groups or one stock with two distinct spawning periods occurred in the region (Norcross et al. 1974; Kendall and Walford 1979; Hare and Cowen 1993; Smith et al. 1994). Later, Graves et al. (1993) concluded that there was a single population based on mitochondrial DNA, and a morphometric study (Austin et al. 1999) corroborated the one-stock hypothesis despite the evidence of phenotypic plasticity. Our study confirms the one-stock hypothesis based on both nuclear and mitochondrial DNA, but the Bayesian mitochondrial DNA results suggested that there are two different lineages within the American panmictic population that may have evolved at different times.

Our results support two genetic discontinuities for Bluefish: one in the middle of the Atlantic Ocean and the other in the Mediterranean Sea. However, regional permeability and migration can be inferred to occur across both of them. The Mediterranean barrier could be at the level of the Siculo-Tunisian Strait and may be due to the hydrographic isolation of the Aegean and Ionian and Adriatic seas, or either of them, but not in the Gibraltar Strait or Alboran Sea. The Siculo-Tunisian Strait is a barrier to gene flow for other species (Stefanni and Thorley 2003; Zardoya et al. 2004), and in most cases the major genetic break or limitation to larval dispersal between the Eastern and Western Mediterranean occurs in the straits separating the Adriatic, Aegean, and/or Black seas (Nikula and Vainola 2003; Costagliola et al. 2004; Domingues et al. 2005; Peijnenburg et al. 2006; Perez-Losada et al. 2007; Zulliger et al. 2009). The accurate locations of the barriers for this species cannot be deduced from the present results.

AMOVA	Variance	% Variation	φ Statistics	Ρ			
Locus by locus (eight microsatellite loci)							
Among groups	0.065	2.96	φ _{cτ} = 0.057	<0.001			
Among populations within groups	0.015	0.70	φ _{sc} = 0.005	0.168			
Within population	2.109	96.33	$\phi_{st} = 0.062$	<0.001			
Standard (881bp COI-cyt b)							
Among groups	3.811	70.61	φ _{cτ} = 0.709	<0.001			
Among populations within groups	0.005	0.09	φ _{sc} = -0.006	0.345			
Within population	1.581	29.30	φ _{st} = 0.708	<0.001			

Based on microsatellite loci (locus by locus AMOVA) and mitochondrial sequence variation (standard AMOVA). Significant *P*-values in bold.

The most probable factor influencing Bluefish population genetic structure seems to be geographical, such as the distance to continents and shallow waters. Small fish are commonly found in shallow coastal waters (e.g., Juanes et al. 1996), and apparent population genetic isolation associated with different continents has been reported before (Goodbred and Graves 1996). Bluefish is a highly migratory species (Juanes et al. 1996). Water temperature and photoperiod are major factors described to influence movement patterns in Bluefish (Olla and Studholme 1972; Wilk 1977; Juanes et al. 1996), but other factors, like salinity, could contribute to shape their population structure. We have compared annual sea surface temperature as well as annual temperature at 200 m depth (maximum depth for Pomatomus saltatrix) with the Bluefish genetic structure detected in this study. In this case, changes in temperature might not explain the barriers detected here or the genetic structure of different Bluefish populations. Similarly, salinity gradients at the surface and at 200 m depth did not explain the genetic structure and barriers detected. Neither factor showed differences along the genetic units detected, suggesting that those factors are not a barrier in our sampling area. In contrast, both annual salinity and water temperature along the North Atlantic Ocean and Mediterranean Sea could explain the permeability across the two boundaries detected and could allow Bluefish to migrate. This connection across barriers could prevent vicariant speciation, because Pomatomus saltatrix is the sole member of its genus and family.

Table	Table 4. Population expansion test.								
	Misma	atch analysis (Neutrality test (Ho = No expansion)						
	Demog	graphic							
	Expan	sion	Fs						
	SSD	Raggedness	SSD	Raggedness					
NJ	0.002	0.011	0.003	0.011	-5.648				
MD	0.104	0.016	0.005	0.016	-10.917				
NC	0.009	0.029	0.012	0.029	-1.769				
F	0.137	0.173	0.049	0.173	-2.774				
В	0.036	0.133	0.036	0.133	-3.576				
С	0.031	0.120	0.027	0.120	-4.298				
TC	0.000	0.000	0.000	0.000	0.000				
TI	0.022	0.185	0.022	0.185	-0.921				

Mismatch analysis of demographic and spatial expansion and neutrality tests: SSD, Schneider and Excoffier's test of sudden expansion (Schneider and Excoffier 1999); raggedness index (Harpending 1994); F_s : Fu's test of neutrality (Fu 1997), respectively. Values indicating population expansion are marked in bold. Locality acronyms as described in Table 1.

Northwest Atlantic Bluefish exhibited higher diversity than European populations, and west Mediterranean populations were more diverse than east Mediterranean populations. Hewitt (1996, 2000) demonstrated that the last glaciations had a profound effect on genetic diversity. If genetic diversity remains high or increases at the limits of the range, then these populations may be composed of two or more lineages that differentiated in distinct glacial refugia, which is consistent with the two U.S. lineages detected in our study. Therefore, the occurrence of high levels of genetic diversity in previously glaciated areas would suggest colonization from multiple refugia (Griswold and Baker 2002). This could be the case of the northwest Atlantic Bluefish population, which has the highest genetic diversity and was dated as the oldest population, having necessarily passed through several glacial cycles (Riss, Würm). On the opposite side of the Atlantic, the emergence of the Mediterranean clade occurred during the Riss glacial cycle, a harsh period when the Gibraltar Strait was closed due to the decrease in sea level (Loget and van den Driessche 2006). Later, the Mediterranean Sea was closed and part of the Bluefish population was probably isolated for a long period. Further radical hydrographical changes that occurred during the course of the late Pleistocene climatic cycles, such as fluctuations in water level that repeatedly isolated totally or partially the Black Sea, Aegean Sea, and Eastern Mediterranean (Svitoch et al. 2000) may have contributed to differentiate those populations. As reported for other marine species (e.g., Borrero-Perez et al. 2011), this isolation may have been maintained until the present due to the anticyclonic front located in the Peloponnese peninsula (Millot 2005). The Atlantic European clade may have colonized the western Mediterranean after the opening of the Strait of Gibraltar and continued its expansion until the present. The paleogenetic history of Bluefish seems therefore associated with glacial-interglacial cycles, as suggested by the estimated TMRCA of the different clades. TMRCA for the Bluefish analyzed here was dated to the Aftonian II, an interglacial period of favorable conditions with growth and expansion of species, and the TMRCA of both south European and east Mediterranean clades corresponded to glacial periods (fourth cycle of Mindel and Riss glaciation, respectively). Bluefish populations may have migrated to different refuges and stayed isolated for long periods until the climatic conditions became favorable again.



Figure 4. Barriers to dispersal. Detected spatial genetic discontinuities along the distribution of the samples based on Monmonier's maximum difference algorithm are marked with red arrows and green letters: A is the first detected barrier and B the second barrier.



Figure 5. Maximum population growth rates for the studied Bluefish during the last 50,000 years. Population growth rates (in percentage) estimated with the extended Bayesian skyline of BEAST software for the European (East Atlantic and Mediterranean) and American (West Atlantic) Bluefish clades.

In conclusion, the present study suggests that the paleoecological history (e.g., glaciations and interglacial periods in the late Pleistocene) has been crucial for shaping the present genetic variability and population structure of *Pomatomus saltatrix* in the North Atlantic Ocean and in the Mediterranean basin.

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SUPPLEMENTAL MATERIAL

Supplemental data for this article can be accessed on the publisher's website at www://dx.doi.org/10.1080/03632415 .2014.976701

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144th Annual Meeting in Québec City—From Fisheries Research to Management: Think and Act Locally and Globally

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Poster Session



Speed Mentoring



Always the gracious host city, Québec was once again the site of the American Fisheries Society (AFS) Annual Meeting, last held there in 2003. This year's meeting drew 1,694 attendees (not including guests) from 37 nations. The 40 symposia and 32 contributed paper sessions included 1,445 oral papers, and 221 posters were displayed.

The meeting kicked off with the Governing Board meeting and retreat, which focused on communications issues. Emerging Leaders Steve Midway, Cari-Ann Hayer, Patrick Cooney, and Justin Davis provided the perspective of younger professionals on Society communications. Saturday and Sunday each featured well-attended Continuing Education Workshops on topics such as geographic information systems (GIS), leadership, programming in R, and web sites and social media. The main part of the meeting began with Sunday night's networking reception, where attendees were greeted by the Honorable Gail Shea, Minister of Fisheries and Oceans Canada, among other dignitaries.

Following Monday morning's Plenary Session (see sidebar), the symposia and contributed paper sessions began. Some symposia, such as the 38th Larval Fish Conference and the International Eel Symposium, were massive events featuring dozens of speakers over multiple days. Summaries of most of the symposia, highlighting the major themes, follow. The Monday evening Trade Show and Poster Session brought a lot of lively interaction, along with many browsers for the Silent Auction.

Students were the focus of Tuesday's special events, which included a Career Fair, Speed Mentoring, and an off-site social. During Speed Mentoring, about 60 students made the rounds of the 20 tables of mentors, each with a different specialty. The groups of three students had 8 minutes to ask each mentor questions, and several students remarked that it was the most informative thing that they had ever done.

The following day, the nearly 200 runners and walkers who participated in the Spawning Run on Wednesday morning could not have asked for better weather or a prettier location than the Plains of Abraham park. Jullien Flynn finished first for the women and John Wiedenmann came in first for the men.

Wednesday afternoon brought the Business Meeting, where President Bob Hughes turned over the gavel to our new president, Donna Parrish. Attendees at the Business Meeting also saw preview videos for the 2015 Annual Meeting in Portland, Oregon, and the 2016 World Fisheries Congress in Busan, Korea. Photos of the Plenary and Business Meeting award presentations are available

online at www.flickr.com/photos/americanfisheriessociety/sets. The day culminated with a networking social at the Cruise Terminal Québec, where attendees could talk over the meeting, enjoy gourmet food, and watch a spectacular fireworks display over the St. Lawrence River.

Next year's Annual Meeting in Portland, Oregon, from 16 to 20 August 2015, is forecasted to be a record breaker. But even as members plan their symposia proposals and abstract submissions for next year's meeting, nothing can eclipse the warm memories of this year's great collegiality sparked by Québec City's *joie de vivre*.

PLENARY SESSION

Louis Bernatchez—The Essential Contribution of Basic Science towards Improved Fishery Management

Bernatchez began by describing how basic research is fuel for economic growth, with a return on investment of 20–60% plus the benefits of helping to create a better world. Reducing basic science funding brings the peril of short-term vision and limits the fuel for long-term growth. Because innovation arrives from unlikely sources, basic research is easy to bash. Who would have thought that Thomas Brock's 1967 work on extremophiles in Yellowstone would lead to the invention of polymerase chain reaction? And that DNA barcoding of all North American freshwater species would reveal a 20% increase in species diversity, as well provide practical applications in the identification of seafood served in restaurants? Such DNA research has also revealed that there is not panmixia in lobster stocks as previously thought and that selective



harvest can affect the genetic makeup in fish growth rate. Bernatchez noted three major changes underway in Canadian science: (1) reduction in the ability of scientists to communicate research to the public, (2) erosion of Canada's basic science capacity, and (3) reduction in the role of evidence in policy decisions. Because of the connection between basic and applied research, he concluded, the long-term stability of basic science is crucial.

Thierry Oberdorff—Patterns in Riverine Fish Diversity: A Macroecological Perspective

Due to the threats to freshwater fish biodiversity, predictive models for fish diversity are needed at all scales, Oberdorff began. Rivers are a type of biogeographical island that limit dispersal. He analyzed 10,300 species in 2,300 drainage basins and looked at the role of area, climate, productivity, and history in shaping fish communities. In the native richness model, 54% of species richness was attributed to habitat, 34% to climate/energy, and 12% to historic factors. Exotic richness was 70% due to anthropogenic causes and 30% to natural immigration. To explain the historic factors, Oberdorff showed maps of how river basins were connected during the last glacial maximum when the sea level was 120 m lower. Larger areas provide more habitat and niche diversity, and more productive or warmer systems increase the population density and de-

crease extinction rates. He noted that fish communities often show convergence where the same cause produces the same effects and species richness increases along a longitudinal gradient at the same slope across all continents. These models of biotic indices can provide a surrogate for other organisms, help forecast climate change scenarios, and measure river health, he concluded.

Anna Parma—Leveraging Local Experience to Improve Sustainability of Global Fisheries: It Is Not about Tools but Processes

Parma began by discussing the state of fisheries management for data-rich fisheries. Prescriptive frameworks with a top-down management model require a demanding knowledge base to determine the total allowable catch (TAC). Even in the United States, the status of 50% of stocks cannot be determined, so this approach will not work for most world fisheries that are data poor. Small-scale fisheries are very heterogeneous and regulations are difficult to enforce. Instead of individual transferable quotas, some small-scale fisheries are managed through territorial use rights in fisheries, but scaling up this approach is problematic due to the diversity of fisheries. Parma gave examples of small-scale South American shellfisheries—some where that territorial use rights in fisheries work well, such as Chilean loco, and others where total allowable

catches work better, such as sea urchins. In the Juan Fernandez Islands lobster fishery, a tenure system using markers limits any increase in effort. One size does not fit all—prescriptive management frameworks restrict available options and discourage innovations. She cautioned that fisheries managers should avoid the panacea trap and look at the local social dynamics, institutions, and knowledge base in order to play with the full deck.

David Bella—Systemic Distortion

Bella promised the audience that he would shift their imagination about how information moves through organizational systems. These patterns tend to be found throughout the character of the whole but can be changed. Bella showed a complex flowchart showing how high-level employees believe things are going well, mid-level employees are sending unfavorable information back down and favorable information up to the highest levels, and lower level employees are too busy to see the big picture or afraid to be considered troublemakers for passing along unfavorable information. These multiple, self-reinforcing loops mean that unfavorable information is often forgotten. Within the pattern, behaviors have a reason to continue, leading to systemic distortion. Catastrophic problems are addressed through blaming but the system is let off the hook. Bella urged audience members to break the pattern and sustain credible disturbances, although you cannot expect applause when you act out of context with the system. He noted that those who become "combat biologists" don't regret it.





Note: Videos of the entire Plenary Session and the Business Meeting are available at http://vimeo.com/user14635418/videos.

SYMPOSIA SUMMARIES



38th Annual Larval Fish Conference conveners Pascal Sirois (left) and Dominique Robert (right), helping Chris Chambers with the promotion of the new Early Life History Section T-shirt at the AFS Trade Show. Photo credit: Chris Chambers.

38th Annual Larval Fish Conference

This year marked the third time that the annual meeting of the Early Life History Section was held in conjunction with the Annual Meeting of the American Fisheries Society. The symposium attracted more than 150 delegates from 17 countries and included 131 oral and poster presentations, grouped into five main theme sessions: (1) Hjort 100th Anniversary Session on the Contribution of Mortality during Early Life in Driving Recruitment Variability; (2) Larval Dispersal and Population Connectivity; (3) Contribution of Early Life History Studies to the Management of Fish Populations; (4) Larval Development: How Physiological Tools Can Be Used for Studying Global Challenges; and (5) Ecology, Modeling, and Emerging Issues for Fish Early Life History in the Laurentian Great Lakes. Those five theme sessions were led by inspiring keynote addresses from Akinori Takasuka (Japan), Paul V. R. Snelgrove (Canada), John M. Farrell (United States), Guy Claireaux (France), and Stuart A. Ludsin (United States). The scientific program of the Larval Fish Conference highlighted the crucial contribution of early life physiology and ecology to the regulation of recruitment and dispersal of freshwater, estuarine, and marine resources. A better understanding of processes occurring during the egg, larval, and juvenile stages may thus provide powerful tools for the management of fish stocks.



