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Translocating Adult Pacific Lamprey

Standardized Monitoring of Fish Populations

Demographic Diversity in Natural Resource Science Professions

Tilapia in South India

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Cover: *Salmon Spawning* by S. Gilbert Fox

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COLUMN
President's Hook

The Functioning AFS Network

Bill Fisher, President

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As my journey as American Fisheries Society (AFS) President comes to an end, it is time to reflect on this past year and bring things to a close. It has been an enjoyable but arduous journey to be sure. At the time of this writing, the upcoming annual meeting and meetings within that meeting (Governing Board, Business, etc.), still loom large. I am up for it and really excited about the plans underway for the gathering in the Twin Cities in August. In this, my last "Hook," I want to highlight some of the things that were accomplished this year but, most important, thank the many people who worked to help achieve these accomplishments. My observations tell me that the AFS network is functioning well at most levels, but like any organization it could use some tweaking to make it function better. Using our Strategic Plan and my Plan of Work as guides, the following are some of the noteworthy accomplishments that occurred in 2011–2012.

GOAL 1 - Supporting our Global Fisheries Leadership: The AFS played a key role in two very important international events: the 6th World Fisheries Congress in Edinburgh, Scotland, in May 2012, and the 142nd Annual Meeting of the American Fisheries Society in St. Paul–Minneapolis, Minnesota, in August 2012. The Congress attracted more than 1,300 delegates from 65 countries who addressed the theme of "Sustainable Fisheries in a Changing World." AFS was well represented by our leadership (executive director and three officers) and members (over 50). A highlight of the opening plenary was a surprise address by His Royal Highness The Prince of Wales (a.k.a. Prince Charles) on the International Sustainability Unit he established to facilitate consensus on how to resolve key environmental challenges facing the world. He gave a very credible and insightful talk about sustainable management of wild marine fisheries. He even mentioned the importance of sustainable fisheries management to the fish and chips industry in the United Kingdom. Gus Rassam and I serve on the World Council of Fisheries Societies, and the council selected South Korea's bid to host the 7th World Fisheries Congress in Busan in 2016. As for AFS, around 2,000 attendees are expected to attend our 142nd Annual Meeting in the Twin Cities to address the theme "Fisheries Networks: Building Ecological, Social and Professional Relationships." We received 1,202 abstracts for 1,028 oral and 174 poster presentations that will occur in 96 sessions including 44 symposia. This year, we opened symposia to general contributors, making the symposia more inclusive. We also gave registrants the option of going green by electing for a digital program app rather than a printed copy. There will be a great plenary session featuring talks by Drs. Villy Christensen, Barb Knuth, and Bill Taylor, as well as society awards. The annual meeting team of over 60 volunteers, led by Don Pereira, Brian Borkholder, and Ann Schneider, has done a terrific job of arranging what should be an outstanding meeting. Two additional items of importance were accomplished under the Global Fisheries Leadership goal. First, most of you have visited the new and improved AFS website fisheries.org. The Electronic Services Advisory Board, led by Jeff Kopaska and webmaster Farasha Euker, orchestrated and implemented the update following many of the recommendations of The Canton Group, a business technology services firm we contracted to evaluate our web service. You no doubt have noticed improvements to the layout and content of *Fisheries.* Thanks go to Managing Editor Sarah Gilbert Fox and Senior Editor Gus Rassam for making our highest impact publication more appealing. Second, the AFS Policy Statement titled the "Need for an Immediate-Release Anesthetic/Sedative for Use in the Fisheries Disciplines" was completed by the Resource Policy Committee and passed by the membership. Jesse Trushenski and Jim Bowker, past and present presidents of the Fish Culture Section, respectively, led a delegation to Washington, D.C. to meet with leaders at the Center for Veterinary Medicine to present the newly adopted policy. Overall, AFS continues to provide global leadership in fisheries by promoting sound science and conservation, distributing fisheries science through our publications, and presenting our science to decision makers for consideration.

GOAL 2 - Education and Continuing Education: This goal challenges AFS to facilitate lifelong learning to educational resources for developing and current professionals. In September 2011, the Coalition for Natural Resource Societies organized and led the Natural Resource Education and Employment Conference in Denver, Colorado. The conference brought together leaders from state and federal resource agencies, universities, professional societies, industry, and nongovernmental organizations to review issues about the training and supply of natural resource professionals and the changing employment scene, and to make specific recommendations for action. The conference report, which was released in April 2012, provided a series of recommendations for adapting natural resource education to changing demographics, workplace needs, and global environmental challenges. AFS provides a myriad of continuing education courses delivered at chapter, division, and annual society meetings. These courses support the lifelong learning needs of fisheries professionals, including the small percentage of whom are AFS certified. Education of fisheries professionals

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The Long-Term Illinois River Fish Population Monitoring Program

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Programa de Largo Plazo de Monitoreo de Poblaciones de Peces del Río Illinois

RESUMEN: *El monitoreo ecológico de largo plazo es esencial para entender la interacción entre patrones espaciales y temporales de variabilidad. Los objetivos de este estudio fueron determinar tendencias en (1) capturas totales de peces; (2) riqueza específica y abundancia relativa de peces nativos y foráneos; y (3) ensambles ícticos a lo largo del tiempo utilizando más de 50 años de datos poblacionales colectados en el Río Illinois. La riqueza de especies de peces se incrementó en el tiempo y los análises comunitarios revelaron cambios en la composición específica, de una comunidad dominada por la carpa común (*Cyprinus carpio*) y el pez dorado (*Carassius auratus*) a una de mayor diversidad de especies. Antes del año 1976, las abundancias de peces nativos declinaron sensiblemente, pero a partir de entonces han mostrado un incremento significativo. Las abundancias de especies foráneas de peces se redujeron durante el periodo 1957-2000; no obstante, el rápido crecimiento de la carpa asiática (*Hypophthalmichthys spp.*) en el Río Illinois se acompañó de un aumento de las capturas de especies foráneas. Muchas de las tendencias observadas pueden ser reflejo de los efectos positivos de la rehabilitación llevada a cabo a lo largo del Río Illinois. Nuestras colecciones destacan la importancia de los programas de monitoreo a largo plazo para detectar cambios espaciales y temporales de las poblaciones de peces en el contexto de cambios antropogénicos y naturales en ecosistemas acuáticos.*

ABSTRACT: *Long-term ecological monitoring is essential to gain an understanding of the interaction between spatial and temporal patterns and variability. The goals of our study were to test for trends in (1) overall fish catches; (2) native and nonnative fish species richness and relative abundance; and (3) the fish species assemblages over time using greater than 50 years of fish population data collected from the Illinois River. Fish species richness increased over time and community analyses revealed changes in fish species composition from a community dominated by common carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*) to one of greater species diversity. Prior to 1976, abundances of native fish species were declining significantly but have since shown a significant increase. Abundances of nonnative species declined from 1957 to 2000; however, rapid population growth of Asian carps (*Hypophthalmichthys spp.*) in the Illinois River increased nonnative fish species catches. Many of the trends observed may reflect positive effects of rehabilitation efforts throughout the Illinois River. Our collections highlight the importance of long-term monitoring programs to detect temporal and spatial shifts in fish populations in the context of anthropogenic and natural change in aquatic ecosystems.*

INTRODUCTION

Long-term ecological monitoring is essential to gain a predictive understanding of the interaction between spatial and temporal pattern and variability of populations. Depending on the temporal and spatial scale of potential change, sufficient long-term monitoring is critical for making informed management decisions, inferences, and/or testing for responses to ecosystem variability. As just one example, long-term changes in the duration of ice cover may be misinterpreted depending upon the number of years examined in the overall time series (Magnuson et al. 2000, 2006). The strengths of long-term monitoring lie in its temporal context, the ability to detect trends and surprises, and to test hypotheses in regards to temporal variation. Long-term monitoring programs can be further strengthened by including a broader spatial extent (Carpenter 1998).

Long-term, standardized monitoring of fish populations is critical for fisheries management, yet these programs are often lacking and/or are spatially and temporally discontinuous. Long-term fish population monitoring programs are even rarer for large rivers compared to lentic systems and streams (see Gutreuter et al. 1995). Fish population monitoring is instrumental for informing management decisions to sustain fish populations and communities (Walters and Martell 2004). Without long-term studies and monitoring, science-based decisions for fisheries management are often not possible (Walters 2011; Walters et al. 2005).

The Illinois River was once known to be an exceptionally productive large floodplain river, especially in regards to its fish community (Sparks and Starrett 1975). Changes to the river have altered much of the viability of the system over the past 100 years, effectively diminishing its capacity to maintain this once thriving fish community. Anthropogenic factors such as sewage disposal, levee construction, and increased sedimentation rates from agricultural practices have damaged the fish community (Bellrose et al. 1983; Bhowmik and Demissie 1989). Much of the floodplain, which is the driving force behind the river's great diversity and productivity, is now lost (Junk et al. 1989). Therefore, the Illinois River serves as an ideal study system to test for fish population and community responses to ecosystem change because of the well-documented anthropogenic and natural disturbances that have occurred on the river and the availability of a long-term fish population monitoring program.

Our analyses were conducted as part of the Illinois Natural History Survey's Long Term Illinois River Fish Population Monitoring Program (long-term electrofishing [LTEF]), which tests for differences in the Illinois Waterway (River) fish community along a longitudinal gradient. Dr. William Starrett initiated the LTEF program in 1957 in an attempt to relate changes in the Illinois River fish community in response to various environmental disturbances (Sparks and Starrett 1975). The scope of the LTEF program encompasses the entire Illinois River extending into the lower Des Plaines River of the Illinois Waterway system. The system differs considerably between upper and lower waterway reaches in physical and biological features, relating to its development over geologic and "modern" time. Fixed sites along the Illinois River and Lower Des Plaines River of the Illinois Waterway are sampled each year using the same methods to maintain a standardized long-term data set.

The goals of our study were to test for trends in (1) overall fish catches; (2) native and nonnative fish species richness and relative abundance; and (3) the fish species assemblages over time using greater than 50 years of fish population data collected from the Illinois River. Additionally, we evaluated the fish species assemblages in three distinct time periods corresponding to known major changes in the Illinois River ecosystem; pre–Clean Water Act (1957–1969), Clean Water Act (1970–1989), and post–Clean Water Act (which includes Asian carp *Hypophthalmichthys* spp. establishment; 1990–2009). We also compared these variables between previously established upper and lower Illinois River fish communities (Pegg and McClelland 2004) among individual reaches and tested for breakpoints of change in these variables using the entire time series (1957–2009). Our objective was to test for correlations between observed fisheries characteristics and key changes in the Illinois River ecosystem (e.g., nonnative species establishments, habitat loss/restoration). We evaluate our findings in the context of those found in Pegg and McClelland (2004) following an additional 9 years of data collection to compare and contrast our results and discuss the importance of continued long-term fish population monitoring.

STUDY AREA—THE ILLINOIS WATERWAY

Our study was conducted in six navigation reaches of the Illinois Waterway (Alton, La Grange, Peoria, Starved Rock, Marseilles, and Dresden reaches) that contain the Illinois River (Figure 1). The Illinois River begins at the confluence of the Kankakee and Des Plaines rivers at river kilometer 439.5 of Dresden Reach near Channahon, Illinois, and connects to the Mississippi River downstream at Mississippi rkm 350.8 near Grafton, Illinois.