Elbert H. Ahlstrom Lifetime Achievement Award recipient, William C. Leggett. Photo credit: <u>Chris Chambers</u>.

One of the main highlights of the 38th Annual Larval Fish Conference came on the last day of the meeting with a plenary tribute session to William C. Leggett (Principal Emeritus, Queen's University). Five former Ph.D. students and postdoctoral fellows of Dr. Leggett's laboratory presented an overview of their research programs featuring early life stages of fish. During the evening following the tribute session, the Early Life History Section presented its prestigious Elbert H. Ahlstrom Lifetime Achievement Award to William C. Leggett. The exceptional contributions of Leggett to our understanding of the early life history of fishes have inspired the careers of a number of fisheries scientists worldwide and led to major progress in fish ecology and studies of recruitment dynamics.

On Thursday evening, during the Section banquet hosted at the Aquarium du Québec, the Sally Richardson (best oral paper) and John H. S. Blaxter (best poster) Awards were presented to Alison Deary (Virginia Institute of Marine Science) and Carissa Currie (Memorial University of Newfoundland), respectively.

Members of the Early Life History Section had a wonderful week in Québec City and attended or contributed to several other symposia within the AFS meeting. The highly positive comments received throughout the week are setting the way for another future joint meeting of the Section with the entire Society!

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Are We Still Fishing down the Food Web?



American Institute of Research Fisheries Biologists's "Fishing Down" symposium keynote speakers, Trevor Branch (left) and Villy Christensen (right), discuss their different perspectives with another symposium presenter, Tim Essignton (middle).

Just over 15 years ago, the phrase "fishing down the food web" was coined. That phrase described how fisheries systematically target fish species lower and lower in the food web as they deplete higher trophic levels. This fishing pattern can have dramatic impacts on an ecosystem. The American Institute of Research Fisheries Biologists convened a session that revisited this topic with investigations from several perspectives, including lower trophic level impacts, economic impacts, and even the effectiveness of the mean trophic level of the catch as an ecosystem indicator. The symposium was highlighted by two keynote presentations. The first keynote address was by one of the original authors of the concept, Villy Christensen. The other keynote was by Trevor Branch, who has contributed several reanalyses of trophic levels and fishing patterns. The two keynotes offered some reconciliation of their different perspectives and answered questions together during a discussion session following their presentations. Throughout all of the presentations, evidence was provided for fishing down, "fishing through" (systematically adding lower trophic level fisheries), and even "fishing up" in some places. Opinion pieces by both keynote authors will be available along with other highlights from the symposium in an upcoming issue of Fisheries.

Sean M. Lucey, NOAA National Marine Fisheries Service, Northeast Fisheries Science Center

BEST STUDENT PAPER SYMPOSIUM

2014 AFS/Sea Grant Outstanding Student Presentation Award and AFS Outstanding Student Poster Award

In March 2014, we received over 80 applications, but only 44 submissions were complete, meaning that they included standard abstracts, extended abstracts, and advisor confirmations. Is it possible that many students and advisors are still unaware of the extended abstract or advisor confirmation requirement that has been in place for over five years? Detailed announcements, newsletter articles, and an award webpage (www.fisheriessociety.org/education/BSP.htm) provide application instructions, so please let us know how else we can spread the word about the application process. We hate to turn away applications from the future of our Society—help us help you!

Each submission was assessed against a judging rubric by two judges, one being a Division Representative from the Education Section and one being a Division Representative from the Student Subsection. Twenty finalists were selected to give oral presentations during the Best Student Paper Symposium, and six finalists were selected to give poster presentations during the Best Student Poster Symposium. Note that this is twice as many poster finalists as in 2013, but we still strongly encourage more students to submit applications to the poster competition—the monetary award size is the same!

At the 2014 AFS Annual Meeting in Québec City, more than 120 meeting registrants volunteered to serve as oral and poster judges—our Society is incredibly grateful for their service to arguably the most important sector of the Society: our students! We selected four professional judges and one student judge to evaluate the oral presentations and the same number to evaluate the posters. Why did we increase the number of poster judges from three to five? We felt that with the large number of volunteers and the small number of posters



Samreen Siddiqui receives the 2014 Best Student Paper Award in the poster presentation category from President Bob Hughes.



Corey Eddy won the 2014 Best Student Paper Award in the oral presentation category.

there would be ample time for the judges to meet with all six finalists during the Trade Show and Poster Session Networking Event on Monday evening. We also felt that equating the number of judges between the oral and poster presentations would emphasize that excellent poster presentations are just as important as excellent oral presentations. All six finalists' posters were located next to one another in the exhibit hall to facilitate judging and highlight the Best Student Paper Symposium.

The Best Student Paper Symposium was held on Monday afternoon and Tuesday morning. New this year was an option for judges to either use electronic judging forms or the traditional hard copy judging sheets. The Judges' Luncheon (free!) immediately followed on Tuesday and, for the first time, the winners were announced at the AFS Business Meeting at the same Annual Meeting. Corey Eddy (University of Massachusetts Dartmouth) was the winner of the oral presentation category for his paper entitled "Capture-Related Mortality and Post-Release Survival of Pelagic Sharks Interacting with Tuna Purse Seines in the Eastern Pacific Ocean." Honorable Mention went to Elizabeth Ng (University of Idaho) for her paper entitled "Estimation of Gill-Net Selectivity for Lake Trout and Application to Demographic Parameter Estimates." Samreen Siddiqui (Valdosta State University) won the poster presentation category for her paper entitled "Copper Oxide Nanoparticles Are More Toxic Than Dissolved Copper to the Sea Anemone, *Aiptasia pallida*." Honorable Mention went to Craig Schake (South Dakota State University) for his paper entitled "Gape: Body Size Relationship in Smallmouth Bass."

Cochairs of the symposium were Matt Catalano (Auburn), Mark Fincel (South Dakota Game, Fish and Parks), and Katie Bertrand (South Dakota State University).

Katie N. Bertrand, South Dakota State University



Big Data Science and Its Impacts on Fish Conservation and Management

Researchers from diverse backgrounds highlighted emerging strategies that exploit the tsunami of "big data," as delivered by genomics, geographic information systems (GIS), and remote sensing. Several presentations underscored the tremendous scientific potential produced by genotyping many individuals across thousands of loci but also the analytical and data management challenges that result. Speakers discussed creative solutions and showcased conservation applications, such as use of environmental DNA (eDNA) to detect rare or invasive species and identify adaptive loci that can be used to track their movements. Similarly, high-resolution satellite images of Earth and real-time weather, hydrology, and water quality data have likewise forced GIS and remote sensing applications to innovate. Automated GIS workflows, multiscale analyses, and novel statistical approaches now exemplify the ongoing methodologies for manipulation of large data. Researchers repeatedly demonstrated the necessity of big data

in assessing habitat changes, barriers to movements by fishes, and resilience of habitat to climate change. A panel discussion juxtaposed perspectives from genomics and macroecology and identified data management as an overarching challenge, particularly as it relates to standardization, centralized archiving, and eventual access by stakeholders. The panel reiterated that interdisciplinary communication and diverse coalitions are essential for optimizing the value of big data.

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Challenges in Managing United States Marine and Estuarine Recreational Fisheries

The symposium was very informative about the complicated process of managing marine recreational fisheries along the U.S. East Coast and also highlighted some interesting data collection and science programs being used to address marine recreational fisheries issues. One paper was about how the U.S. Fish and Wildlife Service Sport Fish Restoration Program has been a very stable source of funding for state marine fisheries agencies and delved into issues faced when states use those funds to build artificial reefs in federal waters. Two economic papers were most interesting. One highlighted the major economic contribution recreational fishing provides to the U.S. economy, and the other was a groundbreaking Massachusetts study that gives definitive evidence on how much anglers value their ability to go fishing in real dollar values. Another presentation looked into how to engage Florida anglers in fisheries management, and the session ended with an exceptionally good panel discussion on that same issue on a coastwide basis. We included a graduate student sociologist on the panel with some experienced fisheries scientist and managers. Everyone who attended learned something new.

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Common Challenges and Opportunities for Global Fisheries: An International Perspective

Marine fisheries are a huge global industry with many challenges. At present, we are approaching our production limits in sustainable fisheries, climate change continues to change the world's oceans and the fisheries that rely on them, human populations and demands for food continue to increase, and the cost of fossil fuel continues to rise and affect the economics of industrial fishing. This symposium featured 12 speakers from the fishing, fish processing, management, and research sectors representing major fisheries nations (United States, Canada, Japan, South Korea, and United Kingdom). Discussions addressed the major challenges and social and scientific needs perceived by each sector; opportunities for future fisheries were also discussed. The goal was to identify a set of common guidelines or key issues of concern for future management of global fisheries. Several additional talks were added to expand on this theme.

A central theme of the session was the challenge of management in the context of climate change, and hence overlap of these two aspects was a common thread. Several talks described the effect of changing environments on fish distribution and fishing success. Topics ranged from the interactions between young of year Alewives and juvenile Atlantic Herring with Gulf of Maine Cod, to anticipated effects of climate change on fisheries in the Shiretoko World Natural Heritage Site (Japan) and the profound impact of climate change on European fish populations. Stock enhancement and improved use of bioresources programs were of particular interest and concern. Given the complexity of ocean ecosystems, another common thread was risk management based on adaptive and potentially mitigative impacts resulting from diverse human activities in oceans.

The role of management in the coming years was also a major consideration. In addition to a nice history of the U.S. Fishery Conservation and Management Act, modifications underway were discussed. How U.S. seafood is acquired, processed, and provided to the market is and will change, resulting in new fisheries management policies. Profound changes in North American social–ecological systems also has led to significant changes in the governance and management of marine fisheries. With fishing harvests fluctuating in recent decades in Korea, the importance of fisheries resource management has emerged. Data collection and research on the development of semiquantitative and qualitative management indicators and biological reference points are under development. As enhanced understanding develops about the impacts on marine ecosystems and changes within the seafood industry, third-party standards must keep pace and stay relevant. Determining international "best practice" science and management for sustainable fisheries was described as part of a 2013 fisheries standard review. Finally, the carbon footprint of different fisheries was examined based on case studies of fisheries in North America, Europe, and Australia.

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Community Ecology and Trophic Interactions of Fishes

The intent of the symposium was to revitalize the Gutshop Symposium series that was active during 1980s and 1990s. Jason Link opened the proceedings by explaining the current and historic role that trophic ecology has in fisheries biology. The next 34 presenters put on a showcase for the new generation of Gutshops. Some presenters reviewed methods, including the application of insulin-like growth factor to evaluate trophic status, use of genetic barcoding to assess diets, and the relative benefits of stable isotope and fatty acid analysis. Others combined stable isotope and diet analysis with bioenergetic models to describe interactions in fish communities and assess the impact of invasive species. Still others described methods for estimating the number of stomachs to examine, discriminating bottom-up versus top-down effects, and applications of the size relationships between predators and their prey. Talks covered marine ecosystems from the northeastern United States to the Gulf of Mexico and the Bering and Ross seas, and freshwater systems extended from North America to Kenya. All in all, the session revealed trophic ecology to be a powerful way of understanding how fish and fish communities relate to their environment.

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Dam Effects on Fishery Resources

The Dam Effects on Fishery Resources symposium sponsored by the Water Quality Section, Fish Habitat Section, Bioengineering Section, and International Fisheries Section provided an international discussion on the impacts of dams on fisheries. The primary goal of the symposium was to evaluate the effects of both dam removal and construction of new dams on fishery resources, including ecological, social, and economic impacts.

This symposium brought together 35 speakers from the United States, Canada, the United Kingdom, France, Portugal, Malaysia, and China. The audience was challenged to think about a future without the Conowingo Dam, and five different presentations on the Yanghtze River basin highlighted the changes in the fish community as well as social impacts within the watershed following construction of multiple dams, the largest of which is the Three Gorges Dam. Several speakers documented dam removals and increased access to historic spawning grounds for migratory species, and others discussed the role of dams in controlling invasive species in the Great Lakes. One presentation provided a comprehensive view of combining new construction for flood control while providing habitat enhancements for threatened and endangered species. The symposium was well attended, with the room filled to capacity during many of the presentations. We expect the discussions to continue as both dam removals and construction of new dams continues around the world.

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Developing a National Fisheries Data Exchange Standard

The AFS Fisheries Information and Technology Section (FITS) and the Organization of Fish and Wildlife Information Managers cohosted a symposium moderated by Andrew Loftus, AFS Fisheries Information and Technology Section, and Jennifer Bayer, U.S. Geological Survey. As the title indicates, the symposium featured nine talks framing the national fisheries data exchange standard discussion and highlighting recent efforts to develop a foundation for moving forward with the initiative. Topics ranged from Doug Austen's (AFS) keynote address entitled "The Timing Is Right for Fisheries Data Exchange Standards" to Janice Gordon's (U.S. Geological Survey) "Semantic Web Methodologies: Facilitating the Design of a National Fisheries Exchange Standard." Talk summaries/abstracts, PowerPoint presentations, and additional information on the fisheries data exchange initiative will soon be available on the FITS website at: www.fishdata.org.

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Potential fisheries data exchange elements and relationships

Ecosystem Services: Bridging Natural and Social Sciences toward Sustainable Polices

Inland fisheries provide essential ecosystem services to society both locally and globally. These services provide for human well-being through benefits such as food security, nutrition, recreation, prosperity, and regulation of ecosystem processes. Fisheries exist in the context of complex socioeconomic needs on the environment that threaten fisheries production, including overfishing, impacts to water quality and quantity, and other habitat degradation.

Presentations in this session focused on the need to appropriately communicate the value of inland fisheries locally and globally, including all sectors that may inadvertently affect inland fisheries production. Interdisciplinary approaches were stressed by participants that would assist fisheries managers in attempting to balance stakeholder demands, integrate new knowledge and technology into fisheries management, and more effectively enforce fisheries regulations. The ecosystem services framework presented provides a mechanism for better describing the value of inland fisheries.

The symposium highlighted the importance for inland fisheries to the overall health and productivity of human society worldwide and laid the groundwork for the upcoming Global Conference on Inland Fisheries, which will be held at the Food and Agriculture Organization of the United Nations in Rome, Italy, 26–28 January 2015.

eDNA: A New Tool for Aquatic Conservation and Fisheries Management

Reflecting the rapid expansion of eDNA technology and applications, an eDNA symposium convened 16 speakers representing diverse interests, including private companies, government agencies, and university-based geneticists and ecologists. The eDNA symposium and the social event were cosponsored by Genidaqs and the AFS Genetics Section.

A keynote presentation by David Lodge reviewed recent progress in eDNA research and remaining challenges to refine methods and increase the information that can be gleaned about species and ecological communities from the DNA contained in water samples. Other speakers revealed the latest discoveries about the nature of eDNA (sources, size distribution of eDNA-bearing particles, and fates), methodological and molecular advances and limitations (including the most recent ultrasequencing approaches), and the reli-



David Lodge gives the keynote presentation at the eDNA Symposium. Photo credit: Melania Cristescu.

ability of species detection. Presentations about the restricted spatial and temporal distribution of eDNA in natural ecosystems confirmed that eDNA provides evidence of local and recent species occurrence. However, increasing safeguards against contamination must accompany technological increases in detection sensitivity. Overall, it is clear that eDNA methods will continue to develop rapidly but that eDNA is already an increasingly useful tool in conservation and fisheries management.

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Engaging the Right Partners: Multidisciplinary Approaches to Propagation to Support Conservation and Management

This symposium, sponsored by the Fish Culture Section, included 17 presentations discussing the proper use of cultured aquatic animals to support conservation management. Though hatchery-reared organisms must be carefully used in restoration and management efforts to avoid pitfalls, they are an indispensable tool. Proper use, monitoring, and methods to improve the use of hatchery-produced aquatic organisms were discussed.

The symposium began with a presentation entitled "Progress on the AFS Initiative: Hatcheries and Management of Aquatic Resources." This presentation set the stage for a day of diverse talks that included culture of aquatic organisms from Lake Sturgeon, Black Bass, Bloater, and Smelt to freshwater mussels, amphibians, marine finfish, and salmonids. The need for cooperation among disciplines was evident in every presentation. The symposium was well attended (with up to 45 attendees in the room at a time) and generated excellent discussion throughout.

An added highlight was the presymposium dinner held in the Old City on Tuesday night. About 20 participants and friends got to know each other better over dinner. This social interaction led to a more integrated symposium with more audience interaction during the question-and-answer opportunities.

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Fire Management and Aquatic Ecosystems: Past, Present, and Future

As we move into the 21st century, climate change continues to exacerbate the frequency, severity, and size of wildfires worldwide. Knowledge of how this natural disturbance impacts aquatic systems will be crucial to managing wildfire and the systems it affects. The Fire Management and Aquatic Ecosystems Symposium was, therefore, a timely event, featuring a small but passionate group of scientists intent on learning more about the intersection of disturbance ecology with aquatic resources. We represented a fascinating cross section of the state of the science of this emerging discipline: ecosystem ecology, invertebrate community ecology, food web ecology, fish life history, stream temperature modeling, and managing fire to minimize effects on endangered Chinook Salmon or Bull Trout. Put together, the different focuses of each researcher made up a more comprehensive picture of the effects of wildfire on aquatic ecosystems. The symposium served the very valuable purpose of bringing together researchers from disparate parts of North America to talk about fire and aquatic systems-those who study this topic are comparatively few and often scattered across states and institutions. At the symposium's end, a holistic picture of fire effect on aquatic systems began to emerge: aquatic systems and their biota can be extremely resilient to the effects of fire, and even benefit from it, but full ecosystem recovery may occur on a decades-long scale. At the same time, to be truly resilient, a system or a population needs to be healthy, unfragmented, and not subject to a suite of other stresses-and therefore, wildfire can have detrimental effects on already vulnerable populations. Hence the need to learn more about its effects and how to predict and manage them. At the end of the day, symposium participants discussed the need for a comprehensive "state of the science" review of fire effects on aquatic systems and resolved to begin work on a review paper to accomplish this.

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Fish Migration and Ocean Tracking Network

The Fish Migration and Ocean Tracking Network Symposium, including 17 oral presentations, presented the objectives and structure of the Ocean Tracking Network (OTN; http://oceantrackingnetwork.org) and provided a forum for the presentation of fish telemetry studies performed by a wide variety of researchers, both members and nonmembers of OTN. The symposium keynote speaker, Kenneth Lohmann, presented the body of evidence demonstrating how turtles and salmon are using the Earth's geomagnetic field (particularly two components of it: inclination and total intensity) to navigate. He showed that the distribution of juvenile Pacific salmon was partly explained by the year-to-year variability in the geomagnetic field. David Noakes presented novel work demonstrating that Pacific salmon juveniles have a magnetic map sense that is inherited. Several talks focused on the use of coupled biophysical particle-tracking models as a means of testing different hypotheses concerning orientation ability relative to oceanic circulation patterns. The array of species studied by participants was impressive, from Striped Bass in the St. Lawrence and Atlantic Cod in the Gulf of Maine to several



Cliff Creek, Frank Church Wilderness, Idaho, after the severe Diamond Peak wildfire.



Several years after the Diamond Peak wildfire, riparian vegetation and stream biota are beginning to recover and thrive on Cliff Creek. Photo credit: Jim and Holly Akenson.



Fred Whoriskey, OTN executive director, presents the goals of OTN during the AFS symposium on fish migration and OTN. Photo credit: Kyle McKenzie, OTN, Halifax.

freshwater species in Toronto harbor. The diversity of these acoustic telemetry studies demonstrated the importance of multidisciplinary networks such as OTN to promote telemetry technology to identify not only mechanisms of migration but also topics of immediate management, policy, and decision-making importance such as habitat preference, habitat connectivity, and the success of habitat enhancement programs.

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Fishing Gear Selectivity and Selective Fishing: Means, Methods, and Implications

The recent shift to ecosystem-based fishery management has propelled debate and discussion concerning well-established management strategies that promote selective fishing for larger fish and more valuable species. This symposium offered the opportunity to present recent developments in selectivity analysis and selective fishing methods, to discuss broader implications of selective harvest, and to consider alternative harvesting strategies. The balanced harvest concept was introduced and broad uncertainties and challenges of its implementation were revealed and discussed during the symposium. A consensus developed that the implementation of balanced harvest would not be simple, and a consequence of its implementation, perhaps counterintuitively, would be a need for even more selective fishing gears and practices. Other talks included the consequences of harvesting only large fish and how selectivity of fishing gears might affect stock assessment outcomes. Several talks sought to disturb the "common truths" of fishing gear selectivity: dome-shaped trawl selectivity, poor applicability of cod-end selectivity studies to the commercial fleet, and others. The messages of the symposium were as follows: (1) the concept of balanced harvest is still in its infancy and needs further elaboration and definition, (2) balanced harvest may require more complex survey gears and more selective commercial fishing gears, and (3) we should remain skeptical toward even basic principles and "facts" of fishing gear selectivity. Chairs and conveners were Pingguo He, Michael Pol, and Petri Suuronen.

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Future of Fisheries: Perspectives for Emerging Professionals

In this fast-paced world of hectic schedules, impending deadlines, and increasingly long to-do lists, why would anyone want to make the time to be a mentor? Mentoring is a significant time commitment, often involving integrating the mentee within the networks that a mentor has developed over the years and investing resources to benefit a mentee's personal and professional development. But, as many mentors have remarked, they also benefit and learn from their mentees, making mentoring a mutually enriching experience for both. To foster such a mentoring environment, we held the "Future of Fisheries: Perspectives for Emerging Professionals" symposium. Forty distinguished speakers shared valuable lessons and advice that played a significant role in their professional and personal development. The objective of this symposium, and its companion book by the same name (published by AFS), was to use these unique experiences, lessons learned, and valuable perspectives to guide emerging fisheries professionals on the path to self-improvement and career development. We hope that both the symposium and book empower the newer generations of fisheries professionals and assist in their professional growth by providing examples relevant to personal and professional development.

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Gaining Better Understanding of Resources and Resource Users through the Application of Emerging Technologies

The Fisheries Information and Technology and Socioeconomics sections cohosted a symposium to highlight and discuss innovative technologies being used by fisheries biologists. Recent advancements have brought new tools and applications for use in science, social science, and human dimensions. Some of these emerging technologies are being utilized by fisheries scientists to better understand the resource and resource users. Smartphones, digital tablets, digital pens, trail cameras, and other technologies are being utilized to increase efficiency, effectiveness, and accuracy in data collection. Angler survey methods are evolving to better exploit new hardware

and software applications. Data mining software has enabled agencies to better understand anglers and utilize such information to increase angling participation and revenue. Fifteen presenters provided examples on improving the types, quality, quantity, and speed of data collection, including (1) improving knowledge of resource user by using digital cameras and mining data from neighborhood demographics and social media; (2) collecting field data electronically to improve efficiency and accuracy; (3) studying movement and behavior; (4) classifying habitat; (5) uploading commercial and recreational harvest data; and (6) determining food sources. Summaries of each talk and links to the presentations will be available on the FITS website www.fishdata.org soon.

> Joanna Whittier, University of Missouri, whittierj@missouri.edu, and Julie Defilippi, Atlantic Coastal Cooperative Statistics Program, julie.defilippi@accsp.org

Genomics Tools for Fisheries Management and Conservation: Promises and Challenges

This two-and-a-half-day symposium featured 38 invited and contributed talks from a global community of professionals and students. Michael Hansen and Kristi Miller set the stage with their keynote talks by outlining their distinguished research programs that draw heavily on emerging genomic technologies to answer key questions about adaptation in wild populations of fishes. This theme was carried forward in contributed talks that focused on the incredible advances in both sequencing technology and statistical analyses. The presentations demonstrated how these tools are used to determine the genetic basis of key adaptive traits, to identify patterns of introgression

and hybridization at the genomic level, to define and manage fisheries resources and populations with increased resolution using high-throughput genetic marker technologies, and even how to assemble genomes of non-model species. Attendees were inspired to use advanced statistical methods to better explore the polygenic basis of complex traits, to utilize draft genome assemblies and high-density genetic maps to better inform their studies, and to explore adaptation in dynamic environments. The success of this symposium could entirely be attributed to the high caliber of talks outlining exciting research being conducted by this community.

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New genomic tools are used for fisheries management and conservation.

Integrated Pest Management Approaches for Combating Aquatic Nuisance Species

During the Integrated Pest Management (IPM) Symposium, sponsored by the Introduced Fish Section, presenters covered a broad range of systems and topics on integrative approaches to combat aquatic nuisance species. Common themes throughout the symposium included integrating new technology with current techniques and utilizing other research programs and management agencies.



Commercial fishing is used to combat Asian carp on the Illinois River. Photo credit: Blake Ruebush (IL DNR).

Given the high priority for management, a large portion of the symposium included IPM strategies for Asian carp. Commercial fishing has shown great

promise to stall the movement, new technologies (e.g., water guns, paupier nets, and pound nets) are being evaluated for capturing carp, and large strides are being made using eDNA for detection. Canada also revealed their Asian carp plan.

A variety of IPM techniques for other aquatic nuisance species were also discussed. Elevated pH (11.2–12) was shown to be a safe and effective way to disinfect ship ballasts. Management of Sea Lamprey that once included only lampricides and physical barriers now aims at lessening ecosystem impacts by using new methods such as pheromone attractants. Lake drawdown with netting or trapping is being used to manage Common Carp in Minnesota as well as Largemouth Bass in Japan. In the Midwest, multiple researchers are testing water guns to deter or kill invasive species (Round Goby, rusty crayfish, and Asian carp) with mixed results. Furthermore, South African research highlighted the socioeconomic, logistical, and legal factors that complicate the management of Smallmouth Bass due to their popularity as a sportfish. Overall, attendees benefited from learning about application of multidisciplinary research to practical management problems.

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Integrating Ecosystem Threshold Responses into Living Marine and Aquatic Resource Management

Our symposium brought together people from different institutions to share research findings and stimulate discussions on "Integrating Ecosystem Threshold Responses into Living Marine and Aquatic Resource Management." Ten speakers presented research on ecosystem thresholds and tipping points from the perspective of multiple disciplines, including ecology, fisheries and ecosystem management, economics, law, and policy. The symposium was well attended and it highlighted the great progress being made to identify and understand the prevalence of ecological thresholds, account for them in fisheries and ecosystem models, and implement them in management and policy frameworks. In addition, the symposium brought to light many avenues for future work, including identifying threshold responses to multiple stressor combinations; testing the utility of early warning indicators in detecting tipping points; improving our understanding of the interactions and feedbacks among ecological, social, and economic systems that can prompt ecosystem shifts; and further evaluating of the performance of management control rules using empirically defined thresholds in ecological indicators.

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International Eel Symposium 2014: Are Eels Climbing Back up the Slippery Slope?

After the international anguillid eel symposium that was held at the AFS Annual Meeting in Québec City in 2003, the participating scientists unanimously agreed that they must raise an urgent alarm about the declines in recruitment and juvenile abundance and call for precautionary actions to be taken immediately to protect these eel species. Eleven years later, an international anguillid eel symposium was held again at the 2014 AFS Annual Meeting in Québec City, which was entitled "Are Eels Climbing Back up



the Slippery Slope?" This symposium provided the opportunity for scientists from 21 countries from North America, Europe, Africa, New Zealand, and East Asia to report and reflect on recent research efforts, management actions, and progress to help conserve anguillid eels. The 2003 Québec Declaration of Concern may have had an important effect that helped to stimulate a wide range of research, monitoring, and management efforts for some species. The three Northern Hemisphere species have been further studied for understanding their biological characteristics, genetics and genomics, recruitment, abundance, and escapement and their relationships with anthropogenically created challenges. Some studies have provided new information about other *Anguilla* species. Further progress also has been made to raise

eel larvae in the laboratory for providing seedlings for aquaculture but not yet at commercial scales. Much of this research was examined in the 2014 symposium, along with efforts to monitor and manage these commercially harvested species. In addition, as overviewed during the symposium, most anguillid eel species are now listed on the International Union for Conservation of Nature Red List, and the Convention on International Trade in Endangered Species has banned all international export of the European eel beginning in 2010. This had unintended consequences, however, by increasing fishing pressure on other species to supply seedlings for aquaculture in East Asia. These problems and the continued lack of clear evidence to link the declines of eels with specific anthropogenic or ocean–atmospheric causes continue to cause concern among scientists. The symposium highlighted the need for the establishment of greater interregional coordination among the many countries where the individual eel species are found. For example, little is known about the eels in the Southernmost parts of the ranges of the European and American eels, and research has only recently begun on American eels in the Mississippi River drainages and the Caribbean. Information exchange has been occurring among scientists and eel industry members in East Asian countries, as has occurred among scientists in the United States and Canada in recent years, but formal governmental organizations have not yet been formed to oversee the management of the American and Japanese eels or the greater number of tropical anguillids in the Indo-Pacific region. It was evident during the 2014 eel symposium that progress has been made through research, management, and conservation and that recent increases in recruitment of some species offer some hope for optimism, but much effort in all aspects of work with anguillid eels is still needed.

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Cochairmen of the symposium "Jawless Fishes of the World" Alexei M. Orlov (left) and Richard J. Beamish (right).

Jawless Fishes: Global Advances and Perspectives

Living jawless fishes are elongate eel-like animals lacking paired fins, represented by hagfishes and lampreys. These animals are the only living representatives of ancient creatures that gave rise to the fish and eventually humans.

Hagfishes are marine animals that are widely distributed in the world's oceans and are among most abundant demersal fishes in many areas. They represent a very diverse group of fishes whose taxonomy is poorly understood and documented. It is widely believed that hagfishes damage commercial catches of other species. However, some of them have commercial importance, for example, in Japan and Korea. Fisheries for hagfish have developed over the last few decades off both coasts of Canada and the United States, as well as off Mexico. Despite wide distribution, high abundance, and the importance of these fisheries, many issues related to taxonomy, distribution, phylogeny, and life cycle of hagfishes are still poorly understood.

Lampreys inhabit freshwater, brackish, and marine environments and are represented by over 40 parasitic and nonparasitic species. They are widely distributed and most abundant in the Northern Hemisphere, but some species also occur in the southern part of the world. These animals have specific life cycle characterized by

a long larval stage (ammocete) in freshwater with subsequent radical metamorphosis. Lampreys play a significant role in freshwater and marine ecosystems as prey and parasites or predators for variety of aquatic animals. On the one hand, some species are commercially important. On the other, they may damage fish in commercial catches. Despite a long history of research, lampreys still remain insufficiently studied.

The main purpose of the one-day symposium (entitled "Jawless Fishes of the World") was to provide an overview of the current status of knowledge on the variety of topics related to jawless fishes, including their taxonomy, zoogeography, phylogeny, molecular biology, behavior, life history, role in the ecosystem, stock assessment, species interactions, and fisheries management of hagfishes and lampreys worldwide.

The symposium attracted presenters from Canada, Germany, New Zealand, Russia, and the United States. There were 18 oral presentations and three posters. The symposium was convened by Alexei M. Orlov (Russian Federal Research Institute of Fisheries and

Oceanography, Moscow, Russia) and Gordon A. McFarlane (Fisheries and Oceans Canada, Pacific Biology Station, Nanaimo, retired) with the support of the Marine Fisheries Section and International Fisheries Section of the American Fisheries Society. It was cochaired by Alexei M. Orlov and Richard J. Beamish (Fisheries and Oceans Canada, Pacific Biology Station, Nanaimo, retired).

The main output of this symposium will be the book entitled Jawless Fishes of the World (tentative title) that is intended to publish with Cambridge Scholars Publishing and be coedited by Alexei Orlov and Richard Beamish. Authors from nine nations, including Brazil, Canada, Czech Republic, Japan, Mexico, Portugal, Russia, Spain, and the United States, are enthusiastic in preparation of their chapters for the book that will likely be published in the first half of 2015.