The river changes physically from upstream to downstream as a result of alterations from different geological events creating upper river and lower river segments. The upper river is defined by a relatively narrow basin of rocky substrate and higher gradient from the "big bend" area at Hennepin, Illinois (rkm 334.1), extending upstream. The lower river (below Hennepin to the Mississippi River) is defined by a wide basin of soft substrate and low-gradient common among large floodplain rivers (Mills et al. 1966). This large floodplain of the lower river is an important feature that differentiates it from the upper river. Nearly all of the basin acreage (93%) and river length (85%) is located in the lower river (Theiling et al. 2000). About 90% of the open water acreage of the Illinois River is located in the lower river.

METHODS

Fish Sampling

Collections have occurred at 27 fixed sites annually in the six navigation reaches; 25 sites are located on the Illinois River with 2 sites in the Des Plaines River portion of the Dresden Reach of the Illinois Waterway. Collection sites are all in areas that retain a connection to the main stem of the Illinois River even at low water stages. Stations are typically located in side channel habitats; however, some stations are located in contiguous backwaters or along the borders of the main channel.

Figure 1. Map of sampling sites in six navigation reaches sampled by the Long-Term Illinois River Fish Population Monitoring Program from 1957 to 2009. The lower river is comprised of the Alton, La Grange, and Peoria reaches from the confluence with the Mississippi River to the Starved Rock Lock and Dam. The upper river is comprised of the Starved Rock, Marseilles, and Dresden reaches from the Starved Rock Lock and Dam to the Brandon Road Lock and Dam.

Sample site allocation was standardized as about one site for every 17 rkm. Because navigation reaches vary in length, the larger reaches were given more sampling sites to increase reach coverage. Alton and La Grange reaches each have 6 collection sites, Peoria Reach has 8 sites, Starved Rock Reach has 2 sites, Marseilles Reach has 3 sites, and Dresden Reach has 2 sites (Figure 1).

Electrofishing consists of a two-man crew: a driver and single dip-netter using a boat-mounted three-phase, 3,000-W, 230-V AC generator with power transmitted from the generator to the water via a three-cable system. We collected stunned fishes using a 6.35-mm mesh dip net and captured fishes were placed in a live well for identification, weighed (grams), and measured for total length (millimeters). We based collections on an equal time approach with a goal of 60 min of sampling per site following the collection of ancillary water quality parameters (dissolved oxygen, conductivity, Secchi disc transparency, and velocity). We sampled during a 6-week period in late August to early October when water temperatures exceeded 14°C. This period was selected to ensure the likelihood of sampling during low water conditions that will be at or above the water temperature criteria (≥14°C) throughout the waterway. Sampling was only conducted when water levels were less than 762 mm above a flat pool in Starved Rock, Marseilles, and Dresden reaches and 457 mm above a flat pool in Alton, La Grange, and Peoria reaches. Our standardized sampling efforts during low water conditions were implemented to minimize variability associated with fish movements that are typical when water levels rise and fall. Collections were omitted at locations that did not meet water level criteria during the sampling period to ensure standardization of the data.

Data Analysis

We tested for spatial and temporal differences in overall fish catches, native and nonnative fish species richness and relative abundance, and the fish species assemblages using greater than 50 years of fish population data collected from the Illinois River. We pooled collection numbers from all sites within a given reach to represent that specific reach as a whole (e.g., sites a, b, and c = Dresden Reach), and then the three upper reaches (Starved Rock, Marseilles, and Dresden) were grouped to represent the upper river segment and the three lower reaches (Peoria, La Grange, and Alton) were grouped to represent the lower river segment according to delineations previously established by Pegg and McClelland (2004) and McClelland et al. (2006).

Overall Catches 1957–2009

We tested for differences in species richness and relative abundance between the upper and lower river during 1957–2009 using a two-sample *t*-test. We used a generalized linear model (GLM) to test for differences among reaches. We made pairwise comparisons to test for significant differences among reaches from the GLM using Tukey's multiple comparison procedure. We used the null hypothesis of no differences among mean values at the $\alpha = 0.05$ level with a Bonferroni correction for pairwise comparisons ($\alpha = 0.0083$). Data were standardized as catch per unit effort for each sample where the number of fish collected per hour of electrofishing was calculated to give relative abundance.

Trends in Fish Species Richness and Relative Abundance

We examined river-wide temporal data to test for trends in fish species richness and relative abundance. We used simple linear regression and segmented regression models to test for relationships of fish species richness and relative abundance over time. We tested all trends for possible thresholds where break points in the data existed to support more than one temporal linear relationship. The segmented regressions with unknown break points were developed according to Oosterbaan (1994) and Oosterbaan et al. (1990). If no significant break point was identified, we used simple linear regression to test for a relationship. Our initial analysis tested for trends as an overall river-wide unit. We further subdivided the data into upper river and lower river segments to test for trends at a broad, longitudinal scale. After testing for trends in the data as an overall unit, we further subdivided the river-wide and river segment data into native and nonnative fish species groups to test for trends in each group.

Trends in Fish Species Assemblages

We tested for differences in fish species contributions and community patterns among time periods for relative abundance using analysis of similarity (ANOSIM), similarity percentages procedure (SIMPER), and nonmetric multidimensional scaling (NMDS) using Primer software (version 5; Primer-E Ltd., Plymouth, England). We used a square root transformation on the fish community data to decrease effects of single event extremes in $CPUE_N$ (Digby and Kempton 1987). A Bray-Curtis similarity matrix was then created using $CPUE_N$ of all fish species within a sample prior to community tests (Bray and Curtis 1957). We tested for community differences among three time periods—1957–1969, 1970–1989, and 1990–2009—to evaluate potential shifts in the Illinois River fish community. These time periods were chosen to represent major known changes in the Illinois River ecosystem; pre–Clean Water Act (1957–1969), Clean Water Act (1970–1989), and post–Clean Water Act (with establishment of Asian carp; 1990–2009).

To test for potential temporal trends in fish species assemblages from the community data, we created a two-dimensional NMDS plot with samples classified according to the time period from which they were taken. The NMDS plot mapped values from the Bray-Curtis similarity matrix according to their distances in similarity from one another, where samples of high similarity grouped close together (Clarke and Warwick 2001). We also established two separate variable overlays to test for relative abundance changes in fish species groups over time in the NMDS plot. The first variable overlay consisted of common carp *Cyprinus carpio* and goldfish *Carassius auratus* relative abundances, the second consisted of centrarchid (black crappie *Pomoxis nigromaculatus*, bluegill *Lepomis macrochirus*, green sunfish *L. cyanellus*, largemouth bass *Micropterus salmoides*, longear sunfish *L. megalotis*, orangespotted sunfish *L. humilis*, pumpkinseed *L. gibbosus*, rock bass *Ambloplites rupestris*, redear sunfish *L. microlophus*, smallmouth bass *M. dolomieu*, spotted sunfish *L. punctatus*, warmouth *L. gulosus*, and white crappie *P. annularis*) relative abundances. Common carp and goldfish represent the two nonnative fish species that have been present in the Illinois River since initiation of our project. The centrarchid group not only represents a popular and important sportfish resource but also a group important in determining biologic integrity because they are less tolerant to poor ecological conditions such as low dissolved oxygen (Karr 1981). Overlays were formatted as bubble plot configurations that showed an increase in bubble size as an increase in relative abundance for each group. A one-way ANOSIM procedure with pairwise comparisons then allowed for a statistical calculation of the fish community among the three time periods (Clarke and Warwick 2001).

We used the SIMPER procedure in an effort to isolate contributions of individual fish species to given catches; the SIMPER procedure is a similarity/dissimilarity percentage procedure (Clarke and Warwick 2001). The SIMPER procedure gives higher contribution percentages to fish species with consistently higher abundances across samples, whereas fish species with uneven extremes in catch would have a lower contribution percentage regardless of an overall high catch value (Clarke and Warwick 2001). We used a 90% cutoff level to identify the species that were most likely to be observed among collections. We initially calculated fish species contributions across the entire river over all years combined to test for dominant species over all catches. We then examined contributions by each time period from our NMDS and ANOSIM tests to determine fish species that dominated each individual period.

RESULTS

Overall Catches, 1957–2009

A total of 200,201 fishes were collected from 1957 to 2009 during 928.8 h (1,007 collections) of electrofishing throughout the Illinois River (Table 1). We collected 102 fish species representing 18 families (Table 1). The greatest collection occurred in 1962, with a total of 27,552 fishes; relative abundance for 1962 represented 7.8% of the relative abundance over all years and was dominated by high catches of emerald shiners *Notropis atherinoides* and gizzard shad *Dorosoma cepedianum* (84% of the catch for 1962). Collections in the lower river were the greatest overall. A total of 148,730 fishes representing 90 fish species were captured in the lower river (Table 1). Mean species richness was significantly greater in the lower river compared to the upper river ($P < 0.001$; $n = 1{,}007$; df = 1,005; $t = 3.93$). Mean relative abundance overall and for native fish species was greatest in the upper river, whereas nonnative fish was greatest in the lower river; however, test results were not statistically significant.

Significant differences existed among reaches for mean fish species richness ($P < 0.001$; $n = 1{,}007$; df = 5, 1,001; $f = 11.63$), mean relative abundance overall ($P < 0.001$; $n = 1{,}007$; df = 5, 1,001; $f = 6.12$), and mean native fish relative abundance ($P < 0.001$; $n = 1{,}007$; df = 5, 1,001; $f = 5.85$) but not for mean nonnative fish relative abundance ($P = 0.26$; $n = 1{,}007$; df = 5, 1,001; $f = 1.30$). Peoria Reach showed the greatest fish species richness and abundance (Table 1). Peoria Reach collections produced 80% of the total fish species and 40.7% of the total abundance of fish over all reaches. Peoria Reach mean fish species richness was greater than all reaches; a post hoc test revealed Peoria Reach was significantly greater than Marseilles, Starved Rock, LaGrange, and Alton ($P < 0.001$). Peoria Reach overall mean relative abundance was greater than all other reaches and significantly greater than Alton Reach ($P < 0.001$). Mean native fish relative abundance was also highest in Peoria Reach and significantly greater than the LaGrange and Alton reaches ($P < 0.001$). Mean nonnative fish relative abundance was greatest in LaGrange Reach, significantly greater than in Marseilles, Starved Rock, and Alton reaches ($P < 0.001$).

TABLE 1. Fish collections for the six reaches of the upper and lower Illinois River from 1957 to 2009.