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Linear Developments across Waterbodies and Their Potential Effects on **Fish and Fish Habitat**

Linear developments (i.e., pipelines, roads, transmission lines, utility corridors, canals, etc.) are a driving force of today's economy. When they intersect watercourses, construction, mitigation, and restoration planning can determine the development's potential impact to fish and fish habitat. The Linear Development Symposium brought together presentations on preconstruction assessment

methods and recommendations, construction methods and mitigation, postconstruction monitoring, crossing restoration and remediation, and associated regulatory requirements.

Specifically, presentations included studies on fish passage through culverts, mitigation for fish during in-stream construction on large rivers, a general breakdown of construction methods for a trenched pipeline watercourse crossing, restoration and recovery of waterbodies after pipeline construction, a summary of NEB regulations surrounding linear developments, and a summary of convictions under 36(3) of the Fisheries Act. The symposium was well received and many of the presentations generated a great deal of discussion.

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Marine Mammal and Fisheries Interactions: Management Challenges in a Changing World

Interactions between marine mammals and fisheries can be either direct (or operational), through bycatch, depredation, and disturbance, or indirect (or ecological), through competition, trophic interactions, or habitat degradation. In both cases, such interactions pose serious conservation challenges, and this has become an increasingly important topic in managing marine ecosystems and the species they support, resulting in new paradigms in fisheries management. Accordingly, we convened the first symposium on this topic to be held at an AFS meeting. A wide spectrum of topics was included in our symposium, ranging from technology-based approaches for documenting predation to large-scale ecosystem modeling. Several student presenters shared their work as poster and oral presentations. Among the recurring themes of the presentations and discussions were the importance of collaboration among scientists and the fishing community, multidisciplinary approaches, and novel applications of technology to document and mitigate direct interactions. With respect to modeling and understanding ecological interactions, common themes included the importance of diet, population, and distributional data collected at the appropriate spatiotemporal scales. We look forward to synthesizing these and other topics as part of a special AFS journal issue or other publication in the near future.

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Cover illustration for the book on

jawless fishes of the world (by Svetlava Orlova).

A large river pipeline under construction. Photo credit: TERA **Environmental Consultants.**



Student Aline Carrier delivers her presentation, "An Ecosystemic Approach to Understand the Relationship between Species in Risk and Species in Overabundance in the Gulf of St. Lawrence."



The Next Generation of Fish Stock Assessments

The symposium entitled "The Next Generation of Fish Stock Assessments" featured keynote speakers Richard Methot (National Oceanic and Atmospheric Administration [NOAA] senior scientist for stock assessments) and Jason Link (NOAA senior scientist for ecosystems). The diverse assembly of presenters included representation from government, academia, and industry from various U.S. and international groups and covered a spectrum from established and renowned scientists to up-and-coming students and early career professionals. Themes that arose during presentations and postpresentation discussion were continued in a capstone discussion at the end of the symposium. The discussion focused on two central questions: (1) What are the key developments in stock assessment science? and (2) What investments are required to implement these developments? Themes of analytical methods, ecosystem considerations, quantifying and communicating uncertainty and risk, as well as other miscellaneous contributions were further explored. Ultimately, the symposium culminated in several recommendations for further development. The symposium was organized, chaired, and moderated by Tara Dolan and Patrick Lynch, with Keith Chanon as rapporteur, all of the NOAA Fisheries Office of Science and Technology.

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Temperature-controlled deck tank system aboard commercial vessel. Photo Credit: Ryan Knotek.

Out of Sight, Not Out of Mind: Estimating and Reducing Release Mortality in Commercial and Recreational Fisheries

The disposition of animals discarded as bycatch in commercial fisheries or catch-and-release recreational fisheries is receiving broad interest worldwide. In response to this interest, a symposium sponsored by the Marine Fisheries and Fish Physiology sections was convened to highlight current research efforts. The major focus of the presentations revolved around topical studies with the objective of estimating discard mortality rates for specific species or species groups. The geographic range of the taxa studied, as well as the methodological approaches discussed in the presentations, was expansive, reflecting growing research efforts in this field. Though the focus of the symposium was related to species specific studies, participants and attendees also received a context of how research efforts can fit into a framework to better manage fishery resources. Identification of data gaps, approaches to scale study results to the fishery level, and fishery management implications represented the bridging of study-level information to a better understanding of the human impact on fishery resources. The symposium closed with

a presentation that asked the question, "What's become of the discarded?" Though we may not have yet fully answered that question, based on the presented works, efforts will continue to further the experimental and analytical methods to estimate this often cryptic source of fishing mortality.

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Population Dynamics and Sustainable Fisheries for Highly Migratory Large Pelagic Species

The symposium entitled "Population Dynamics and Sustainable Fisheries for Highly Migratory Large Pelagic Species" was broad in scope, covering topics from basic life history and stock structure to bycatch, assessment modeling, and management. A number of speakers focused on Bluefin Tuna, but with presentations spanning one-and-a-half days, there was plenty of time for talks on other tunas, billfish, and sharks. The symposium brought together international experts with strong representation from government agencies and academia. The sustainable management of highly migratory large pelagic species is faced with numerous challenges, but there were several novel ideas for confronting challenges presented in this symposium, providing hope for future sustainability. The symposium was organized, chaired, and moderated by Jon Brodziak and Patrick Lynch of NOAA Fisheries.

Patrick Lynch, NOAA, Patrick.Lynch@noaa.gov



A lake sturgeon spawning pod in the Winnebago system. Photo credit: Bob Rashid.

Practical Applications of Sturgeon Research

Members of the order Acipenseriformes are threatened throughout their native ranges, mostly due to the negative impacts of overharvest and habitat loss. Due to their threatened status, North American Acipenseriformes species have been heavily researched over the last 35 years. This research has substantially advanced the understanding of sturgeon and Paddlefish life history, behavior, and population dynamics. Working toward surgeon conservation and restoration goals, the North American Sturgeon and Paddlefish Society was recently formed. As part of these overarching goals, the North American Sturgeon and Paddlefish Society sponsored a symposium entitled "Practical Applications of Sturgeon Research" that provided a venue for sturgeon professionals to present exciting results from cutting-edge research geared toward sturgeon rehabilitation and conservation. Over 40 papers were presented during the 2-day symposium. Topics spanned a wide array of research topics, including sturgeon aquaculture, conservation genetics, telemetry and movement, early life history, and modeling. Overall, this was a successful symposium that sparked a lot of discussion between sturgeon professionals, while providing extraordinary networking opportunities for staff working in a specialized field of fisheries research and management.

Ryan Koenigs, Wisconsin Department of Natural Resources, Ryan.Koenigs@wisconsin.gov

Protecting Fish at Cooling Water Intakes: Advancing Science to Support Clean Water Act §316(b) Compliance (#2930)

The symposium "Protecting Fish at Cooling Water Intakes: Advancing Science to Support Clean Water Act §316(b) Compliance (#2930)," organized by the AFS Bioengineering Section, focused on the recently released U.S. Environmental Protection Agency's Rule to reduce the losses of fish and shellfish due to impingement and entrainment at existing cooling water intake structures. This regulation affects more than 700 facilities (e.g., power plants, pulp and paper mills, iron mills, chemical plants) around the United States. For successful implementation, the industries, federal and state regulatory and resource agencies, nongovernmental organizations, and the public all need the latest information on fish and shellfish protection at these facilities. Therefore, this symposium gathered practitioners in fish protection/bioengineering analyses at cooling water intake structures to present and discuss the latest scientific developments. The 45 presentations and eight posters addressed such topics as the regulation's requirements; fish protection technology design, operation, and performance; entrainment and impingement sampling and data analysis; benefit valuation; and the value of long-term monitoring to inform management decisions. There were nearly 150 attendees representing federal (U.S. and Canada), state, and provincial government agencies; power producers and other industrial facilities; research institutes; consulting firms; and nongovernmental agencies. All presenters agreed to share their presentations and copies can be obtained by contacting either Jon Black, BES Secretary/Treasurer (Alden Research Laboratory, jblack@aldenlab.com, 508-829-6000 x6431) or Doug Dixon, BES Past President (Electric Power Research Institute, ddixon@ epri.com, 607-869-1025).

Doug Dixon, Electric Power Research Institute, ddixon@epri.com

Reproductive Behavior and Recruitment in Marine Fishes: Emerging Understanding and Future Needs

The main objective of this full-day symposium was to develop a comprehensive view of the factors that drive stock productivity in marine fishes, with an eye toward incorporating these findings into management. The session had four main themes, each with a keynote speaker: (1) spatiotemporal aspects of reproductive behavior, (2) ecological processes driving egg and larval survival, (3) biophysical modeling techniques, and (4) applications to fisheries management. The symposium included 19 presentations and a group discussion session.



Presentations on reproductive behavior addressed a range of spatiotemporal dynamics, including spawning site selection, linkages between

spawning and nursery habitat, and sex-specific spatial ecology. Later in the day, the focus shifted toward larval survival and dispersal, as well as biophysical models. These talks highlighted new understanding in larval dynamics, including the interaction between growth and mortality, larval behavior, self-recruitment, fishing effects on closed populations, and the importance of initial conditions (i.e., reproduction). The last presentations focused on emerging ecological understanding and what role it should play in stock assessments. With the ability to integrate reproductive and recruitment data into management of marine fishes, a new challenge will be to understand when and where these efforts are most necessary.

Mandy Karnauskas, mandy.karnauskas@noaa.gov, and Sue Lowerre-Barbieri, Susan.Barbieri@MyFWC.com

Research and Innovation for Sustainable Fishing in the St. Lawrence Estuary and Gulf

This day-and-a-half-long bilingual symposium was organized by colleagues from four fishing industry associations, two First Nations fisheries management groups, and the federal and provincial departments responsible for fisheries in the province of Québec. This symposium attracted close to 125 participants that attended one or more of the 30 oral presentations.

Four presentations dealt with the environmental and ecosystem challenges to the estuary and Gulf of St. Lawrence, addressing in particular past and current temperature trends of the water masses, the impact of global warming on commercially fished species, an ecosystem approach to understand relationships between species at risk and species in overabundance, and interactions between fisheries and bivalve aquaculture. Attendees were served seven presentations on new challenges or avenues for sustainable fisheries and resource conservation, including an overview of Canadian policies for sustainable fisheries, traceability and its benefits, reconciliation of fisheries with other human activities in a marine protected area, and adding value to fishery byproducts.

The symposium was a great opportunity to learn from the First Nations fisheries professionals about the Mi'kmaq, Maliseet, and Innu ecological knowledge on species at risk; the aboriginal communal fisheries for sea cucumber and green sea urchin; certification of aboriginal food products; as well as collaborative efforts for the assessment of harvested macroalgae stocks.

Fifteen or so other presentations by scientists and fisheries professionals overviewed recent innovative approaches to face challenges to established lobster and shrimp fisheries and to developing fisheries. Topics included conservation measures, stock enhancement, alternative baits, electronic logbooks, eco-certification and traceability, reclamation of biomass, and development of tourist fishing.

Participants to the symposium all appreciated a presentation on the necessity for scientists, industry, and managers to act together locally and globally, all the more so because the symposium was successful in demonstrating the benefits of this approach for the development of Québec fisheries.

Bernard Sainte-Marie, Fisheries and Oceans Canada, Bernard.Sainte-Marie@dfo-mpo.gc.ca

A Retrospective of Fisheries Advances Emanating from the Queens University Biological Station

Field station support of biological research, including logistical support of equipment, access to sites, and room-and-board facilities for field crews has been critical for many disciplines for decades, and fisheries research is no exception. The Queen's University Biological Station (QUBS) is one of the premier field stations in North America and has provided innovative leadership in research and education since its inception in 1946. The symposium "A Retrospective of Fisheries Advances Emanating from the Queens University Biological Station" provided a historical overview of the station and a summary of some of the significant fisheries contributions by long-term QUBS researchers. Jen Harker began the session with a review of the work of Allen Keast, a pioneer in freshwater ecology from Queen's University. That presentation was followed by six more by researchers from other universities that highlighted the 30-plus years of work on centrarchid ecology and reproductive strategies. The symposium ended with a general discussion on what makes biology stations today successful (or not) and the key roles they play in advancing field studies. The program clearly illustrated how fisheries research at QUBS (and other field stations) has shaped fisheries resource management and conservation decisions across Canada and the United States.



Julie Claussen, Illinois Natural History Survey, juliec@illinois.edu

River Herring: Toward a Holistic Understanding

River herring collectively refers to Blueback Herring (Alosa aestivalis) and Alewife (Alosa pseudoharengus), both anadromous species that have experienced precipitous declines since the 1960s. The objective of this 2-day symposium, sponsored by the Diadromous Species Restoration Research Network, was to synthesize the growing body of research on the species and address the multiple stressors that impact river herring throughout their range and across all life history stages. Presentations ranged from basic biology (salinity tolerance, batch fecundity, parentage patterns) to assessments of individual spawning runs (passage, migration behaviors, changing population numbers) and coastwide population assessments (distribution, stock structure, bycatch, and response to climate change). The symposium ended with several talks that explored and advocated for stronger collaboration between scientists and managers in the study and management of these important fishes. Significant symposium findings suggest that river herring populations have responded quickly and positively when allowed access to

habitat, river herring are using nearshore habitat throughout much of their life and should be available for nearshore predators, increased presence of Striped Bass may be causing heavy in-river predation, and implementing integrated, watershed-based conservation is encouraged to achieve sustainable management and restoration goals.

Karen A. Wilson, University of Southern Maine, karen.wilson@maine.edu; Adrian Jordaan, University of Massachusetts Amherst, ajordaan@eco.umass.edu; Janet Nye, Stoney Brook University, janet.nye@stonybrook.edu; Barbara S. Arter, BSA Consulting, bsarter@panax.com

Roads and Rivers: Reconciling Access to Land and Integrity of Riverine Ecosystems

The Roads and Rivers Symposium, sponsored by the AFS Bioengineering Section, Transports Quebec, Fisheries and Oceans Canada, and the U.S. Department of Agriculture's Forest Service, included 24 presenters from Canada, the United States, and Europe who addressed a diversity of topics related to the interactions between roads and river systems. In three distinct sessions, professionals from various backgrounds shared science, practical experience, and ideas about the effects of roads on the physical characteristics of rivers and riverine habitats, fish passage and fluvial connectivity issues, and the biological response to the presence of barriers or restored connectivity. Among specific topics discussed during these sessions, we found road sediment models, the mobility space of rivers, the efficacy of connectivity metrics, ecohydraulic concepts, and novel genetic techniques applied to fish passage determination. The fourth session, which closed the symposium, was dedicated to the opportunities and best practices for design and restoration of stream–road crossings. This session was a chance to learn more about creative tools and solutions developed and implemented at different locations in North America. With high participation, relevant content, and a warm atmosphere, the symposium was undoubtedly a success!

Elsa Goerig, Institut National de la RechercheScientifique (INRS), Québec City, Elsa.Goerig@ete.inrs.ca

Size-Based Models of Aquatic Ecosystems: Theory and Practice—A Symposium in Honor of Rob Peters

The symposium brought together 24 scientists working on a diverse array of size-based approaches to aquatic ecosystems. It included historical overviews of size-spectrum theory, its advantages and limitations, with links to the macroecology literature and the pioneering work of Rob Peters. Theoretical and applied modeling research encompassed a range of model types, from traditional food web models with size-structured interactions to more recent models of size-spectrum dynamics, which can be organized into three types: (1) community, (2) trait-based, and (3) multispecies size-spectrum models. The research presented included theoretical foundations and comparisons of models and went further by showing applications to exploitation management at both the community level and the population level (e.g., balanced fishing and reference points in stock assessment). New empirical results ranged from North American, South American, European, and African systems, both marine and freshwater. They included a diversity of methods for sampling (e.g., gill netting and hydroacoustics) and estimating size distributions in the field, tackling questions



Intersection of Highway 172 and Morin Creek, Québec. Photo credit: Elsa Goerig (INRS).

concerning the proper characterization of size structure at different levels of resolution and scale (e.g., primary versus secondary size-structure), and its response to several environmental and anthropogenic gradients, such as climate, nutrients, ecosystem size, and exploitation.

Henrique Giacomini, hgiacomini@gmail.com

Robert Henry Peters,

1946-1996.

Sustainable Solutions to Benefit Fisheries and Hydropower Energy at a Basin Scale

Due to increasing domestic and international interest in hydropower, the goal of the symposium was to highlight basin-scale initiatives, tools, and technologies to guide sustainable hydropower energy development and balance energy production with improvements to fisheries. Several initiatives were presented, including (1) the Penobscot River Restoration, where removal of dams was offset by increasing energy generation at remaining dams, leading to a net increase in energy production; (2) the Basin Scale Opportunity Assessment, an integrative approach for assessing mutual benefits



Penobscot River at Veazie Dam (Maine) before and after dam removal. Spawning migration of river herring in the Penobscot benefits from restoration. Photo credits (in order): Cheryl Daigle (Penobscot River Restoration Trust), Joshua Royte (The Nature Conservancy), and Margaret Pizer (The Nature Conservancy).

between hydropower energy and environmental improvements within river basins; (3) the Hydropower Sustainability Assessment protocol, a standardized guidance for assessing best practices for the global hydropower industry; and (4) the Pacific Northwest Power Act, a multi-organization collaboration to balance the needs of fisheries with that of hydropower generation. Due to aggressive hydropower expansion in Brazil, one presentation discussed the importance of creating reserves for free-flowing rivers to ensure self-sustaining fish populations, as opposed to relying on ineffective mitigations. Another presentation discussed how dam locations should be arranged to optimize hydropower energy and ecological services, including American Eel survival. Other presentations included tools to balance multiple competing energy and environmental demands and new technologies including improvements in water quality, decreases in fish movement-related mortality, and 2D acoustic fish tracking.

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Researchers prepare an autumn deployment of an acoustic telemetry receiver associated with an oceanographic buoy in the Gulf of Maine from the *RV Connecticut*. Photo by Ian Hay.

Telemetry on the Atlantic Coast: Tagging Locally and Observing Globally

Telemetry researchers from Florida to Nova Scotia examined local and long-range movements of fish as small as Atlantic Salmon smolts and as large as white sharks; additional talks on sea turtles and marine mammals expanded the spectrum. Seventeen talks and two posters illustrated how combinations of acoustic, radio, and satellite telemetry increased knowledge of Northwest Atlantic habitat use. Novel use of mobile receivers on AUVs, gliders, drifters, and animal platforms provided additional insights and new modeling and social network analyses presented a glimpse of emerging science. Presenters described both local movements (<100 km) within core study areas and distant observations from regional and global receiver networks. The power and potential of collaborative science networks were highlighted in these presentations. From Florida to the mid-Atlantic, the Atlantic Cooperative Telemetry (ACT) and Florida ACT networks were essential to data sharing. North of Cape Cod, the OTN was essential to collaboration. Sustaining and enhancing collaborative networks is essential to (1) the evolution of studies across vast seascapes and (2) a better understanding of marine

habitats in context of ecosystem dynamics. Scientists identified future symposia at AFS Annual Meetings and other venues as necessary to sustain a broad collaborative network.

John Kocik, NOAA, john.kocik@noaa.gov



bine's effects on fish are underway. Here, the tides force water through narrow channels of the bay, creating current speeds up to 5 knots as well as the large waves and eddies shown here. Photo credit: James D. McCleave.

Understanding Fish and Their Ecosystems in Challenging Environments

The purpose of this symposium was to present and discuss methods of researching fish in challenging environments (e.g., environments that complicate study design, data collection, or analyses). Several presentations came from research on tidal power (Bay of Fundy and Cobscook Bay, Maine) and others from remote locations in Iceland, northern Canada, and a heavily trafficked river in Tennessee. Common obstacles and potential solutions were discussed after the symposium. One issue identified was the need for both spatial and temporal coverage, with sufficient resolution to capture processes occurring on multiple scales. This is especially true in rapidly changing areas (e.g., Bay of Fundy) or large spatial domains. Researchers must creatively plan studies to achieve the necessary spatial and temporal coverage; for example, sampling on a rotational basis or combining multiple sampling types (e.g., hydroacoustics with telemetry). Presenters stressed the need to allow an iterative learning process to occur. Another challenge identified was the high variability of data. One suggestion was to limit the influence of cyclic environmental changes (e.g., tidal cycles) via survey timing.

Researchers must carefully consider effects of survey design, natural variability, and the environment itself on data, in an effort to identify limitations prior to drawing conclusions.

Haley A. Viehman, School of Marine Sciences, University of Maine, haley.viehman@umit.maine.edu

AWARDS

Steven Berkeley's Marine Conservation Legacy Lives On

The Steven Berkeley Marine Conservation Fellowship was established in 2007 to honor the memory of Steve Berkeley, a dedicated fisheries scientist with a passionate interest in integrating the fields of marine ecology, conservation biology, and fisheries science to improve fisheries management. Through this fellowship, Steve's legacy lives on by supporting graduate student research in marine conservation. As we announce the 2014 Berkeley fellowship recipient and present the call for applications for the 2015 fellowship, we revisit Steve's life and also get updates from previous fellows on how the award impacted their research and careers.

A LIFE OF FISHING AND FISHERIES CONSERVATION

By Susan Sogard

Steve was born and raised in Queens, New York. As a city kid, he was embedded in the rich cultural world of New York City and loved classical music and opera. He became an accomplished musician himself, primarily on the bassoon, and later played professionally with the Miami Philharmonic Orchestra. Although his parents' lives revolved around art and music, they also loved fishing. Steve's lifelong passion for fish and fishing was launched by his early experiences catching cod and fluke on party boats off Long Island. He fished at every possible location and at every opportunity and was delighted with every successful catch, from tiny trout in alpine lakes to giant tuna in offshore seas. In later years, as his conservation consciousness prevailed, most of those fish were released unharmed.

Steve began his career in academia, as a research scientist at the University of Miami. He worked on a range of subjects and species, including ichthyoplankton ecology; population dynamics of clupeids, halfbeaks, and Swordfish; and fisheries management aspects of penaeid shrimp. He then moved to Charleston, South Carolina, to work directly in the management arena as a staff biologist with the South Atlantic Fishery Management Council, where he developed management plans for Swordfish, billfish, and sharks and participated on numerous international scientific and management panels for these species. In 1993, he returned to academia as a research scientist, first at Oregon State University and later at the University of California in Santa Cruz. His research interests on the West Coast focused on ecology and life history of longlived species, in particular rockfish and Sablefish. He was deeply concerned with the evidence of continuing age truncation in heavily fished species, a pattern that clearly countered the bet-hedging advantages of a long life span. His research on maternal effects in rockfish demonstrated the importance of maintaining large, old females in a population and validated, for rockfish, the importance of marine reserves as the most viable management approach to protect age diversity in long-lived fishes.

As an avid fisherman himself, Steve focused not on shutting down fisheries but on determining ways to ensure continued production and accessibility to commercial fishers. Throughout his career, he worked closely with fishermen around the country, gaining their respect and listening carefully to their suggestions for improving fishing practices. He fished commercially for Swordfish and sharks in Miami and later involved Swordfish captains in research projects. On the West Coast and in the Gulf of Mexico, he collaborated with numerous commercial fishermen on one of his ongoing interests, reducing bycatch. These projects involved both basic ecological studies of life history and behavior in an effort to reduce where and when fish are vulnerable to capture as well as practical development of gear modifications.



Steve (right) and his brother David (left) with a 687 lb bluefin tuna caught off Cape Cod in 1965. Photo credit: S. Sogard.



Steve with a chinook salmon caught in Monterey Bay. Photo credit: S. Sogard.



Photo credit: S. Sogard.

Steve effectively melded research with management applications throughout his career. Some of his key advisory service included the International Commission for the Conservation of Atlantic Tunas, the Scientific and Statistical Committees of both the North Pacific and Pacific fishery management councils, and panels addressing marine ecosystem-based management and integration of marine protected areas with fisheries management. Reflecting his concerns with declining fish populations, he worked closely with several nongovernmental organizations in later years, providing both advice and review of fisheries-related programs. He was one of the few people I know who was equally comfortable in the sometimes divergent arenas of university research, commercial fishing, fisheries management, and conservation groups. I believe that this reflected his genuine interest in having these groups work together toward common goals.

Steve was an active member of the American Fisheries Society since 1991 and served as president of the Marine Fisheries Section from 1998 to 2000. He was also a member of the founding Board of Directors for the Fisheries Conservation Foundation. Steve directly advised several graduate students over his career and served on numerous committees for others. He was demanding of his students but perpetually fair, expecting their dedication to the research at hand but also respecting their individuality. When it was clear that he was losing the battle with cancer, we met with our lawyer to go over his affairs. When she asked him about his estate, he quietly said he wanted it to go to supporting graduate students. Despite the pain of that time period, I had to smile, recognizing and admiring how like him it was to want to give students some help during potentially difficult financial times. With his estate and generous donations from his family, friends, and other AFS members, we established the Steven Berkeley Marine Conservation Fellowship in late 2007. It brings me tremendous satisfaction to honor Steve's wish and I know it would delight him immensely to know that we are able to provide this award on a continuing basis. All of the selection committee members have been extremely impressed with the quality of the applications we have received since the fellowship's inception. In every year, we have had a very tough job of deciding among so many outstanding candidates. The future of marine conservation research is clearly in good hands.

POSTSCRIPT: More details about Steve's career are available in his obituary in the September 2007 issue of Fisheries.

2008–2013 Steven Berkeley Marine Conservation Fellowship Recipient Updates

By Howard Williams (AFS Administrative Specialist and Berkeley Fellowship Coordinator)

Since the scholarship began in 2008, more than 300 outstanding students have applied. We asked previous recipients to update us on their research and how the fellowship has impacted both their research and their careers. We also asked them to relate how they believe that their research will impact the marine conservation cause. Steven Berkeley's marine conservation legacy lives on through the vision of our marine fisheries students.

2008: Adam Peer, University of Maryland

Advisor: Thomas Miller

I am a fisheries biologist for the Federal Energy Regulatory Commission's (FERC) Division of Hydropower Licensing in Washington, D.C. I started at FERC after my dissertation at the University of Maryland Center for Environmental Science Chesapeake Biological Lab. With the support of the 2008 Berkeley Fellowship, I investigated how female phenotype influences reproductive potential of Atlantic Coast Striped Bass. My research combined analyses of historical survey data with laboratory and field studies and indicated that (1) water temperature is the primary factor influencing timing of female movement onto spawning grounds, with timing negatively related to both temperature and female length; (2) female condition has a positive influence on fecundity. oocyte volume, and indirectly the probability of spawning; and (3) female weight, not condition, has a greater influence on offspring phenotype. This research would have been incomplete without the fellowship, which supported field sampling, histological analysis, and travel to obtain eggs for experiments. I believe that my research has and will continue to provide pieces in the larger puzzle of sustainable fisheries by demonstrating the connection between climate, migration timing, and fisheries management and by refining our understanding of recruitment, which can improve stock-recruitment models and predictions of population sustainability.



2009: Aleksandra Maljković, Simon Fraser University

Advisor: Isabelle Côté

The Steven Berkeley Marine Conservation Fellowship was the greatest accolade I received during my Ph.D. and validation that I was doing something tangible and, in conservation terms, worthwhile. I studied the effects of variable prey spectra, generated by gradients of fishing pressure, on the trophic and spatial ecology of Caribbean reef sharks. Sharks inhabiting lightly fished or unfished reefs fed at higher trophic levels (or in longer food webs) and spent more time at their "home" reefs than sharks inhabiting areas with greater fishing pressure on their reef fish prey. Fisheries therefore have indirect impacts on the trophic ecology and energetic requirements of these top predators, and this research proved especially



useful in determining the mechanisms by which selective fisheries can generate trophic cascades in complex coral reef food webs. The Berkeley Fellowship allowed me to focus solely on research for a full year—and there are no words to describe how grateful I am for that. I am now investigating how fear effects generated by top predators influence the health of coral reefs. This research is particularly exciting because preliminary results suggest that restoration of top predator communities to degraded reef habitat may accelerate recovery of corals, and subsequently fish populations, via their impacts on herbivore foraging behavior. Thank you AFS for awarding me the Berkeley Fellowship and stoking my passion for marine conservation.

2010: Kristina Cammen, Duke University

Advisor: Andrew Read

The Berkeley Fellowship that I received in 2010 was instrumental in funding my dissertation research on the susceptibility of bottlenose dolphins to red tides in the Gulf of Mexico. More broadly, the fellowship also provided me with an invaluable opportunity to advance my career interests in marine ecology and conservation genomics. In collaboration with the Sarasota Dolphin Research Program and NOAA Fisheries, I conducted both a candidate gene and genome-wide analysis of variation among bottlenose dolphins from two geographic regions that differ in the frequency of red tide occurrence and the apparent susceptibility of dolphin populations. I found that the frequency of some genetic markers varied signifi-

cantly between dolphins that died and dolphins that survived red tide exposure, and I concluded that genetics is likely one of several factors that influence the susceptibility of bottlenose dolphins to red tide exposure. My research contributed to our understanding of the ecology of harmful algal blooms and the potential for upper trophic level organisms to adapt to this growing threat in coastal ecosystems. I completed my Ph.D. at Duke University in May 2014 and am currently a postdoctoral teaching and research associate at the University of Maine in Orono.

2011: Valentina Di Santo, Boston University

Advisor: Phillip Lobel

I am currently a postdoctoral researcher working with Professor George Lauder at Harvard University to investigate the effect of climate-related stressors on swimming performance of fishes. I received the Steven Berkeley Marine Conservation Fellowship in 2011, about halfway through my Ph.D. at Boston University. The award funded my dissertation research on physiological responses of embryonic and juvenile skates (*Leucoraja erinacea*) to increased ocean acidification and warming. I employed a comparative approach by analyzing the responses of skates from two latitudinally separated populations reared in common garden conditions. The results show a decrease in body condition and developmental and exercise performance in skates exposed to temperature and CO_2 levels projected by the end of century. Furthermore, the two populations responded differently to warming and



acidification, indicating that the northern population may be more vulnerable to climate change. In particular, the Steven Berkeley Marine Conservation Fellowship funded the equipment that allowed me to set up an ocean acidification exposure seawater system. Results from my research enhance the capacity to predict near-future responses of skates to ocean warming and acidification and underscore the importance of tailoring specific management and conservation strategies for species challenged by climate change.



2012: Tony Spitzack, Washington State University

Advisor: Brian Tissot

Recently, managers have sought to increase coral reef ecosystem resilience by implementing marine protected areas (MPAs); however, researchers are still unclear whether MPAs enhance resilience. The objectives of my study were to (1) use exclusion cages as a disturbance to evaluate the relative resistance along an MPA network with a gradient of protection and (2) use three levels of exclusion to manipulate the herbivore guild structure, identifying aspects of the community structure that may be vital to benthic community resistance. Monthly, I photographed changes within fish exclusion cages as well as following the cage sites after removal for a total of 18 months. Preliminary results indicate a high level of



protection, and a diverse herbivore guild structure is significantly positively correlated with higher coral reef resilience. The study has the potential to impact marine conservation by providing evidence that MPAs increase resilience and, given the short time period required to see significant results, offer a method for quickly assessing coral reef resilience. The Berkeley Fellowship was invaluable to my research allowing me to cover a large portion of the operating expenses and material costs associated with my research. Currently, I am working for the Forest Service and processing the photos.