		N	Hours	Total Species	Total Number	Mean no./h
Upper River	Dresden	63	62.7	61	13,346	216
	Marseilles	125	109.3	72	18,891	175
	Starved Rock	79	72.8	69	19,234	261
	Total	267	244.8	87	51,471	210
Lower River	Peoria	314	286.8	82	81,434	264
	LaGrange	236	222.2	66	46,529	201
	Alton	190	184.9	65	20,767	113
	Total	740	694.0	90	148,730	206
Illinois River	Total	1,007	938.8	102	200,201	207

Trends in Fish Species Richness and Relative Abundance

Overall Trends

Fish species richness increased significantly from 1957 to 2009 in the Illinois River (richness = 0.46 × year − 866.91; $P < 0.05$; $n = 45$; df = 1, 43; $f = 40.05$; $r^2 = 0.48$). Nearly one new fish species was added every second year of sampling and many of the new fish species were added after 1985. Mean relative abundance showed a significant break point in 1976, where numbers declined significantly from 1957 to 1976 (mean relative abundance = −10.74 × year + 21,375.68; $P < 0.05$; $n = 79$; df = 1, 77; $f = 12.93$; $r^2 = 0.14$) and then showed a significant increase from 1977 to 2009 (mean relative abundance = 2.53 × year − 4,861.96; $P < 0.05$; $n = 161$; df = 1, 159; $f = 7.49$; $r^2 = 0.05$). Mean relative abundance in the Illinois River over all years was 207.1 fish/h of electrofishing. Relative abundances for the upper river declined significantly over time (mean relative abundance = −1.63 × year + 3,452.95; $P = 0.05$; df = 1, 117; $f = 4.02$; $r^2 = 0.03$), whereas relative abundances for the lower river showed no change (mean relative abundance = −0.911 × year + 2,012.33; $P = 0.20$; df = 1, 119; $f = 1.66$; standard error [SE] = 119.23; $r^2 = 0.01$). Mean relative abundance was 210.3 and 206.0 fish/h in the upper and lower river, respectively.

Native Fish Species Trends

Native fish species richness increased significantly in the Illinois River from 1957 to 2009. On average, one new native fish species was collected approximately every 3 years of sampling throughout the river (native fish species richness = 0.36 × year − 24.03; $P < 0.05$; df = 1, 43; $f = 28.99$; $r^2 = 0.40$; Figure 2a). Native fish species richness increased significantly in the upper river at an average rate of one new fish species approximately every 3 years (native fish species richness = 0.41 × year − 787.66; $P < 0.05$; df = 1, 42; $f = 78.65$; SE = 4.92; $r^2 = 0.65$), whereas the lower river richness increased significantly at a slower rate of one new fish species about every 5 years (native fish species richness = 0.22 × year − 411.85; $P < 0.05$; df = 1, 41; $f = 17.32$; $r^2 = 0.30$). Four darter, two topminnow, three dace, and one centrarchid species have been added to the native fish species collections since 1985.

Mean native fish relative abundance in the Illinois River showed a significant break point in 1976. Native fish relative abundance declined significantly from 1957 to 1976 (mean native fish relative abundance = −9.17 × year + 18,225.10; $P < 0.05$; df = 1, 77; $f = 9.34$; $r^2 = 0.11$) and then showed a significant increase from 1977 to 2009 (mean native fish relative abundance = 3.09 × year − 5,995.81; $P < 0.05$; df = 1, 159; $f = 14.97$; $r^2 = 0.09$; Figure 3a). Mean native fish relative abundances showed a similar pattern for the upper and lower Illinois River segments, except that the breakpoint for the upper river was 2 years later. A significant break point for the upper river occurred in 1978, where native fish relative abundance showed no change from 1957 to 1978 ($P = 0.33$) but increased significantly over time from 1979 to 2009 (mean native fish relative abundance = 4.96 × year − 9,682.44; $P < 0.05$; df = 1, 76; $f = 4.26$; $r^2 = 0.05$; Figure 4a).he lower river showed a significant break point in 1976, where mean native fish relative abundance significantly declined from 1957 to 1976 (mean native fish relative abundance = −4.60 × year + 9,205.86; $P < 0.05$; df = 1, 38; $f = 5.093$; $r^2 = 0.12$) and then significantly increased from 1977 to 2009 (mean native fish relative abundance = 2.76 × year − 5,375.94; $P < 0.05$; df = 1, 78; $f = 12.07$; $r^2 = 0.13$; Figure 4b).

Nonnative Fish Species Trends

A significant break point occurred for overall nonnative fish species richness in 1985. From 1957 to 1985, no change was observed in overall nonnative fish species richness ($P = 0.41$). A significant increase in nonnative fish species richness occurred after 1985 (nonnative fish species richness = 0.23 × year − 463.99; $P < 0.05$; df = 1, 19; $f = 41.97$; $r^2 = 0.69$) as a new nonnative fish species was collected nearly every 4 years in the Illinois River. Seven nonnative fish taxa have been added to the collections in the Illinois River since 1985. Striped bass *Morone saxatalis* × white bass *M. chrysops* hybrid, Asian carps (grass carp *Ctenopharyngodon idella*, bighead carp *Hypophthalmycthys nobilis*, and silver carp *H. molitrix*), round goby *Neogobius melanostomus*, white perch *Morone americana*, and white perch *M. americana* × yellow bass *M. mississippiensis* hybrid have all been found at various locations in the Illinois River. Nonnative fish species richness increased significantly in the upper river (nonnative fish species richness = 0.01 × year − 26.02; $P < 0.05$; df = 1, 42; $f = 4.43$; $r^2 = 0.09$) and lower river (nonnative fish species richness = 0.09 × year − 177.39; $P < 0.05$; df = 1, 41; $f = 70.25$; $r^2 = 0.63$) from 1957 to 2009.

Overall mean nonnative fish relative abundance showed a significant break point in 2000. Mean nonnative fish relative abundance declined significantly from 1957 to 2000 (mean

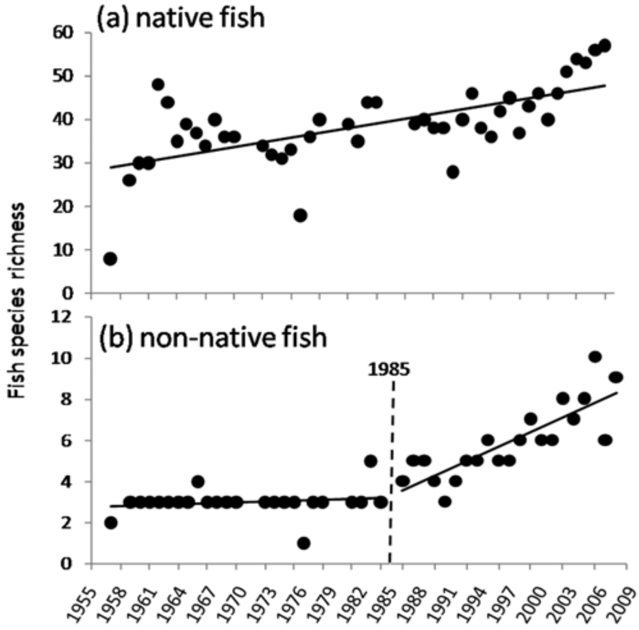

Figure 2. Trends in fish species richness in the Illinois River from 1957 to 2009 for (a) native and (b) nonnative fish species. Dashed line with associated year represents break point in trend.

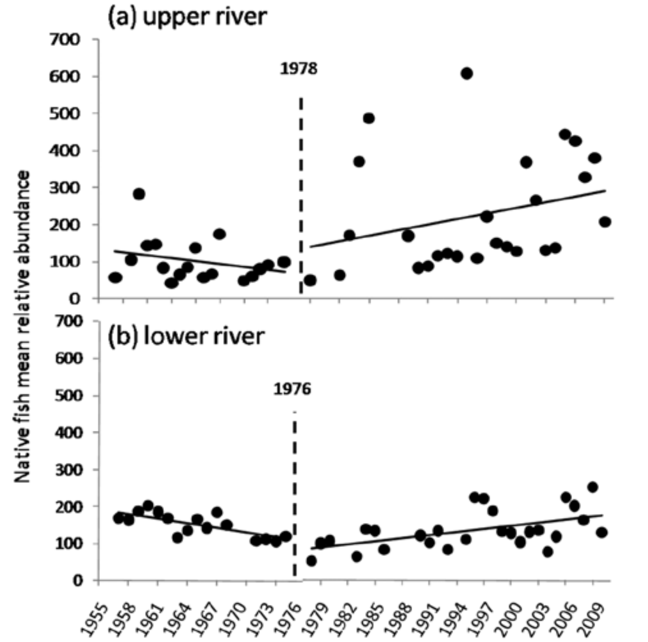

Figure 4. Trends in relative abundance of native fish species from 1957 to 2009 in the Illinois River for (a) upper river and (b) lower river segments. Dashed line with associated year represents break point in trend.

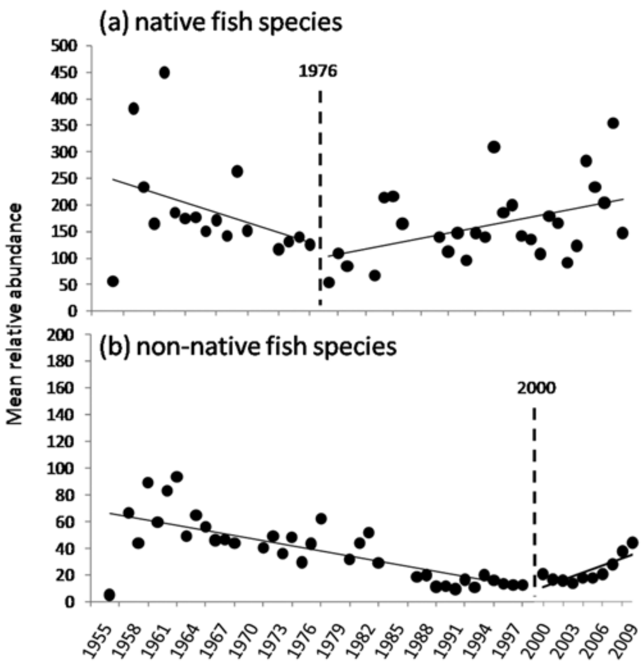

Figure 3. Trends in relative abundance from 1957 to 2009 in the Illinois River for (a) native and (b) nonnative fish species. Dashed line with associated year represents break point in trend.