2013: Christian Conroy, Northeastern University

Advisor: Jonathan Grabowski

I just started my third year as both a Ph.D. student in the Marine and Environmental Sciences Department at Northeastern University and as a dad. My dissertation research concerns physical and behavioral diversity of Atlantic Cod (*Gadus morhua*) and its importance in exploited populations. Specifically, I focus on red ("rock") and olive ("white-belly") Atlantic Cod phenotypes that coexist in shallow, structured habitat within the Gulf of Maine. Through the sampling efforts made possible by the Steven Berkeley Marine Conservation Fellowship, I was able to identify and describe the consistent coloration and morphometry (i.e., body shape) of red cod as distinct from that of olive cod, despite collecting both phenotypes in locations from Salem Sound (Massachusetts) to Sheepscott Bay (Maine). Preliminary telemetry results indicate habitat limitation of red cod based on depth; this phenotype has avoided a known cod spawning ground frequented by larger olive cod in close proximity to the shallow, structured rock ledges and humps where monitoring is ongoing. Such stark differences in physical characteristics and habitat preferences at the local scale may have important consequences for the sustainability of exploited stocks. These research efforts would not be possible without the generous funding provided by the Berkeley Fellowship.



BERKELEY FELLOWSHIP RUNNERS-UP 2008–2014

2008

Keith Dunton, Stony Brook University Mandy Karnauskas, University of Miami

2009

Jack Kittinger, University of Hawai'i at Manoa Annie Schmidt, University of California Davis

2010

Justin Perrault, *Florida Atlantic University* Hollie Putnam, *University of Hawai'i at Manoa*

2011

Lewis Barnett, *University of California Davis* Pablo Granados-Dieseldorff, *Texas A&M University*

2012

Caitlin Cleaver, University of Maine Geoffrey Smith, University of Florida

2013

Alexander Filous, University of Hawai'i at Manoa Alexis Jackson, University of California, Santa Cruz

2014

Nathan Furey, University of British Columbia Marissa McMahan, Northeastern University

The 2014 Steven Berkeley Marine Conservation Fellowship Winners

RECIPIENT – Casey Benkwitt

Casey Benkwitt is a fourth-year Ph.D. student in Dr. Mark Hixon's lab at Oregon State University. For her dissertation, she is studying the population dynamics, behavior, and ecological effects of an invasive coral-reef fish. Originally released off the coast of Florida through intentional and/or accidental aquaria releases, the Pacific Red Lionfish (Pterois volitans) is now spreading rapidly throughout the greater subtropical and tropical western Atlantic regions. Lionfish are altering coral-reef ecosystems through their over-consumption of small native fishes, but little is known about their ecological effects in other coastal habitats and the mechanisms of those effects other than predation. Benkwitt's current research seeks to determine how invasive lionfish are affecting native fish in seagrass beds surrounding coral reefs, and whether lionfish affect the settlement of native fishes through chemical cues. If lionfish are foraging substantially in seagrass areas and/ or if settling coral-reef fishes do not recognize chemical cues from lionfish, then lionfish are having greater effects on native fishes than previously documented. Benkwitt's research can aid in controlling the lionfish invasion, as understanding the extent of lionfish impacts will help marine resource managers direct limited resources to habitats most affected by lionfish.



RUNNER UP – Nathan Furey

Nathan Furey is a Ph.D. candidate at the University of British Columbia in the Department of Forest and Conservation Sciences and is advised by Scott Hinch. His dissertation research focuses on the migration and movement ecology of juvenile salmon smolts, particularly Fraser River Sockeye Salmon (*Oncorhynchus nerka*) as they leave natal freshwater habitats and migrate to marine feeding grounds. Fraser Sockeye have undergone dramatic declines in recent years, and thus there is a need to better understand the factors influencing migration behavior and survival. Through acoustic telemetry and large-scale arrays such as the Pacific Ocean Shelf Tracking (POST) project and the Ocean Tracking Network (OTN), a large database of individual smolt movements and survival has been developed



that will be used to develop empirical models relating migration experience to intrinsic and environmental factors. Field research will characterize fine-scale movements of predator-prey dynamics for outmigrant smolts and predating Bull Trout (*Salvelinus con-fluentus*) in a lake-river transition. Lastly, a large-scale individual-based modeling (IBM) framework will be developed as a tool to simulate smolt migrations in realistic oceanographic conditions. The results of these studies will help describe the role of movement behaviors play in determining individual fitness through multiple landscapes. Furey has a BSc from the University of New England in marine biology and environmental science, and a MSc in wildlife and fisheries sciences from Texas A&M University.

RUNNER UP - Marissa McMahan

Marissa McMahan is currently a Ph.D. student at Northeastern University and works in Jonathan Grabowski's lab located at the Marine Science Center in Nahant, Massachusetts. She received her MS from the University of Maine in 2011, where she researched how predators influence lobster movement behavior and how increasing water temperatures in the Gulf of Maine influence lobster growth. Her background in commercial fishing gives her a unique perspective on marine science and she attempts to incorporate fishermen in much of her research, which focused on predatory-prey dynamics in the Gulf of Maine (specifically between cod and lobster), and now focuses on fisheries and community ecology, in hopes of better understanding the impacts of emergent species on local ecology, food web dynamics, and fisheries productivity. In light of recent and continuing climate change, emergent species are becoming more common in areas such as the Gulf of Maine, and her interest is in the recent range expansion of the Black Sea Bass (Centropristis striata) into the Gulf of Maine.

Call for 2015 Applications for the Steven Berkeley Marine Conservation Fellowship

This fellowship was established in 2007 to honor the memory of Steven Berkeley, a dedicated fisheries scientist with a passionate interest in integrating the fields of marine ecology, conservation biology, and fisheries science to improve fisheries management. Berkeley was a long-time member of the AFS and a member of the first board of directors of the Fisheries Conservation Foundation. The fellowship includes a competitively based \$10,000 award to a graduate student actively engaged in thesis research relevant to marine conservation. Research topics may address any aspect of conservation; a focus on fisheries issues is not required.

Requirements for application:

- 1. The applicant must be a student officially accepted or currently enrolled in an M.S. or Ph.D. program.
- 2. The student must be actively engaged in thesis research related to some aspect of marine conservation; the intent of the award is to support ongoing research costs.
- 3. The student must be a member of the AFS in good standing; membership can be obtained at the time of application submission.
- 4. Applications must be e-mailed by 1 February 2015.

Berkeley Fellowship application details are located on the AFS Marine Fisheries Section website: sfrc.ufl.edu/mfs and click on S. Berkeley Fellowship.





AFS Seeks Journal Editor

The American Fisheries Society (AFS) seeks a scientist to serve as editor of *Journal of Aquatic Animal Health (JAAH)*. Editor must be committed to fast-paced deadlines, and would be ap-

pointed for a five-year renewable term. Duties include:

- Deciding on the suitability of contributed papers, and advising authors on what would be required to make contributions publishable, using advice of associate editors and reviewers. Reviewing papers for scientific accuracy as well as for clarity, readability, and interest to scientists and culturists concerned with the health of aquatic organisms;
- 2. Soliciting manuscripts to ensure broad coverage;
- 3. Setting editorial standards for JAAH in keeping with the objectives of the publication in accordance with AFS policies, and guidance provided by the Publications Overview Committee and the JAAH editorial board;
- 4. Making recommendations to enhance the vitality and prestige of the journal.

To be considered, send a current curriculum vitae along with a letter of interest explaining why you want to be the journal editor by e-mail to alerner@fisheries.org. To nominate a highly qualified colleague, send a letter of recommendation to the same e-mail address.

Note: Editors receive an honorarium, and support to attend the AFS Annual Meeting.

Call for Award Nominations: 2015 American Fisheries Society Awards

All award nominations are due 1 April, 2015.

The American Fisheries Society (AFS) is seeking nominations and applications for several 2015 awards. Award recipients will be honored at the 145th Annual Meeting to be held in Portland, Oregon, from 16–20 August 2015. Nominations typically require a candidate's name, full contact information, biographical information, and/or history of service to the Society. Some awards require additional nomination materials. For more information, visit fisheries.org and click on Awards or contact Jasmine Sewell at jsewell@ fisheries.org. Note: The award name should be listed in the email subject heading for each nomination.

AWARD OF EXCELLENCE

The Society's highest award for scientific achievement is presented to a living AFS member for original and/or outstanding contributions to fisheries and aquatic biology.

CARL R. SULLIVAN FISHERY CONSERVATION AWARD

Presented to an individual or organization for outstanding contributions to the conservation of fishery resources. Eligibility is not restricted to AFS members, and accomplishments can include political, legal, educational, scientific, and managerial successes.

DISTINGUISHED SERVICE AWARD

Recognizes outstanding contributions of time and energy for special projects or activities by AFS members. The number of recipients may vary. Eligible candidates include a single member, a group of members, and AFS staff.

EMERGING LEADERS MENTORSHIP AWARD

The AFS Emerging Leaders Mentorship Award Program was established to develop future leaders of the Society and the fisheries profession as a whole, by providing selected AFS members an opportunity to participate for one year in activities of the AFS Governing Board. Awardees will be paired with a mentor who is a member of the Governing Board and will be awarded up to \$500 to offset costs associated with attending the Management Committee Meeting, the Governing Board Retreat, and the Governing Board Meeting that are held in conjunction with the AFS Annual Meeting.

MERITORIOUS SERVICE AWARD

Presented annually to an individual AFS member for loyalty, dedication, and meritorious service to the Society over a long period of time and for exceptional commitment to the programs, objectives, and long-term goals of the Society.

OUTSTANDING CHAPTER AWARD

Recognizes outstanding professionalism, active resource protection, and enhancement programs, as well as a strong commitment to the mission of the Society. Three awards are given: one for small chapters, one for large chapters, and one for a student subunit of a chapter.

PRESIDENT'S FISHERY CONSERVATION AWARD

Presented in two categories: (1) an AFS individual or unit or (2) a non-AFS individual or entity, for singular accomplishments or long-term contributions that advance aquatic resource conservation at a regional or local level.

WILLIAM E. RICKER RESOURCE CONSERVATION AWARD

Presented to any entity (individual, group, agency, or company) for accomplishment or activity that advances aquatic resource conservation that is significant at a national or international level.

THE EMMELINE MOORE PRIZE

The AFS has established a career achievement award, named after the first female AFS president, Emmeline Moore (1927-1928), to recognize efforts of an individual member in the promotion of demographic diversity in the Society. This award will be presented to an AFS member who demonstrates strong commitment and exemplary service to ensuring equal opportunity access to higher education in fisheries and/or professional development in the broad range of fisheries science disciplines.

EXCELLENCE IN PUBLIC OUTREACH

Presented to an AFS member who goes the "extra mile" in sharing the value of fisheries science/research with the general public through the popular media and other communication channels

HONORARY MEMBERSHIP

Presented to individuals who have achieved outstanding professional accomplishments or have given outstanding service to the Society. Honorary members must be nominated by at least 100 active members and elected by a two-thirds majority of active members voting.

RETIRED MEMBERS TRAVEL AWARD FOR THE AFS ANNUAL MEETING

The AFS has established this travel award to encourage and enable members of the Society to attend annual meetings, particularly those members who might play a more active role in the meeting. The Society recognizes that some retired members who desire to participate in the Annual Meeting might be inhibited for financial reasons. Retired members may not have funds for travel to meetings that were available to them while employed.

STUDENT WRITING CONTEST

Recognizes students for excellence in the communication of fisheries research to the general public. Undergraduate and graduate students are asked to submit a 500- to 700-word article explaining their own research or a research project in their lab or school. The article must be written in language understandable to the general public (i.e., journalistic style). The winning article will be published in *Fisheries*.

AWARDS ADMINISTERED BY SECTIONS

Education Section

EXCELLENCE IN FISHERIES EDUCATION AWARD

The AFS Excellence in Fisheries Education Award was established in 1988. The award is administered by the Education Section and is presented to an individual to recognize excellence in organized teaching and advising in some aspect of fisheries education.

JOHN E. SKINNER MEMORIAL FUND AWARD

The John E. Skinner Memorial Fund was established in memory of John Skinner, former California-Nevada Chapter and Western Division AFS President. The fund provides monetary travel awards (up to \$800 per award) for deserving graduate students or exceptional undergraduate students to attend the 145th Annual Meeting to be held in Portland, Oregon, from August 16–20, 2015.

Equal Opportunities Section

J. FRANCES ALLEN SCHOLARSHIP AWARD

The J. Frances Allen Scholarship was established in 1986 to honor Dr. Allen, who pioneered women's involvement in the AFS and in the field of fisheries. The scholarship fund was established with the intent of encouraging women to become fisheries professionals. The qualified applicant must be a female PhD student conducting aquatic research in line with AFS objectives and an AFS member as of 31 December 2014.

Marine Fisheries Section (*award nominations due February)

STEVEN BERKELEY MARINE CONSERVA-TION FELLOWSHIP*

This fellowship was created by AFS in 2007 to honor the memory of Steven Berkeley, a dedicated fisheries scientist with a passionate interest in integrating the fields of marine ecology, conservation biology, and fisheries science to improve fisheries management. Berkeley was a long-time member of AFS and a member of the first Board of Directors of the Fisheries Conservation Foundation. The fellowship comprises a competitively based \$10,000 award given to a graduate student actively engaged in thesis research relevant to marine conservation; a focus on fisheries issues is not required.



AWARDS

American Fisheries Society Section Awards for 2014

The following American Fisheries Society (AFS) sections announced award recipients at the Annual Meeting in Québec City, Québec:

CANADIAN AQUATIC RESOURCES SECTION

Peter A. Larkin Award: Ph.D. level—Vivian Nguyen, Carleton University; Runner up: Natalie Sopinka, University of British Columbia

M.Sc. level—Sean Godwin, Simon Fraser University, and Maxime Veilleux, Carleton University; Runner up: Jacqueline Michelle Lavery, University of New Brunswick

EDUCATION SECTION

Young Professional Achievement Award: Mark Fincel, South Dakota Game, Fish and Parks

AFS BEST STUDENT POSTER AWARD AT THE 2013 ANNUAL MEETING IN LITTLE ROCK, ARKANSAS

Winner: Nick Sievert, University of Missouri

AFS/SEA GRANT BEST STUDENT PAPER AT THE 2013 ANNUAL MEETING IN LITTLE ROCK, ARKANSAS

Winner: Zach Penney, University of Idaho Honorable Mentions: Antranik Kajajian, Old Dominion University, and Sara M. Turner, SUNY College of Environmental Science and Forestry

ESTUARIES SECTION

Student Travel Award: Geoffrey Smith, University of Florida

FISHERIES AND INFORMATION TECHNOLOGY SECTION

Best Student Poster Award: Nick Sievert, University of Missouri

FISH CULTURE SECTION

Student Travel Award Winners: Paula Caldentey, Mote Marine Laboratory, and Meghan Manor, West Virginia University Best Paper in *North American Journal of Aquaculture*: Louis R. D'Abramo, Terrill R. Hanson, Susan K. Kingsbury, James A. Steeby, and Craig S. Tucker

FISH HEALTH SECTION

Snieszko Student Travel Award Winners: Thomas Rosser, Diem Thu Nguyen, Carissa Gervasi, Megan Kepler, Bikramjit Ghosh, and Kevin Erickson

FISHERIES ADMINISTRATION SECTION

2014 Outstanding Sport Fish Restoration Program Projects: Sport Fishery Development and Management Category:

Texas Parks and Wildlife Department—Collaboration to Maintain Quality Fisheries in Brazos River Reservoirs: Using New Technology to Relate Reservoir Water Levels, Littoral Habitat, and Recreational Access

Fisheries Research and Surveys Category: Wisconsin Department of Natural Resources—Development and Evaluation of Watershed Models for Predicting Stream Fishery Potential

FISHERIES MANAGEMENT SECTION

Award of Excellence: Jake Rice

Conservation Achievement Award: Bonefish and Tarpon Trust **Hall of Excellence:** Gordon C. Robertson and Harold L. Schramm, Jr.

GENETICS SECTION

James E. Wright Graduate Award: Ryan Waples, University of Washington

Stevan Phelps Memorial Award: Helen Neville and Louis Bernatchez for their paper titled, "Coding Gene Single Nucleotide Polymorphism Population Genetics of Nonnative Brook Trout: The Ghost of Introductions Past" *Transactions of the American Fisheries Society* 142(5):1215-1231

MARINE FISHERIES SECTION

Steven Berkeley Marine Conservation Fellowship: Cassandra Benkwitt, Oregon State University

Honorable Mention: Nathan Furey, University of British Columbia, and Marissa McMahan, Northeastern University

Oscar E. Sette Award: Mary C. Fabrizio, Virginia Institute of Marine Science

Student Travel Award: Laura Koehn, University of Washington; Owen Nichols, University of Massachusetts at Dartmouth; and James Robinson, University of Victoria

SOCIOECONOMICS SECTION

A. Stephen Weithman Best Student Paper Award Winner: Ingrid Biedron, Cornell University Honorable Mention: Scott Knoche, University of Maryland

WATER QUALITY SECTION

Best Student Poster Award: Steven Mattocks, University of Massachusetts Amherst

The 2003 Québec Declaration of Concern About Eel Declines—11 Years Later: Are Eels Climbing Back up the Slippery Slope?

Willem Dekker (coordinator)

Swedish University of Agricultural Sciences, Department of Aquatic Resources, Stångholmsvägen 2, SE - 17893 Drottningholm, Sweden. E-mail: willem. dekker@slu.se

John M. Casselman (coordinator)

Department of Biology, Queen's University, 2406 Biosciences Complex, 116 Barrie St., Kingston, ON, Canada K7L 3N6. E-mail: john.casselman@queensu.ca

In 2003, scientists gathered at the American Fisheries Society meeting in Québec and raised an urgent alarm in a Declaration of Concern about the state of eel stocks around the world, with less than 1% of juvenile resources remaining (as documented for northern temperate stocks). In the years since, precautionary protective measures have been implemented, monitoring and research have increased, and sustainable management methods have been developed. Recently, several juvenile resources have increased slightly. Reassembled in Québec in 2014, we reflect on what has been achieved since 2003 and what remains to be done.

Eels are enigmatic animals. These fishes of the family Anguillidae are commonly known as freshwater eels, although they also occur in coastal areas and reproduce in the open ocean. Despite decades of scientific research, crucial aspects

of their biology remain a mystery. In recent decades, the numbers of young eels recruiting from the oceans into estuaries and rivers have rapidly diminished. In Europe, recruitment has declined by 90%-99% since 1980. In North America, recruitment to the upper St. Lawrence River, near the species' northern limit, has virtually ceased, though other areas closer to the spawning area have shown similar, weaker, or no trends in recruitment. In Japan, the decline since 1970 was about 80%. For other eel species, though less information is available, there are some indications of declines too. On all continents, the times when almost every natural water body contained eels and cultural feasts were organized during mass eel migrations are still within living memory.

The causes of the decline are unclear. Global oceanic changes, as well as direct and indirect impacts (barriers to migration, contaminants, fisheries exploitation, habitat loss, parasite introductions, and water quality deterioration), have been suggested. As yet, no conclusive evidence exists, in part because of the long distances these fishes migrate to reproduce. The numbers of eels that successfully complete the long migration to their spawning areas in distant oceans have never been assessed directly. This is in distinct contrast to the situation for other fish species, where safeguarding a minimal spawning biomass is at the heart of stock protection. In 2003, we therefore argued for precautionary protection. A demise of eel resources would represent a severe reduction in biodiversity and a significant loss for the communities where eel fishing is still of economical or cultural significance.

Since 2003, the distressing situation of eel stocks has attracted broad attention—in science, media, and educational programs and among managers and decision makers. Since then, monitoring of major eel stocks around the world has improved and research has advanced considerably, as evidenced by our return to Québec in 2014 for the largest ever eel symposium. All *Anguilla* species have now been considered for or listed on



Figure 1. Time trends in abundance of major juvenile eel stocks of the world. From the 2003 Quebec Declaration of Concern (Dekker et al. 2003), updated: European eel (Anguilla anguilla), glass eels, geometric means of available local series from the International Council for the Exploration of the Sea-Working Group on Eels, provided by C. Briand; American Eel (A. rostrata), small yellow eels ascending upper St. Lawrence River, from Lake Ontario Management Unit, Ontario Ministry of Natural Resources, provided by J. Casselman; Japanese eel (A. japonica), glass eel catches in Japan, from Statistics Bureau, Ministry of Internal Affairs and Communications (prior to 1977 may include young eels larger than glass eels), after 2003 obtained from Fisheries Agency, Japan, provided by K. Tsukamoto. Illustrated using 5-year running means with end-point contractions. Figure prepared by L. Marcogliese.

the International Union for Conservation of Nature Red List. Considerable progress is being made in the design and implementation of management schemes that fit the particularities of eels (including derivation of minimal protection levels, recovery strategies, and stock assessment methodologies; partitioning of responsibilities among international, national, and regional authorities; international coordination between divergent areas; and national and international governance). In Europe, international integration of eel protection is underway, and elsewhere tentative steps have been taken. Indigenous communities and stakeholders around the world have expressed their concerns and have increasingly become involved in policy development and implementation.

An increase in recruitment has been observed in Europe and parts of North America for several years in a row, and the trend in East Asia has fluctuated (Figure 1)—though the actual numbers are still very far below what was commonly observed in the past. It is unclear to what extent these upturns relate to recent protective actions. Regardless, the increased numbers will still contribute to recovery if properly protected.

Recovery of the stocks will require that current protection is maintained or increased and that management plans are expanded (stepwise) to as yet unprotected areas. Further technical development and implementation of management schemes will be essential to ensure that protection achieves the minimal level required for recovery and to achieve stock-wide coordination and good governance for each species.

Each year, as we wait eagerly to find out how many young eels will arrive from the ocean, the future remains as unpredictable as ever. But the recent recruitment increase of some stocks and the relative stability of others indicate that, after many decades of continued decline, depleted eel stocks around the world have the potential to recover. Now is the time to ensure that all stocks are adequately protected throughout their range; now is the time to collaborate on integrated stock-wide management.

Québec City, 21 August 2014. Undersigned by:

- For researchers of European eel: Willem Dekker willem.dekker@slu.se
- For researchers of American eel: John M. Casselman john.casselman@queensu.ca
- For researchers of Japanese eel: Katsumi Tsukamoto tsukamoto.katsumi@nihon-u.ac.jp
- For researchers of New Zealand eels: Jacques Boubée jacques.boubee@niwa.co.nz
- For researchers of tropical eel species: Shun Watanabe watanabe.shun@nihon-u.ac.jp
- For Maori communities involved with eels: Doug Jones doug.jones@teohu.maori.nz

For First Nations involved with American eel: Konrad Sioui, Grand Chief of the Huron-Wendat Nation

Following the plenary discussion at the end of the International Eel Symposium 2014, this Declaration was prepared by a group of volunteers: Willem Dekker, John Casselman, Laurent Beaulaton, Jacques Boubée, David Cairns, Martin Castonguay, Sheila Eyler, Eric Feunteun, Matthew Gollock, Reinhold Hanel, Courtney Holden, Brian Jessop, Doug Jones, Michael Miller, Katsumi Tsukamoto, Alan Walker, Shun Watanabe, and Håkan Wickström.

The following participants of the plenary discussion, in alphabetical order by country and name, approved this Declaration:

- Algonquin: L. McDermott
- Canada: B. Boivin, C. Burliuk, D. K. Cairns,
 G. Carey, Y. Carey, J. M. Casselman, M. Castonguay,
 D. Eyland-Reiss, D. Hatin, C. Holden, B. Jessop,
 N. Langlois, L. A. Marcogliese, A. Mathers, D. Meerburg, J. Nguyen, T. Pratt, T. Stewart, G. Verreault
- Denmark: M. I. Pedersen
- Estonia: P. Bernotas, A. Järvalt
- France: L. Beaulaton, C. Boisneau, H. Drouineau, E. Feunteun, P. Lambert
- Germany: U. Brämick, R. Hanel, L. Marohn
- Japan: M. J. Miller, K. Tsukamoto, S. Watanabe
- Maori: A. Gordon, D. Jones, M. Kearney
- New Zealand: J. Boubée
- Norway: C. Durif
- Spain: A. Aranburu, E. Diaz
- Sweden: E. Björkvik, W. Dekker, A. Silfvergrip, H. Wickström
- Taiwan: W.-N. Tzeng
- Tunisia: E. Derouiche
- United Kingdom: M. Gollock, A. Walker
- United States: E. Aalto, C. Bowser, G. Burns,
 B. Chase, M. Draghetti, S. Eyler, J. Johnson, L. Lee,
 A. Lisi, J. D. McCleave, S. J. Mount, K. Oliveira,
 J. Quinn, S. Schlueter, L. Sullivan, S. Welsh,
 J. L. Withers, G. Zydlewski

REFERENCE

Dekker, W., J. M. Casselman, D. K. Cairns, K. Tsukamoto, D. Jellyman, and H. Lickers. 2003. Worldwide decline of eel resources necessitates immediate action. Québec Declaration of Concern. Fisheries 28(12):28–30.

SUGGESTED CITATION FOR THIS DECLARATION

Dekker, W., and J. M. Casselman (coordinators). 2014. The 2003 Québec Declaration of Concern About Eel Declines—11 Years Later: Are Eels Climbing Back up the Slippery Slope? Fisheries 39(12): 613-614.

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IN MEMORIAM

Keith Jefferts 1931–2014

Keith Jefferts' life was characterized by three great passions: salmon, science, and piloting-both air and sea. Much of it was spent at the controls of airplanes, helicopters, and the Wily King-on the trail of the wily king salmon. Salmon and science combined to characterize or define the latter half of his life, when he returned to the Pacific Northwest, took up residence on his beloved Shaw Island, and set about ensuring that there would always be salmon to catch and appropriate wine in his cellar to drink with them. Together with boyhood friend and fisheries biologist Peter Bergman, he addressed the long-term survival of the salmon, engineering a means of identifying and managing various populations by tracking the lifecycle of members of particular populations, from California to Alaska. Jefferts and his team worked over the next decades to expand the technology to include salmon and other aquatic species across much of the globe.

Jefferts was born 10 May 1931, in Raymond, Wash., to Iris Bartlett Jefferts and Sidney Charles Jefferts. He acquired a remarkably broad set of skills and interests from his father, who was a jack-of-all-trades, and his appreciation for education from his mother, a schoolteacher. His father may also have been the source of his passion for flight, as for many years, Sidney kept an airplane, hidden from his wife.

Raised on a farm in Edmonds, Jefferts graduated from Edmonds High in 1949 and went on to earn a B.S. in physics at the University of Washington. From university, he went to the U.S. Naval flight school, flying first Douglas "A-1" "Skyraiders" and ultimately, most of the Navy's inventory of jet fighters in service in the 1950s and 1960s, ending his military flight career in "F-8" "Crusaders." He received several awards during his Navy service, including one for heroism in landing a disabled "A-1" "Skyraider" from which he should have ejected; doing so would have doomed the other person aboard, so Jefferts managed to land the badly damaged aircraft safely.

After completing his active duty tour, he remained in the Naval reserves, returning to the University of Washington where he completed a Ph.D. in atomic physics under Hans Dehmelt (Nobel Laureate, 1989), after presenting a thesis on the hyperfine structure of the H2+ molecule.

Bell Laboratories, in Murray Hill, New Jersey, then became his research home for the next 10 years. There, he became interested in radio astronomy and began a collaboration with radio astronomers Arno Penzias and Robert Wilson (Nobel Laureates, 1978) during which they discovered carbon monoxide in the Orion Nebula, contributing a fundamental component to the understanding of stellar dynamics—astrophysicists would ultimately learn that virtually all stars are formed in galactic molecular clouds similar to Orion's. In the early 1970s, he and his then-wife Elaine formed Northwest Marine Technology (NMT) in order to assume control and begin production of the fisheries management tools Jefferts and Bergman had developed through the previous decade. Existing salmon tagging methods were insufficient to permit researchers



to track the hatchery groups adequately and the population was declining.

In 1974, the Boldt Decision was issued and Jefferts left Bell Labs to move the fledgling NMT to the Northwest. The new management methodology featured binary coded magnetic wire tags, harmlessly implanted in young salmon and recovered when the fish matured.

Coded wire technology finally gave researchers the tools to track and manage a now-critical salmon population. More than a billion tags have since been implanted in salmon and other marine and animal species worldwide: www.nmt.us./aboutnmt/ history.shtml

He was an avid outdoorsman and early member of the Mountaineers and REI— backpacking trips in the Cascades and Olympics (always with a fly rod or two) were an omnipresent part of his graduate-school and early parenting years, and he continued those adventures with his children well into their adulthoods.

Throughout the years at Bell Labs, each summer included a cross-country family haul to the San Juan Islands, first in Bellancas, and four kids and two dogs later, in a series of Cessna 195s, and, ultimately twin-engine Beechcraft, delivering a gleeful family to summers of outdoor joy. His children well remember the long hours between stops and challenging hours over the Rocky Mountains, yet nevertheless three of his children and his granddaughter are pilots.

After he settled again in Washington, his work took him regularly to Alaska, up and down the Pacific coast, and around the world. In later years, he regularly flew a de Havilland Beaver into the interior of Alaska, British Columbia, and Washington in search of fish, solitude, and the occasional case of wine.

He flew a variety of other civilian aircraft over the years, including a Citabria, Cessna 172, Mitsubishi MU-2, Socata TBM, and two helicopters. Jefferts amassed some 16,000 hours

of flight time during his 65-plus years of flying, including some 7,000 hours of radial engine time—quite a feat for a pilot who never flew commercially.

After returning to Shaw, Jefferts made regular field research trips up and down the Pacific coast, discovering the beauty of Tenakee Inlet in southeastern Alaska, and making that his summer base for many years. Inspired by his friend and fishing partner Stan Moberly, he piloted a series of fishing boats (always named the *Wily King*) from Seattle each spring to Tenakee, a perfect base from which to oversee tagging and retrieval operations, travel to the Okanagan Valley's burgeoning vineyards, and, of course, to fish for salmon and halibut.

In 1953, he married Elaine Ryan, also of Edmonds, and together they raised four children. His son Steven, also a physicist, will forever remember the look on Jefferts's face when he performed his first gravitation experiment – jumping from a ladder at the second story while holding an umbrella as a parachute, or his first thermodynamics experiment, during which he penetrated the screen of Jefferts's oscilloscope with a Weller soldering iron.

Katharine will never forget the summer he taught her to dive, the backpacking and flying trips, building a crystal radio with him at age six and learning from him to develop film. Ingrid's fondest memory is of him, smiling through his luxuriant handlebar mustache, while playing his Martin 00 and singing "Scarlet Ribbons" in his rich baritone. Erik will always remember the summertime backpacking and fishing trips that invariably began with provisioning at the original REI store on Capitol Hill.

Jefferts also believed in giving back. In 1984, he formed and funded the Fisheries Management Foundation, and he and Sue Jefferts founded HonorWorks, a nonprofit focused on healing the damage done through ignorance in the raising of children of all cultures.

In 2005, Jefferts was honored with the American Fisheries Society Carl Sullivan Fishery Conservation award; the Western Division jointly recognized him and Pete Bergman with the Award of Excellence in 1985. He was also a fellow of the American Physical Society.

A celebration of his life was held in September. Memorial donations may be made to HonorWorks. www.honorworks.net/ donate.html

Family of Keith Jefferts



IN MEMORIAM

Grace Klein-MacPhee 1939–2014

The American Fisheries Society and Southern New England Chapter (SNEC) lost a dear friend, teacher, mentor and colleague when Grace Klein-MacPhee passed away on 20 September 2014. She was a long-time member of AFS, SNEC, and the Early Life History (ELH) Section. She was SNEC President from 2003 to 2004 and was on many student presentation and travel award committees. She was awarded the SNEC Lifetime Achievement Award for Meritorious Service, presented to her family posthumously at her memorial service.