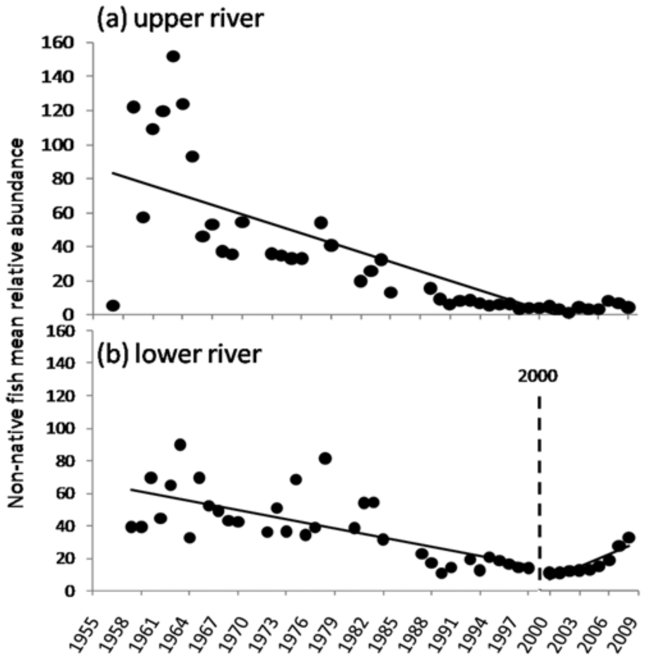

Figure 5. Trends in relative abundance of nonnative fish species from 1957 to 2009 in the Illinois River for (a) upper river and (b) lower river segments. Dashed line with associated year represents break point in trend.

nonnative relative abundance = −1.475 × year + 2,960.110; $P < 0.05$; df = 1, 185; $f = 133.031$; SE = 22.380; $r^2 = 0.418$) and then increased significantly (mean nonnative relative abundance = 3.993 × year − 7,987.001; $P < 0.05$; df = 1, 51; $f = 7.897$; SE = 26.810; $r^2 = 0.134$) from 2001 to 2009 (Figure 3b). Mean nonnative fish relative abundance declined significantly in the upper river (mean nonnative relative abundance = −0.906 × year + 1,832.459; $P < 0.05$; df = 1, 117; $f = 32.562$; SE = 26.307; $r^2 = 0.218$) and showed a break point in 2000 in the lower river. Mean nonnative abundance declined significantly from 1957 to 2000 in the lower river (mean nonnative relative abundance = −1.168 × year + 2,351.694; $P < 0.05$; df = 1, 93; $f = 27.258$; SE = 27.790; $r^2 = 0.218$) and then increased significantly (mean nonnative relative abundance = 2.428 × year − 4,952.988; $P < 0.05$; df = 1, 25; $f = 17.935$; SE = 7.694; $r^2 = 0.394$) from 2001 to 2009 (Figures 5a and 5b).

Trends in Fish Species Assemblages

Fish community analyses showed a temporal change in fish species assemblages in the Illinois River. The NMDS analysis suggested that early period fish assemblages (1957–1969) were distinctly different from late period fish assemblages (1990–2009), and middle period fish assemblages (1970–1989) plotted within portions of these groups (Figure 6a).The ANOSIM test revealed a significant difference among the fish assemblages of time periods ($P < 0.05$; $R = 0.33$) and the pairwise comparisons between each time period showed that fish assemblages of all time periods were significantly different from one another. The GLM tests of overall relative abundances among time periods revealed significant differences among periods ($P < 0.01$; n = 1,007; df = 2, 1,004; $f = 20.40$). Pairwise comparisons between time periods showed mean relative abundances of the early period (1957–1969) to be significantly greater than the middle (1970–1989) and late periods (1990–2009; both $P < 0.01$).

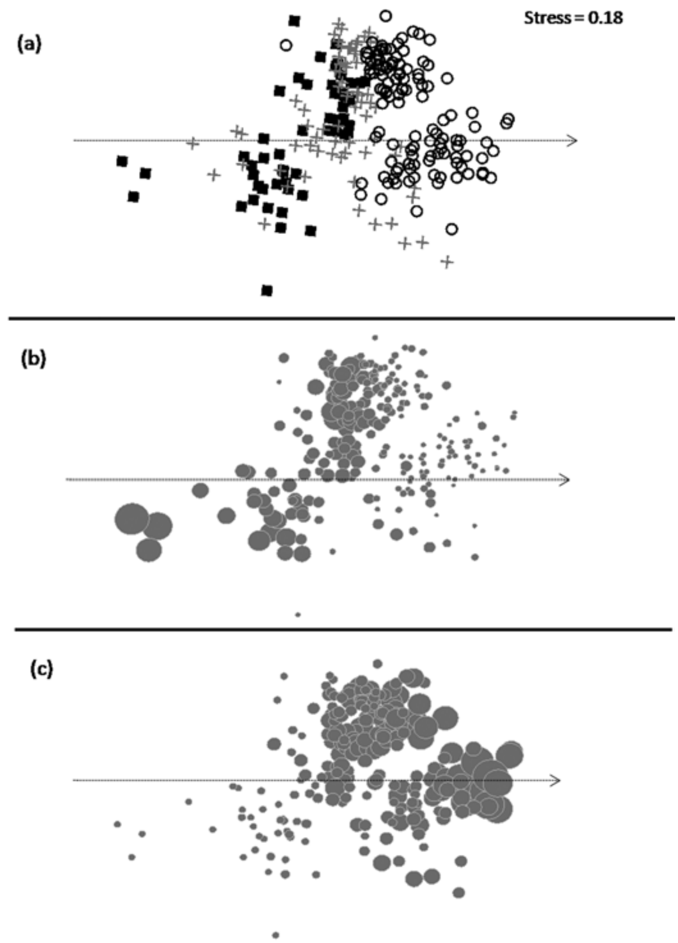

Figure 6. Nonmetric multidimensional scaling plot of the fish assemblages from 1957 to 2009 on the Illinois River. (a) The change in fish community over three time periods with less than 40% Bray-Curtis similarity among samples; (■) denotes the years of 1957–1969, (+) represent the years of 1970–1989, and (o) represent the years of 1990–2009. (b) The shift of relative abundance of common carp *Cyprinus carpio* and goldfish *Carassius auratus* and (c) the shift of relative abundance of centrarchids. Larger gray circles represent greater relative abundance values, and smaller circles represent lesser values. Data points in each plot are arranged by similarity values from single annual collections, where more similar points are plotted more closely together and rotated to depict time horizontally. Dashed arrows indicate direction of increase in time from 1957 to 2009.

The variable overlays of common carp/goldfish relative abundances and centrarchid relative abundances showed temporal changes in the relative abundances of these groups (Figures 6b and 6c). Common carp and goldfish catches declined throughout the Illinois River. Mean common carp and goldfish relative abundances in the early period were nearly 63 fish/year/reach but dropped to an average of 8 fish/year/reach in the late period catches. The GLM tests of common carp and goldfish mean relative abundances between time periods showed significant differences between periods ($P < 0.01$; n = 1,007; df = 2, 1,004; $f = 166.43$). Mean relative abundance of common carp and goldfish in the early period was significantly greater than in the middle period ($P < 0.001$) and in the late period ($P < 0.001$), with the middle period relative abundance significantly greater than the late period ($P < 0.001$). Centrarchid catches showed the opposite pattern. Relative abundances of this group increased over time in the Illinois River from 16 fish/year/reach in the early period to over 52 fish/year/reach in the late period. The GLM results for mean relative abundance of centrarchids also showed a significant difference between time periods ($P < 0.01$; n = 1,007; df = 2, 1,004; $f = 20.40$). The mean relative abundance of centrarchids for the late period was significantly greater than for the early and middle periods (both $P < 0.01$).

The SIMPER procedure provided a finer resolution of fish species that have contributed to the observed changes in the fish assemblages (Table 2). In the early period, collections were dominated by 13 fish species and increased to 17 species by the late period (Table 2). Common carp and goldfish declined in relative abundance and also showed a reduction in contribution to samples. Common carp were the most frequent fish species collected in the early time period, contributing to 24.9% of the catch, but declined to 7.6% of the catch in the late period (Table 2). Bluegill and largemouth bass increased in contribution to catch over time. Bluegill were the second most common fish species collected in the late period, and largemouth bass were the fifth most common (Table 2). Smallmouth bass, orangespotted sunfish, bullhead minnow *Pimephales vigilax*, and bluntnose minnow *Pimephales notatus* were rarely collected in the early and middle periods but were among the most abundant by the late period (Table 2). Although common carp and goldfish declined over time, these species continue to rank among the top 90% of fish species for catches over all years combined (Table 2).

DISCUSSION

Our analyses revealed that significant changes to the Illinois River fish community have occurred over the course of our long-term monitoring program. Many of the changes we observed in fish species richness, relative abundance, and assemblages occurred at different points in time of the project.

TABLE 2. Percentages of species contributing to 90% of fish catches through three time periods (E = early, 1957–1969; M = middle, 1970–1989, L = late, 1990–2009) and over all years of long-term electrofishing sampling.

Fish Species	E	M	L	All
Gizzard shad *Dorosoma cepedianum*	20.4	23.0	16.2	18.6
Common carp *Cyprinus carpio*	24.9	16.4	7.6	14.8
Emerald shiner *Notropis atherinoides*	19.3	10.7	10.6	13.4
Bluegill *Lepomis macrochirus*	2.8	6.2	13.1	8.7
Largemouth bass *Micropterus salmoides*	2.2	5.1	6.4	5.4
Green sunfish *Lepomis cyanellus*	2.4	6.3	5.3	5.2
Channel catfish *Ictalurus punctatus*	n/a	3.5	5.6	4.2
Freshwater drum *Aplodinotus grunniens*	n/a	3.8	4.8	3.8
Black crappie *Pomoxis nigromaculatus*	1.8	4.2	2.9	3.3
Smallmouth buffalo *Ictiobus bubalus*	n/a	1.8	4.5	2.8
White bass *Morone chrysops*	n/a	2.9	2.8	2.7
Bigmouth buffalo *Ictiobus cyprinellus*	1.8	1.8	1.3	1.7
Goldfish *Cassius auratus*	6.6	2.2	n/a	1.7
River carpsucker *Carpiodes carpio*	n/a	1.8	1.6	1.5
Bluntnose minnow *Pimephales notatus*	n/a	n/a	2.3	1.2
White crappie *Pomoxis annularis*	0.6	1.7	n/a	1.1
Common carp × goldfish *Cyprinus carpio × Cassius auratus*	3.0	n/a	n/a	n/a
Quillback *Carpiodes cyprinus*	1.9	n/a	n/a	n/a
Black bullhead *Ameriurus melas*	1.4	n/a	n/a	n/a
Bullhead minnow *Pimephales vigilax*	n/a	n/a	2.9	n/a
Smallmouth bass *Micropterus dolomieu*	n/a	n/a	1.4	n/a
Orangespotted sunfish *Lepomis humilis*	n/a	n/a	1.2	n/a

n/a represents fish species not present in the 90% cutoff of top contributors.

The long temporal scale of the project allowed us to test for factors that likely contributed to these changes in the fish community and revealed several new trends through our use of an additional nine years of data and different statistical analyses compared to Pegg and McClelland (2004).

Overall Catches, 1957–2009

Over 73% of our collections from 1957 to 2009 were conducted in the lower river, resulting in the high total catches and potentially greater species richness observed in this segment (Table 1). Greater mean nonnative fish species richness and significantly greater mean native fish species richness in the lower river is also likely related to increased sample size and length of sampling reaches, resulting in a greater coverage area (Lyons 1992). The lower river reaches (386 km) were typically sampled 20 times annually, whereas the upper river reaches (88 km) were sampled seven times annually. A greater complexity of habitat features existing in the lower river also likely influenced fish species richness (Gorman and Karr 1978). Native fish relative abundances in the upper river prior to the 1980s were below 100 fish/h, yet this segment showed greater mean relative abundance of native fish overall.

In general, Peoria Reach catches were among the greatest in most instances over all other reaches (greatest in mean species richness and mean relative abundance, second in mean native fish relative abundance). Koel and Sparks (1999) reported that greater catches in the Peoria Reach were likely due to the geographic position of the reach compared to other sampling reaches; it is the point of change from physically different habitats of the upper to lower river. The Peoria Reach is also the longest reach of the Illinois River (~128 km) and receives the greatest sampling effort of all the study reaches (8 collections annually). Over 31% of our collection efforts from 1957 to 2009 occurred in Peoria Reach and resulted in the greatest catch across all reaches (40%). LaGrange Reach exhibited the greatest mean nonnative fish relative abundance (54 nonnative fish/h) due to large collections of common carp throughout time. Mean annual catches of common carp were the greatest in LaGrange Reach through the 1990s and the establishment of Asian carp (mostly silver carp) resulted in the greatest abundances of nonnative fish in LaGrange Reach through recent years. Bighead and silver carp were first collected by the Long-Term Resource Monitoring Program in the La Grange Reach in 1995 and 1998, respectively (Sass et al. 2010). Since 2000, population growth of silver carp in the La Grange has been exponential (Sass et al. 2010).

The lower river reaches, which were once quite productive, have lost much of their functional floodplain due to high sediment deposition and levees (Theiling 1999). For example, Alton Reach has experienced the greatest loss of floodplain to levees and also receives the greatest sediment load because it is the furthest downstream reach (Warner 1998). Perhaps as a consequence, Alton Reach mean overall relative abundance, mean native fish relative abundance, and mean nonnative fish relative abundance were lowest of all reaches. LaGrange Reach has lost over 50% of available floodplain to levees, receives high sedimentation, and is also among the lowest catches for overall mean relative abundance and mean native fish relative abundance (Theiling et al. 2000). Dresden Reach, an area once nearly devoid of native fish species due to its close proximity to the poor water quality conditions from Chicago wastewater diversion into the Illinois River, has showed substantial changes in the fish community over time. Great declines in mean relative abundances of common carp and goldfish have been observed

Photograph 1. Electrofishing on the Illinois River. Photo by Kevin Irons.

in Dresden Reach since the late 1980s. Largemouth bass were not present in Dresden Reach catches until 1978. Largemouth bass mean relative abundances in Dresden Reach have been the greatest across all reaches since 1990, double that of catches of the next closest reach. Conditions in the Dresden Reach are now unique compared to those observed in other sampling reaches. Not only has Dresden Reach experienced great improvements to water quality, but stable water levels and the sustainability of aquatic vegetation may have all helped the native fish community to rebound in this reach (Cook and McClelland 2007). Improvements in the water quality conditions and associated positive ecosystem responses are most likely attributed to sewage treatment of wastewater after passage of the Clean Water Act in the early 1970s (Pegg and McClelland 2004).

Trends in Fish Species Richness and Relative Abundance

The increases in overall and native fish species richness we observed throughout the Illinois River provide evidence of improvements throughout the system. Several potential improvements to the system include sewage treatment of wastewater in the upper river and habitat rehabilitation and enhancement projects constructed throughout the waterway (Pegg and McClelland 2004; O'Hara et al. 2008). From 1957 to 1989, we collected as many as 48 fish species in a given year and about 34 fish species on average from around 21 samples taken annually during this period. Through the 1990s, we collected about 39 fish species annually from around 24 samples taken per year. About 48 fish species were collected annually from around 26 samples taken per year from 2000 to 2009. Thus, fish species detection increased over time as sampling efforts increased. However, over the last decade, a large increase in fish species richness was observed with sampling effort that was nearly identical to the effort demonstrated in the 1990s, suggesting a true increase in richness.

Our nonnative fish species richness centered around three taxa from 1957 to 1985: common carp, goldfish, and their hybrid. After 1985, nonnative fish species catches began to increase rapidly as new fish species were collected annually as a result of new introductions. Fish species such as white perch (and eventually white perch × yellow bass hybrid), grass carp, silver carp, bighead carp, and round goby were all relatively new introductions and not known to be present in the Illinois River prior to 1980 (Burr et al. 1996; Steingraeber and Theil 2000; Irons et al. 2002). Once these nonnative fish species began to establish themselves in the Illinois River, we were soon able to detect them and now collect each species on a regular basis.

The temporal changes we observed in relative abundances of native fishes showed a focal point at which catches pivoted from decline to significant increases in numbers. Relative abundances for overall, upper river and lower river catches all exhibited a threshold around the years 1976–1978, with the lowest mean relative abundances occurring from the late 1970s to early 1980s as catches began to increase. Pegg and McClelland (2004) suggested that a shift in the Illinois River fish community occurring around 1982 was likely the result of improvements to water quality. Our breakpoints of change may occurred slightly earlier than those suggested by Pegg and McClelland (2004) because we used a different statistical test and our time series was nine years longer. The declines in nonnative fish relative abundances in the upper and lower river is interesting considering that nonnative fish species richness has increased significantly since 1985. The significant change in river-wide and lower river nonnative fish abundances that occurred in 2000 coincides directly with the invasion of Asian carp (Sass et al. 2010). High catches of silver carp in the lower river caused increases to nonnative fish catches observed in recent years, which could not have been detected in the time series used by Pegg and McClelland (2004). Silver carp were the primary driver of our observed patterns, because their population growth has been exponential in the La Grange Reach and likely the Alton and Peoria reaches since 2000 (Sass et al. 2010).

Trends in Fish Species Assemblages

The differences we observed in the fish community assemblages from the early period (1957–1969) to the late period (1990–2009) were consistent with the findings of Pegg and McClelland (2004) where a fish community shift occurred around 1982 in the Illinois River (Table 2). The significant split in fish assemblages observed between early collections and late collections indicate a substantial change within the system. Because the Illinois River experienced numerous nonnative fish species introductions over the latter course of our program, those nonnatives could have adversely affected the native fish population (Strayer 2010). However, our fish assemblages shifted to a community richer in native fish species, and mean relative abundances of native fishes increased over the same period during which nonnative fish species richness began increasing.

Rehabilitation efforts in the Illinois River system may have led to the decline in relative abundances of common carp and goldfish reflected in our collections. Watershed improvements may have allowed the great increases in centrarchid relative abundances over time, especially in the upper river where aquatic vegetation returned. Perhaps just as important as the increase in centrarchids was the increase in collection of fish species intolerant to poor water quality and habitat conditions. Several darter and dace species, blackstripe topminnow *Fundulus notatus*, and even the Illinois state threatened banded killifish *Fundulus diaphanus* have been collected since the 1990s.

Future Considerations

Long-term monitoring and research is undoubtedly important and necessary for determining environmental change over time (Carpenter 1998). Elliot (1990) remarked on the wealth of information that can be gathered through long-term monitoring not only for detecting large-scale temporal trends but also to establish baseline data and the detection of rare species. With more than 50 years of effort through our long-term fish population monitoring program, we have been afforded the ability to evaluate anthropogenic and natural factors that have been affecting the Illinois River fish community since the 1800s. Factors such as pollution and water diversion from the Chicago metropolitan area and Lake Michigan, habitat loss from levee construction and heavy sedimentation as a result of agricultural practices, commercial navigation and channel regulation, and the introduction of nonnative fish species have all been documented as affecting the Illinois River fish community. We have been able to identify when changes to the fish community occurred and factors influencing those changes, both positive and negative. Past efforts and continuation of fish monitoring will serve as a vital source of information for current large river fisheries issues such as rare native fish species detection, tracking of nonnative fish species invasions, and perhaps those unforeseen.

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Translocating Adult Pacific Lamprey within the Columbia River Basin: State of the Science

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ABSTRACT: *The Pacific lamprey (*Entosphenus tridentatus*) is in decline in the Columbia River Basin, and translocating adult lamprey to bypass difficult migration corridors has been implemented since 2000. We describe and report results from two current translocation programs, provide context for use of translocation, and discuss potential benefits, risks, and uncertainties. Both translocation programs appear to have increased the number of spawning adults and the presence of larvae and juveniles; however, any subsequent increase in naturally spawning adults will require at least one, and likely more, generations to be realized. It was seen that the number of adults entering the Umatilla River increased beginning four years after the first translocations. Potential benefits of translocation programs are increased pheromone production by ammocoetes to attract adults, increased lamprey distribution and abundance in target areas, increased marine-derived nutrients, and promotion of tribal culture. Potential risks include disruption of population structure and associated genetic adaptations, disease transmission, and depletion of donor stocks.*

Translocación de Individuos Adultos de Lamprea del Pacífico dentro de la Cuenca del Río Columbia: Estado de la Ciencia

RESUMEN: *Las poblaciones de la lamprea del Pacífico (*Entosphenus tridentatus*) están declinando en la cuenca del Río Columbia, y desde el año 2000 se ha implementado la translocación de individuos adultos para restablecer los corredores migratorios de esta especie. Se describen y reportan los resultados de dos programas recientes de translocación, se contextualiza el uso de la translocación y se discuten sus beneficios potenciales, riesgos e incertidumbre. Ambos programas de translocación parecen haber incrementado el número de adultos desovantes y la presencia tanto de larvas como de juveniles; sin embargo, para que sea posible cualquier incremento ulterior en el stock natural de reproductores se requerirá de al menos una, aunque muy probablemente de más, generaciones. Se observó que el número de adultos que ingresó al Río Umatilla aumentó en los primeros cuatro años después de la primera translocación. Los beneficios potenciales de los programas de translocación son un aumento en la producción de feromonas por parte de larvas ammocoetes para atraer adultos, incremento en la distribución y abundancia de lampreas en áreas objetivas, incremento en la cantidad de nutrientes derivados del medio marino y la promoción de culturas tribales. Los riesgos potenciales incluyen modificación de la estructura poblacional y las adaptaciones genéticas asociadas, transmisión de enfermedades y agotamiento de los stocks donadores.*

INTRODUCTION

The Pacific lamprey (*Entosphenus tridentatus*) is an anadromous species native to the Pacific Coast of North America and northern Asia, including the Columbia River Basin (Figure 1). Descriptions of Pacific lamprey taxonomy and life history were provided by Beamish (1980), Richards (1980), and Beamish and Levings (1991) and recently summarized by Clemens et al. (2010). Pacific lamprey are an important food source for marine mammal (Roffe and Mate 1984), avian (Merrell 1959), and fish (Semakula and Larkin 1968) predators and may act as a predation buffer for Pacific salmon (*Oncorhynchus* spp.; Close et al. 1995). They are a source of marine-derived nutrients (Close et al. 1995), may be an indicator of ecological health, and serve an important role in the culture of many Native American tribes (Close et al. 2002b).