She was also an organizer and participant in the ELH annual conference and coordinated judging for the ELH Sally Richardson Best Student Paper Award for years. In Quebec, the Section voted to honor Grace by establishing the Grace Klein-MacPhee Student Travel Grant. Although Grace was too ill to attend the meeting, ELH members met with her at home and told her about the travel grant named in her honor.

She had many talents and interests as outlined in her obituary, which follows, but her first loves were her family and her work on larval fish. Her daughter mentioned that there were as many pictures of larval fish as of family members in her photo album!

Throughout her life, she positively impacted the work and lives of many students and researchers in many regions of the world, engaging them in science and fisheries research. She was noted for sharing her expertise, her collegial demeanor, ease of friendship and ability to find humor and goodness in almost any situation. We will miss her dearly.

Syma Ebbin and Carolyn Griswold

Dr. Grace Klein-MacPhee, wife of the late John A. MacPhee, Jr., 74-years-old, from Narragansett, R.I., passed away Saturday, September 20, 2014, at home after a valiant battle with cancer. She was born December 18, 1939 in Lawrence, to Emil Louis Klein and Jessie (McLean). She grew up in Andover.

Klein MacPhee was a marine research scientist who received her bachelor's and master's of art in biology from Boston University (1961 and 1966) and received her Ph.D. from the University of Rhode Island Biological Sciences in 1978. She worked for the EPA in the Narragansett, Rhode Island laboratory, and was known for her outstanding ability to raise larval winter flounder. She also worked at the University of Alaska-Juneau fisheries department in addition to teaching. She also taught at Northeastern University, CCRI and as an adjunct professor at the University of Rhode Island (URI).



She was a member of the American Fisheries Society, the Fisheries Society of the British Isles, the Estuarine Research Federation, American Society of Zoologists, American Association for the Advancement of Science, World Mariculture Society, American Institute of Biological Sciences, International Study of Artemia, Southern New England Chapter of the Project Management Institute, and the Rhode Island Natural History Survey. She received the Rhode Island Natural History Survey Distinguished Naturalist Award in 2002, a Merit Award from EPA, Special Achievement Award from the Northeastern Division of the American Fisheries Society for her outstanding efforts as co-editor of the third-edition of Bigelow and Schroeder's Fishes of the Gulf of Maine, a Certificate of Appreciation from the American Fisheries Society and for serving as president of the Southern New England Chapter of AFS from June 2003-4. In addition she was a contributor of articles to various professional publications. She was very involved with sharing her knowledge with high school students and college undergraduates, and she served on numerous graduate student committees.

She also was an active member of the United States Figure Skating Association and enjoyed studying dance skating. She enjoyed the 2014 USFSA National Championship in Boston among several other ice skating events. She supported the Providence Bruins and URI men's and women's ice hockey teams in addition to being a longtime supporter of the Friends of Boston University Hockey. She was an active member of Peace Dale Congregational Church serving on various boards and committees. She was an active member of the United Church of Christ. She was a member of the URI Alumni Association in addition to the Boston University Alumni Association.

A memorial service was held in South Kingstown, R.I. this past September. In lieu of flowers, please make a donation to: The Grace Klein MacPhee Student Travel Gran, Early Life History Section/AFS 5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814-2199, or to the Rhode Island Natural History Survey, P.O. Box 1858, Kingston, RI 02881.

Family of Grace Klein-MacPhee

IN MEMORIAM



It is with great sorrow that the family of Richard (Dick) Ryder announce his passing on 19 September 2014 at Hogarth Riverview Manor.

1931-2014

Born on 25 February 1931, in Windsor, Ontario, Ryder obtained his M.Sc. in zoology

from the University of Michigan. He was employed with the Department of Lands and Forests/Ministry of Natural Resources for 43 years as a biologist/fisheries research scientist. Ryder received several awards for his long career in fisheries. He was president of the Northwest Ontario Chapter of the American Fisheries Society, as well as the president of the American Fisheries Society in 1980–1981. He was elected into the National Fisheries Hall of Excellence in 1999.

A memorial service was held this past September. In lieu of flowers, donations to the Parkinson's Society of Thunder Bay, c/o J. Forbes, 39 Wishart Crescent, Thunder Bay, ON P7A 6G4 would be greatly appreciated.

Memo to Dick Ryder of Thunder Bay, Ontario, from Henry Regier of Elmira, Ontario, 26 October 2010

Next year around this time, if I survive so long, I'll raise a beer in memory of an event that will then have happened 50 years ago. I had just settled in at the fisheries lab at Wheatley, Ontario, when you, as my colleague within the provincial agency in which we were then employed, came for a professional visit. You brought along a set of data on whole lake ecosystems that you had assembled in an effort to try to quantify a qualitative ecosystem approach that Donald Rawson had applied to a set of Canadian prairie lakes. As I recall, you had gone to spend some time with Rawson in Saskatchewan because you had collected data on a set of northern Ontario lakes and were checking whether Rawson's schema was suitable for your set. Incidentally, the relevant qualitative schema by Rawson (a diagram of several ranks of boxes with spaghetti arrows between some of the boxes) was included by Rawson's student, Pete Larkin, in a small book that he published many years later.

With an informal iterative fitting method you had inferred a ratio algorithm interrelating mean depth, total dissolved solids, and sustainable catch of all preferred species combined for a set of lakes that included watery ecosystems that bore some

general resemblances with respect to physical, chemical, and biological variables. You called it the Morphoedaphic Index or MEI; I think you chose that term because it had a hint of an obscene sound to it.

AFS Past President Richard (Dick) Ryder

At Wheatley in 1961 we had an electrically-driven mechanical calculator, perhaps it was a Marchant. At Cornell I had taken a minor in biometrics with Doug Rawson. So you got me to punching the calculator to fit various algorithms to your data with Gaussian multiple regression methods. As it happened, the best fit with these statistical methods was close to your informally-estimated MEI, even to the extent of the numerical coefficients that went with the variables.

As I recall, editors of some fisheries journal didn't find your paper as impressive as did some of your colleagues, including myself. Eventually it was published in AFS *Transactions* in 1965. Numerous publications followed, with you as lead author or as a coauthor.

Following 1971, as a result of discussions at the Salmonid Communities in Oligotrophic Lakes, SCOL, you and others showed that your morphoedaphic ecosystemic approach was consistent with Richard Vollenweider's lake eutrophication approach published in 1968.

Back to beginnings: Donald Rawson, William Ricker, Fred Ide, Fred Fry, with some others at the University of Toronto, had initiated a generic ecosystem approach of which yours may be perceived to be a particular species. That first generation used this approach with streams and small lakes in southern Ontario. These innovators were networking with researchers in New York State (John Greeley, Bill Green, George Embody, etc.) and others in Michigan State (Justin Leonard, etc.) who were doing something similar with streams and ponds in those states.

In the 1970s you connected with Robert Jenkins of Arkansas who had "discovered" Donald Rawson's work independently. Jenkins had connected with Homer Swingle and his comparative experimental ecosystemic pond work at Auburn and was trying to apply a hybrid Swingle-Rawson approach to quantify some regularity in southern reservoirs. So you and Jenkins interacted beneficially. (Was Richard Anderson's subsequent work on farm ponds in the Midwest influenced by Bob Jenkins' work?)

It happened that I had learned about Swingle's fishpond ecosystemic methodology because my graduate theses related to farm ponds in New York State, which had been stocked with fish according to several variants of Swingle's formula. Eddie Wayne Shell, a graduate of the Auburn fisheries school where Swingle professed, was my laboratory partner at Cornell; he generously helped me to understand the Swingle methods since not all the relevant information was included in Swingle's barebones publications.

Was it in 1971 that you were a fishery advisor with an UNDP-FAO project on Volta Lake in Ghana? Anyway, your morphoedaphic approach attracted favorable attention in an African freshwater fisheries conference that Don Kelley (of California) and I convened in Bujumbura, Burundi in June 1971 (it was subsequently applied to get first estimates of combined sustainable yields of preferred fish species in some African lakes and reservoirs, by Fran Henderson and colleagues).

As you know, variants of the Rawson-Ryder/Vollenweider comparative ecosystem approach have been applied widely with respect to assessing likely consequences to fish and fisheries of climate warming. So, thanks again Dick for your leadership with an ecosystem approach here in the Great Lakes and elsewhere.

PS: I recall with pleasure a presentation by you and Steve Kerr about the theory of the MEI at a morning session at a symposium in the wilds near Thunder Bay about three decades ago. You were addressing complexity with some kind of ergodic harmony concept. To try to get the rest of us to focus on 'harmony' you were playing some of J. S. Bach's music as background sound effects. We eventually came to appreciate your efforts when we learned that you and Steve had been up all the previous night working on your concept, with the help of Spanish wine, perhaps it was Sangria di Toro.

Years later, you and Steve collaborated on extending the MEI concept to the Adriatic Sea in a symposium in the Italian Alps convened by Richard Vollenweider and colleagues. I don't know whether you found some Palestrina music and Italian wine helpful on that occasion.

Henry Regier



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(If space is available, events will also be printed in Fisheries magazine.)

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DATE	EVENT	LOCATION	WEBSITE
January 21–23, 2015	Texas Aquaculture Association–45th Annual Conference & Trade Show	Kemah, TX	www.texasaquaculture.org
January 22–23, 2015	Hatchery vs. Wild Salmonid Symposium: Research, Management, and Reform in the Pacific Northwest	Portland, OR	www.orafs.org
January 26–28, 2015	Global Inland Fisheries Conference	Rome, Italy	inlandfisheries.org
January 28–February 1, 2015	$\frac{1}{S}$ 2015 AFS Southern Division Annual Meeting	Savannah, Georgia	sdafs.org/meeting2015
February 16–19, 2015	$rac{1}{s} \mathbf{F}$ 2015 Annual General Meeting, WA-BC Chapter of AFS	Richmond, British Columbia	wabc-afs.org/2014/06/3530/
February 19-22, 2015	Aquaculture America 2015	New Orleans, LA	www.marevent.com
February 22–27, 2015	Aquatic Sciences Meeeting	Granada, Spain	aslo.org/meetings/
February 24–26, 2015	2nd International Conference on Fisheries Aquacul- ture and Environment in the Indian Ocean	Muscat, Oman	fishconference.com
March 4–6, 2015	$\frac{A}{S}$ 2015 Idaho Chapter Annual Meeting	Boise, ID	www.idahoafs.org/2015AnnualMeeting/
April 28–30, 2015	FLOW 2015: Protecting Rivers and Lakes in the Face of Uncertainty	Portland, Oregon	www.instreamflowcouncil.org/flow-2015
May 17-19, 2015	NPAFC International Symposium on Pacific Salmon and Steelhead Production in a Changing Climate: Past, Present, and Future	Kobe, Japan	www.npafc.org
May 18-22, 2015	$\frac{1}{5}$ F AFS 2015 Piscicide Class	USU, Logan, Utah	www.fisheries.org
May 26-30, 2015	World Aquaculture 2015	Jeju Island, Korea	www.was.org
June 22–24, 2015	Fish Passage 2015	Groningen, Netherlands	www.fishpassageconference.com
July 12-24, 2015	39th Annual Larval Fish Conference	Vienna, Austria	larvalfishcon.org
July 26-31, 2015	World of Trout	Bozeman, MT	www.troutcongress.org
August 16–20, 2015	$\frac{A}{S}$ AFS Annual Meeting	Portland, OR	2015.fisheries.org
November (TBA), 2015	5th International Symposium on Stock Enhancement and Sea Ranching	Sydney, Australia	www.searanching.org
February 22-26, 2016	Aquaculture 2016	Las Vegas, NV	www.marevent.com
September 19-22, 2016	OCEANS 2016	Monterey, CA	www.oceanicengineering.org

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Continued from page 576 (Policy)

more fish than it produces may provide a prime destination for anglers but almost certainly will pose challenges to fisheries managers. Imagine an artificial river habitat that attracts listed salmonids, increases fishing pressure on pre-spawning adults, and complicates court-ordered rebuilding or recovery plans. The reef could provide short-term benefits while jeopardizing longer-term goals. This question should be part of a scientific analysis that is long overdue, one that focuses on the ecosystems we cherish and the services they provide to *Homo sapiens*.

When scientific studies and project monitoring confirm that a specific habitat technique warrants field application, we need to reflect that knowledge in our best practices manuals and agency policies. Our society continually faces habitat threats that demand the most efficient and effective responses, whether we're dealing with a catastrophic chemical spill like that in the Elk River, West Virginia, in January 2014 or chronic prop scarring in shallow, vegetated lagoons nationwide. Imagine the power of knowing ahead which option would yield the best results for a specific habitat or species. Empirical data, management applications, and established policies would equate to shared knowledge and expectations that could shave years from both the protracted environmental and legal reviews and the slow pace of natural ecosystem recovery. Again revisiting our Québec City meeting in August 2014, it was nice to talk with representatives of two companies who are in the business of creating habitat and giving us some options as we seek to increase biomass by improving habitats. We still need to answer basic questions about increasing versus concentrating biomass, but in the interim Mossback Fish Habitat and Fish Habitat Forever are designing easily-deployed systems that might prove to be new tools in our restoration and creation tool box.

We must strive to answer these scientific questions and update our management and policy actions. One approach would be to encourage graduate students to study these issues in their M.S. and Ph.D. research, either through theoretical or laboratory studies of fish habitat conservation strategies or by developing and applying habitat monitoring protocols in the field. Until our uncertainties are resolved, we should revisit existing practices to determine if our restoration or mitigation ratios need to be revised or if it would be more logical to invest more in protection.

The demands of a growing population dictate that our society will never have the authority to protect all ecological assets. Instead, the questions posed in this column will continue to challenge us and we will need to sharpen our capacity to restore, create, and mitigate. That sweeping challenge offers opportunities to every AFS member and Unit. Let's get started!





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BACK PAGE

A Meditation on Food Habit Studies

Milton Love

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Yellowfin sole (Limanda aspera). Photo credit: Catherine Mecklenburg.

This meditation was engendered by my reading of a master's thesis by Geoffrey M. Lang (Lang 1992), who partly based his research on the results of a survey of the food contents of 11,651 Yellowfin Sole stomachs. And while he had some assistance examining the contents of these stomachs, he noted that "the majority [were] handled by myself."

My lord, he looked at the majority of 11,651 stomachs! Over the years, I have done lots of food habit studies. I looked at White Croakers, California Scorpionfish, Kelp Bass, Yellowfin Croakers, California Corbina, Olive Rockfish, oh, just a whole bunch of species. And initially it's kind of exciting; it's kind of like a treasure hunt. Oh, look, that hunk of mung, why that could be a crab, or maybe a worm, or perhaps the keys to Jimmy Hoffa's Cadillac! But each of my studies was only based on a few hundred stomachs. What must it be like to look at "the majority" of 11,651 stomachs? My experience is that after maybe 50 stomachs a food habit study becomes boring and by 100 stomachs the process is positively stultifying. But if looking at Stomach 100 is stultifying, what must happen at Stomach 5,222? Do you enter some sort of altered state of consciousness? Do you start to levitate? Does your office mate have to secure you to your chair? And then at Stomach 9,805 do great gouts of Greek fire erupt from your Third Eye, melting your dissecting implements?

REFERENCE

Lang, G. M. 1992. Food habits of three congeneric flatfishes: Yellowfin Sole, *Pleuronectes asper*, Rock Sole, *P. bilineatus*, and Alaska Plaice, *P. quadrituberculatus*, in the eastern Bering Sea, 1984–1988. Masters's Thesis, University of Washington, Seattle.

Excerpt from Milton Love's (AFS Member 2012) book: Certainly More Than You Want to Know About the Fishes of the Pacific Coast.



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