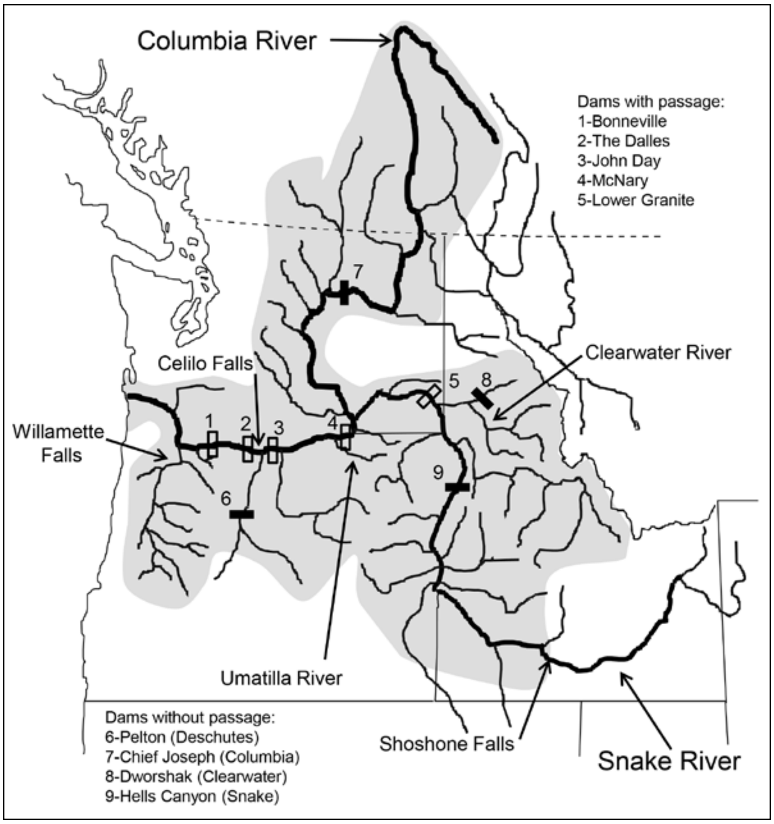

Figure 1. Historic Pacific lamprey distribution in the Columbia River Basin (shaded) and some historically important tribal fishing areas (falls). Some mainstem Columbia and Snake River dams providing passage are labeled for reference, as are some dams that block passage and therefore restrict distribution. Two subbasins with translocation programs are also labeled.

Pacific lamprey along the West Coast of North America have recently experienced declines and widespread localized extirpations (Beamish and Northcote 1989; Moser and Close 2003; Luzier et al. 2011). For example, Wallace and Ball (1978) documented the complete loss of Pacific lamprey from the North Fork Clearwater River upstream from Dworshak Dam (Figure 1) in the five years following the dam's completion in 1971. In addition to the effects of dams, causes for the decline in the Columbia River Basin may include habitat degradation, poor water quality, proliferation of exotic species, and direct eradication actions.

Indigenous peoples historically harvested lamprey throughout the Columbia River Basin (Close et al. 1995; Figure 1), but now harvest is restricted to the lower portions of the basin (Close et al. 2002b). From a tribal perspective, the decline of lamprey continues to have at least three negative effects: (1) loss of cultural heritage, (2) loss of fishing opportunities in traditional fishing areas, and (3) necessity to travel great distances to lower Columbia River tributaries for ever-decreasing lamprey harvest opportunities. As a consequence of restriction or elimination of harvest in interior Columbia River tributaries, young tribal members are losing historically important legends associated with lamprey because they have not learned how to harvest and prepare them. Reintroduction and augmentation of Pacific lamprey in the upper reaches of the Columbia River Basin will renew the relationship and cultural identity between indigenous tribes and lamprey.

Translocation of adult Pacific lamprey is a tool for reintroduction and augmentation and an interim measure to prevent local extirpation (see George et al. 2011) while primary limiting factors (passage and degraded habitat) are addressed. Here we define "translocation" as the collection of adult Pacific lamprey from one location (the mainstem lower Columbia River) and transport for release into a subbasin upstream, where they are scarce or even extirpated. The resulting increase in spawning adults is intended to increase the number of ammocoetes present, which may in turn attract even more adult lamprey (Yun et al. 2011).

We describe and report results from two current translocation programs in the Columbia River Basin and discuss associated benefits and risks. The programs are conducted by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in the Umatilla River Subbasin and the Nez Perce Tribe (NPT) in the Clearwater River and Asotin Creek subbasins (Figure 1). Results from the first few years of monitoring the CTUIR program have been previously provided by Close et al. (2009). Findings since 2007 are available only in agency reports, most recently in Jackson et al. (2011). The NPT program has been described only by Peery (2010). Here we present the first comprehensive summary of both programs since their inception.

Close et al. (1995) conceptualized the goal of lamprey transplantation to "begin reestablishment or supplementation of lamprey in selected tributaries above Bonneville Dam where populations have been extirpated or are at extremely low levels." The goal of the CTUIR program is to restore natural production of Pacific lamprey in the Umatilla River to self-sustaining and harvestable levels (Close et al. 2002a). The purposes of the NPT program are to (1) move adult Pacific lamprey past mainstem dams into Snake River tributary spawning habitat, (2) provide an interim measure to prevent local extirpation of Pacific lamprey in the Snake River Basin, (3) avoid loss of pheromone attractants from larval lamprey that may be key in guiding spawning adults, and (4) preserve tribal culture (Statler 2011).

This information is of worldwide import, because over half of all Northern Hemisphere lamprey species are considered to be vulnerable, endangered, or extinct (Renaud 1997). Recognizing that efforts to restore other aquatic species, notably anadromous salmonids, have been ineffective and even counterproductive at times, regional managers wish to take a thoughtful approach to develop methods to conserve and restore this unique group. We hope that information gained from this effort for Pacific lamprey can benefit other lamprey species.

Case Study: Confederated Tribes of the Umatilla Indian Reservation Translocation Program (Umatilla Subbasin)

Background

Through oral interviews with tribal members and former state and federal agency fisheries personnel, Jackson and Kissner (1997) determined that Pacific lamprey were historically abundant and that fishing occurred throughout the Umatilla Subbasin (Figure 2). No records were kept of lamprey counts, but former agency personnel noted that "there were so many adult Pacific lamprey in the Umatilla River that they were a nuisance." Tribal members and agency personnel stated that abundance decreased dramatically after rotenone treatments in 1967 and 1974. Throughout the 1990s, very few Pacific lamprey were observed, although 12 adult Pacific lamprey were found in the ladder at Three Mile Falls Dam (Figure 2) during dewatering in 1996. No Pacific lamprey were collected during numerous electroshocking surveys upstream from the dam in the 1990s. Kostow (2002) noted that lamprey production in the Umatilla appears to be restricted to the lower few miles of the subbasin and that Pacific lamprey may be gone from the upper subbasin.

In 1999, the CTUIR developed a peer-reviewed restoration plan for Pacific lamprey (Close 1999). The Umatilla Subbasin was chosen for reintroduction because it once supported a traditional lamprey fishery and donor stocks for translocation were geographically close. In addition, numerous habitat improvements in the subbasin had been completed for salmonids. The restoration plan called for (1) locating an appropriate donor stock for translocation, (2) identifying suitable and sustainable habitat within the subbasin for spawning and rearing, (3) translocating up to 500 adult lampreys annually, and (4) long-term monitoring of spawning success, changes in larval density and distribution, juvenile growth and outmigration, and adult returns.

Methods

In 1999 and 2000, the CTUIR began implementing the restoration plan; methods described here are summarized from a detailed account provided by Close et al. (2009). Adult lamprey used for this program were initially collected during winter lamprey salvage operations at John Day Dam (Figure 1). In later years, collections were augmented with fish collected at Bonneville and The Dalles dams. Fish were held through the winter then released the following spring to one of six locations in the Umatilla Subbasin (Table 1, Figure 2).

In 2001 and 2002, surveys were conducted by foot on the Umatilla River and Meacham Creek in June and July to locate lamprey redds. Surveyors walked downstream along the margins or in the river and traversed from bank to bank checking the tail out of each pool and above each riffle.

To study egg viability, a subsample of redds was sampled for eggs in 2001. A probe sample of 10–20 eggs was taken to determine stage of egg development. When eggs were nearing hatching, approximately 200 were taken from each redd. Viable and unviable (covered with fungus or deformed) eggs were counted using a dissecting microscope.

Thirty sites were selected in the Umatilla River for documenting larval densities. All sites were 7.5 m^2 in area with silt substrates where larvae are typically most abundant. During August and September, larvae were collected during two passes with a backpack electrofisher designed for use with lamprey ammocoetes. If no larvae were detected in the first pass, only one pass was conducted. All fish collected were measured (millimeters), a subsample was weighed (nearest 0.01 g), and then fish were returned to the collection site.

The outmigration of larval and metamorphosed lampreys was monitored each year using a rotary-screw trap located 1.9 km upriver from the mouth. The trap was checked and the catch was enumerated twice daily. Lampreys were measured (millimeters) and then returned to the river. Mark–recapture studies were conducted to calculate trapping efficiency of the rotary screw trap and to estimate the total number of outmigrants during trapping.

Adult lamprey entering the Umatilla River each year were captured in portable assessment traps placed just below the water surface on both sides of the entrance to the fish ladder at Three Mile Falls Dam. Traps were checked daily and captured lamprey were measured and released immediately upstream from the dam.

TABLE 1. Releases of adult Pacific lamprey into the Umatilla subbasin, 2000–2011, as part of a translocation program. Rkm = river kilometer. NA signifies that no fish were released. Data from Close et al. (2009) and Jackson et al. (2011).

		Umatilla River					
Year	Number Released	Rkm 98.8	Rkm 118.4	Rkm 139.9	Iskúulktpe Creek	Meacham Creek	South Fork Umatilla River
2000	600	NA	150	300	NA	150	NA
2001	244	NA	82	81	NA	81	NA
2002	491	150	100	141	NA	100	NA
2003	484	NA	90	110	54	230	NA
2004	133	NA	NA	63	NA	70	NA
2005	120	NA	NA	50	15	55	NA
2006	198	NA	NA	90	21	87	NA
2007	394	NA	NA	200	25	169	NA
2008	68	NA	NA	26	NA	42	NA
2009	337	NA	NA	100	25	150	62
2010	291	NA	NA	128	13	150	NA
2011	89	NA	NA	40	10	39	NA

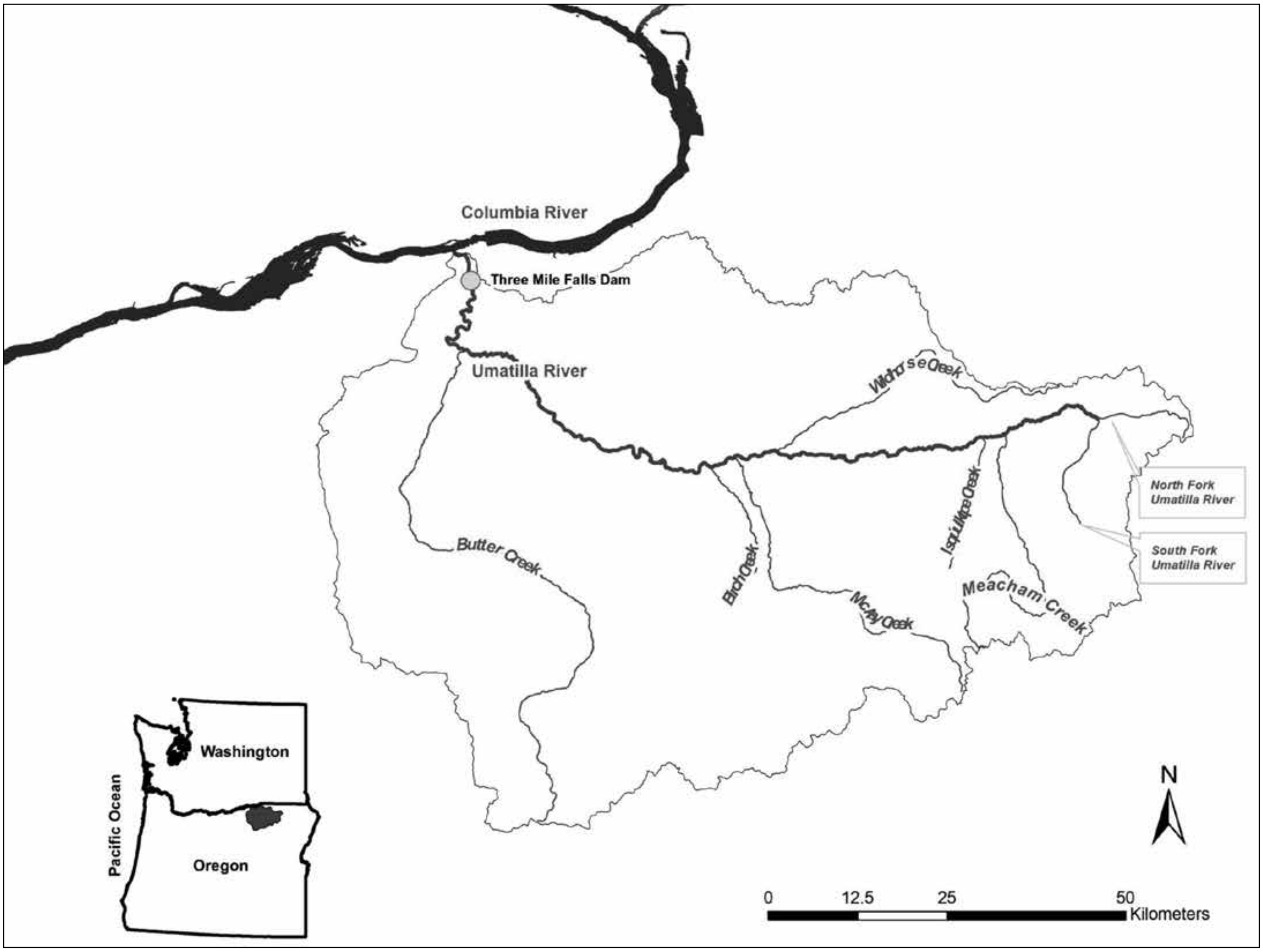

Figure 2. Map of the Umatilla River Subbasin, showing streams utilized in the Umatilla Tribe translocation program.

Results

Translocated lamprey spawned and produced viable eggs. In 2001, 19 viable redds were found in the Umatilla River and 30 in Meacham Creek. In 2002, 21 viable redds were found in the Umatilla River and 46 in Meacham Creek. Mean egg viability per redd was 93.4% (±3.6%) in the Umatilla River ($N = 4$) and 81.4% (±5.1%) in Meacham Creek ($N = 12$). Egg viability ranged from 57.8% to 100.0%, with viability exceeding 99% in 7 of 16 redds. Seventy-five percent of the unviable eggs were covered by fungus and 25% were deformed.

Larval abundance in index plots sharply increased one year after translocation of adult lamprey (Figure 3). Mean larval density increased from 0.08 ± 0.05 larvae/m^2 in 2000 to 5.23 ± 1.73 larvae/m^2 and 6.56 ± 2.44 larvae/m^2 in 2001 and 2002 ($P < 0.01$). Mean densities remained elevated through 2009.

Larval distribution also increased through time (Figure 4). In the years prior to translocation of adults, no larvae were found in the upper Umatilla River. One year after translocation of adults, larval densities increased and the distribution of larvae moved downstream. By 2005, larval distribution extended downstream to the middle reaches of the Umatilla River, with little change in larval densities in the lower river.

Abundance of both migrating ammocoetes and macrophthalmia sharply increased from previous low levels during 2000–2001 (Figure 5). Abundance returned to low levels and then began increasing again in 2005–2006.

The number of adults observed in the Umatilla River increased beginning 4 years after the first translocations, with a clear increase beginning after 6 years (Figure 6). The total number of individuals entering the Umatilla River remained relatively low through 2010, but a large increase was observed in 2011.

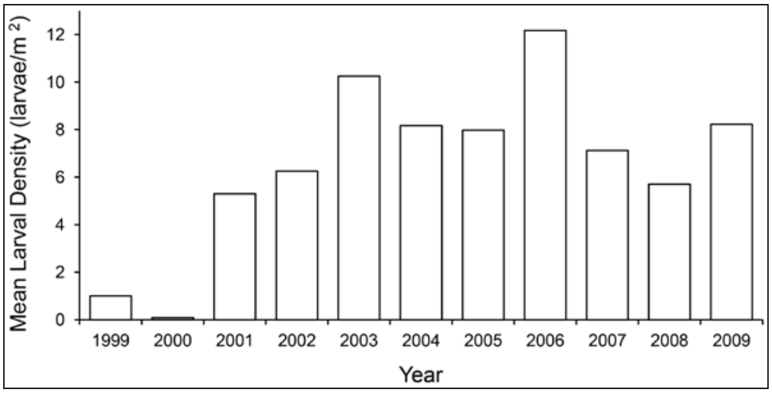

Figure 3. Changes in larval densities (mean of 30 index sites) after translocating adult Pacific lamprey to the Umatilla River, 1999–2009.

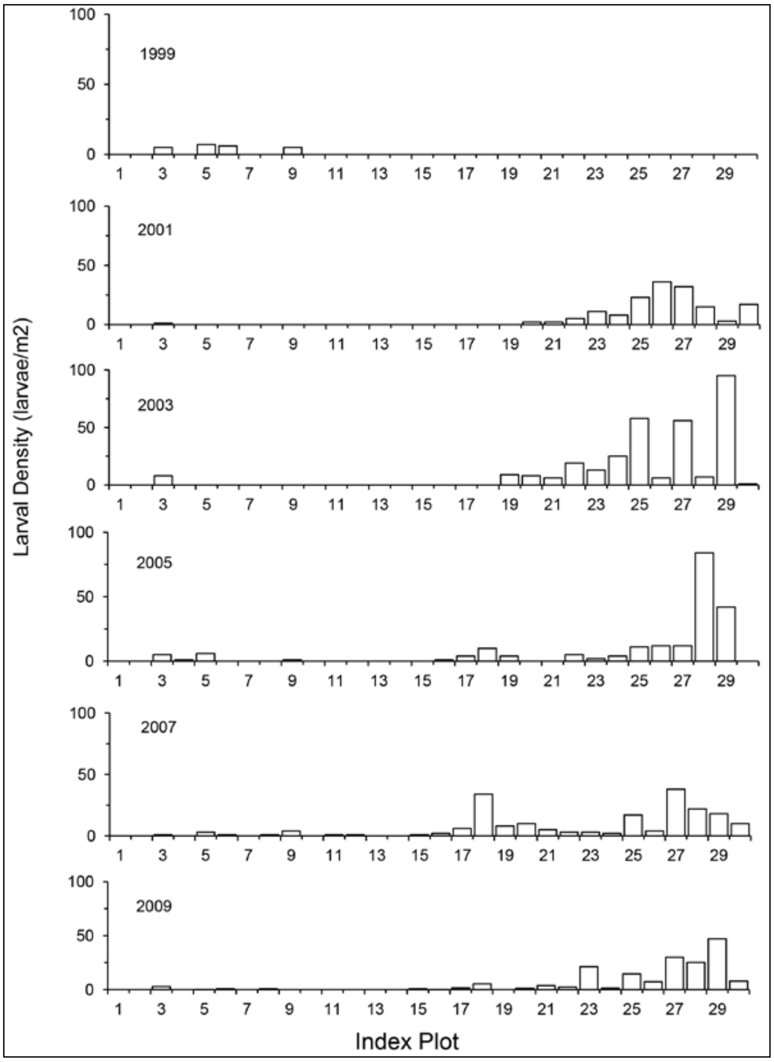

Figure 4. Density of larval Pacific lamprey in the Umatilla River, 1999–2009. Index plot 1 is near the mouth and index plot 30 is in the upper Umatilla River.

Case Study: Nez Perce Tribe Pacific Lamprey Translocation Program (Clearwater and Asotin Subbasins)

Background

Counts of adult Pacific lamprey at Snake River dams did not begin until 1996; therefore, no long-term information at these sites is available. Nevertheless, available count information indicates a decline in numbers of Pacific lamprey returning to the Snake River. Counts at Lower Granite Dam (Figure 1) were 490 in 1996 and 1,122 in 1997 but have failed to exceed 100 since 2004 (Fish Passage Center 2012).

Information summarized by Cochnauer and Claire (2009) from the Clearwater Subbasin (Figure 7) indicates a precipitous decline in lamprey abundance and distribution. The number of kilometers occupied by Pacific lamprey in the Clearwater River and six selected tributaries declined by an estimated 66% between 1960 and 2006. Counts at Lewiston Dam, near the mouth of the Clearwater River, decreased from over 5,000 in 1950 to zero by 1972, after which the dam was removed and lamprey once again had access to the upper drainage. Pacific lamprey ammocoetes and macrophthalmia were collected in Lolo Creek (Figure 7) from 1994 through 2003; however, continued sampling failed to capture any lamprey from 2004 through 2006. Since 2006, biologists with the Nez Perce Tribe have conducted a trial translocation program to augment natural lamprey production in the Clearwater and Asotin subbasins.

Methods

The methods described here are summarized from a detailed account provided by Peery (2010). Adult lamprey salvaged from John Day Dam and The Dalles Dam during the annual winter dewatering period were held through the winter at the Nez Perce Tribal Hatchery on the Clearwater River (Figure 1). In May they were released into one of four Snake River tributaries: Asotin Creek in Washington and Lolo, Newsome, and Orofino creeks (Clearwater Subbasin) in Idaho (Figure 7, Table 2).

To document the effectiveness of the Nez Perce Tribe translocation program, approximately 30 fish each year were surgically outfitted with radio transmitters and released into three of the four streams (Table 2). Lamprey were typically released at two locations in each stream at sites containing suitable spawning and rearing habitat. Weekly surveys were conducted to determine movements of translocated lamprey following release. Limited spawner surveys were made by foot to locate lamprey redds and, if possible, verify spawning activity.

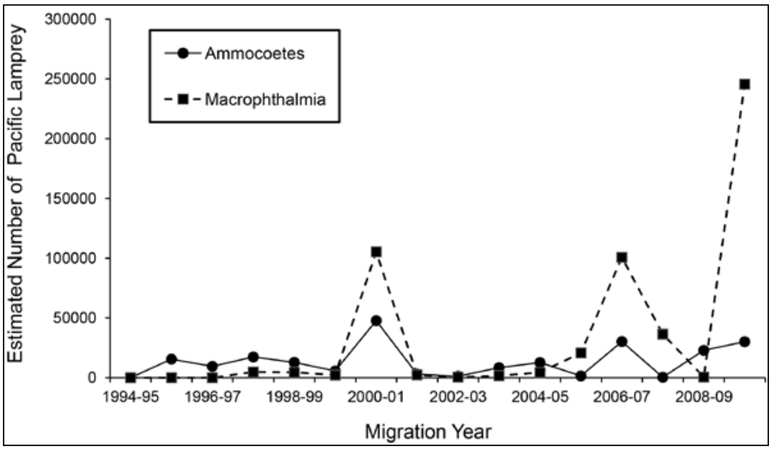

Figure 5. Yearly estimates of the number of migrating Pacific lamprey ammocoetes and macrophthalmia near the mouth (rkm 1.9) of the Umatilla River.

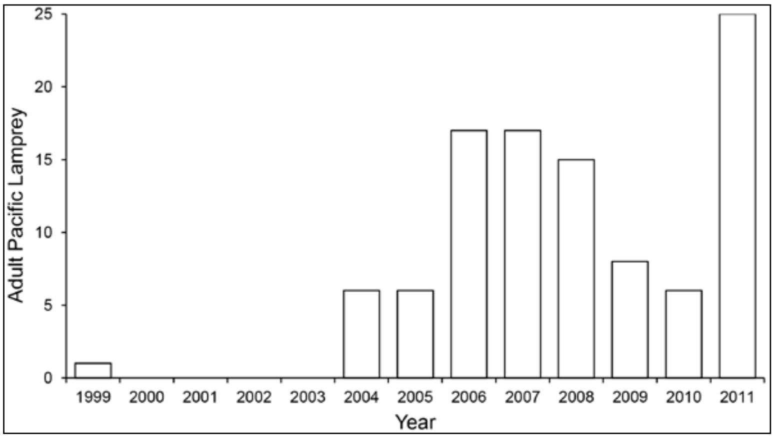

Figure 6. Number of adult Pacific lamprey trapped at Three Mile Falls Dam on the Umatilla River, 1999–2011. An additional 104 lamprey passed the dam in 2011 via a new lamprey passage structure.

During the summer of 2009, surveys to search for juvenile lamprey were initiated in Newsome and Lolo creeks. A specialized backpack electrofisher was used to systematically survey 15-km reaches of the streams, encompassing areas where radio-tagged lamprey had been located. Starting at locations where adult lamprey were released, sites up- and downstream at approximately 1-km intervals were surveyed. At each site, surveys were conducted on approximately 50 m of stream or until 20–30 ammocoetes were collected. Lengths (millimeters) and weights (nearest 0.1 g) of collected fish were measured and then fish were returned to the collection site.

Surveys were repeated in 2010 in Newsome, Lolo, and Asotin creeks. Control streams in the area were also surveyed to gauge the level of natural production: Musselshell and El Dorado creeks (tributaries of Lolo Creek); George Creek (tributary of Asotin Creek); Red, American, and Crooked rivers (tributaries of the South Fork Clearwater River near Newsome Creek); and two locations in the South Fork Clearwater River near Newsome Creek (Figure 7).

Results

From 2007 through 2010, 480 adult lamprey were released into the four study streams, of which 115 were radio-tagged (Table 2). For the first three years, all but two of these fish survived until release the following spring; in 2007 and 2009, one fish died after being radio-tagged. In 2010, 9 fish, including one radio-tagged fish, died prior to release. At release in 2010, we also determined that two radio transmitters had stopped working, one each from the Newsome Creek and Asotin Creek groups.

Following release, adult lamprey either remained near the release areas, moved moderate distances (1 to 5 km) up- and downstream, or moved downstream and out of the release watersheds (Table 3). From three years of information (2008–2010) in which the same three study streams were investigated, 30% (25 of 83 fish) remained at or near the release sites and 12% (10 of 83) left the study streams. Most that left were fish from Newsome Creek (n = 6) and Asotin Creek (n = 3). One of 30 fish released into Lolo Creek was also detected in the Clearwater River in 2010, a distance of over 50 km downstream from the release location. Of the remaining 48 fish (58%) that moved within the release streams, 69% (n = 33) moved about 4.8 km downstream, and the rest moved 1 to 3 km upstream (3.1 km in 2009, 1.3 km in 2010), on average.

Over the four years of the study, 48 redds were observed in study streams. The number of redds observed per stream each year varied from 0 to 8, with most (41 of the 48) observed in Lolo and Newsome creeks. The number of redds observed each year declined from 16 in 2007 and 2008 to 6 in 2010. Based on when redds were first observed, spawning occurred during June and early July in 2007 and 2008 and late July to early August in 2009 and 2010.

Ammocoetes were observed in the study streams but only in the mainstem South Fork Clearwater River for the control sites surveyed. Ammocoetes occurred in a 15-km segment of Lolo Creek (from the upper release to mouth of El Dorado Creek), a 14-km segment of Newsome Creek (from the upper release site to confluence with the South Fork Clearwater River), and a 15-km segment of Asotin Creek (upper release site downstream to river km 3). In 2009, we observed ammocoetes at all sites surveyed in Lolo and Newsome creeks (Figure 8). Mean length of ammocoetes per site ranged from 57 to nearly 88 mm and tended to be largest at downstream sites in Lolo Creek. Mean length per site of ammocoetes in Newsome Creek ranged from 52 to 84 mm and trended smaller at downstream sites. Length frequencies for all ammocoetes sampled produced unimodal distributions with peaks at 70 mm in both streams (Figure 9). No ammocoetes were observed at the control sites sampled in El Dorado and Musselshell creeks and American and Red rivers.

In 2010, ammocoetes were observed at one site 0.6 km upstream from the upper release point for adult lamprey; otherwise, the distribution of ammocoetes in Newsome and Lolo creeks was similar to that observed in 2009. In Asotin Creek,

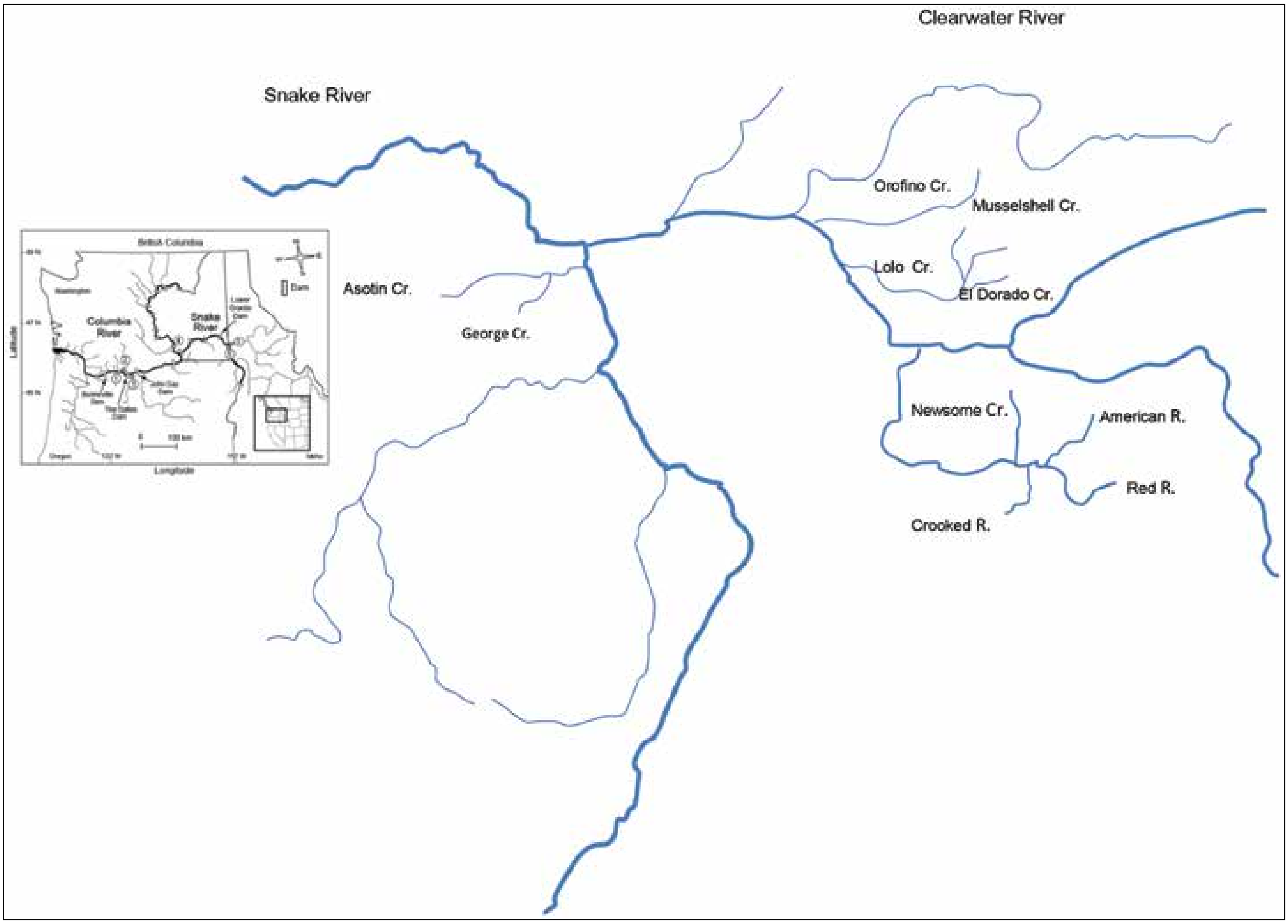

Figure 7. Map of lower Clearwater River and Asotin Creek subbasins, showing streams utilized in the Nez Perce Tribe translocation program.

ammocoetes were found in good abundance in an approximately 3-km section of stream near the adult lamprey release sites (river kilometer [rkm] 11.7 to 14.3), but few were collected in the lower 10 km of the stream (Figure 8). Mean length of ammocoetes per site ranged from 57 to 106 mm in Lolo Creek, 44 to 85 mm in Newsome Creek, and 56 to 149 mm in Asotin Creek (Figure 8). Mean lengths were greater at downstream sites in all three study streams. Length frequency plots described wider distributions for ammocoetes sampled in 2010 than in 2009 (Figure 9). Length–weight curves also suggested a wider distribution of sizes for ammocoetes in 2010 than in 2009 (Figure 10). In general, ammocoetes tended to be larger in 2010 than in 2009 in both Lolo and Newsome creeks. Ammocoetes were collected from two sites in the South Fork Clearwater River 10.1 and 2.4 km upstream from the mouth of Newsome Creek. Mean lengths of lamprey at those two sites were 123 and 139 mm, respectively. No ammocoetes were observed at sites sampled in Crooked, American, and Red rivers or in Musselshell and El Dorado creeks.

DISCUSSION

Results from both programs suggest that translocations of adult Pacific lamprey have resulted in increased spawning in the recipient subbasins, as evidenced by increases in the number and distribution of ammocoetes (and macrophthalmia in the Umatilla) from preprogram conditions. In addition, the Umatilla Subbasin experienced a small but consistent increase in the number of naturally spawning adults within four to six years of the first translocations. Increases in naturally spawning adults

TABLE 2. Releases of adult Pacific lamprey into four study streams in the Clearwater and Asotin subbasins, 2007–2010, as part of a translocation program. NA signifies that no fish were released. Data from Peery (2010).

Release Location	Total Released				Radio-Tagged Released				
	2007	2008	2009	2010	2007	2008	2009	2010	Total
Lolo Creek	50	27	28	22	10	10	10	10	40
Newsome Creek	50	25	25	22	10	9	9	9	37
Orofino Creek	49	27	26	24	10	NA	NA	NA	10
Asotin Creek	28	27	27	23	NA	10	10	8	28
Total	177	106	106	91	30	29	29	27	115

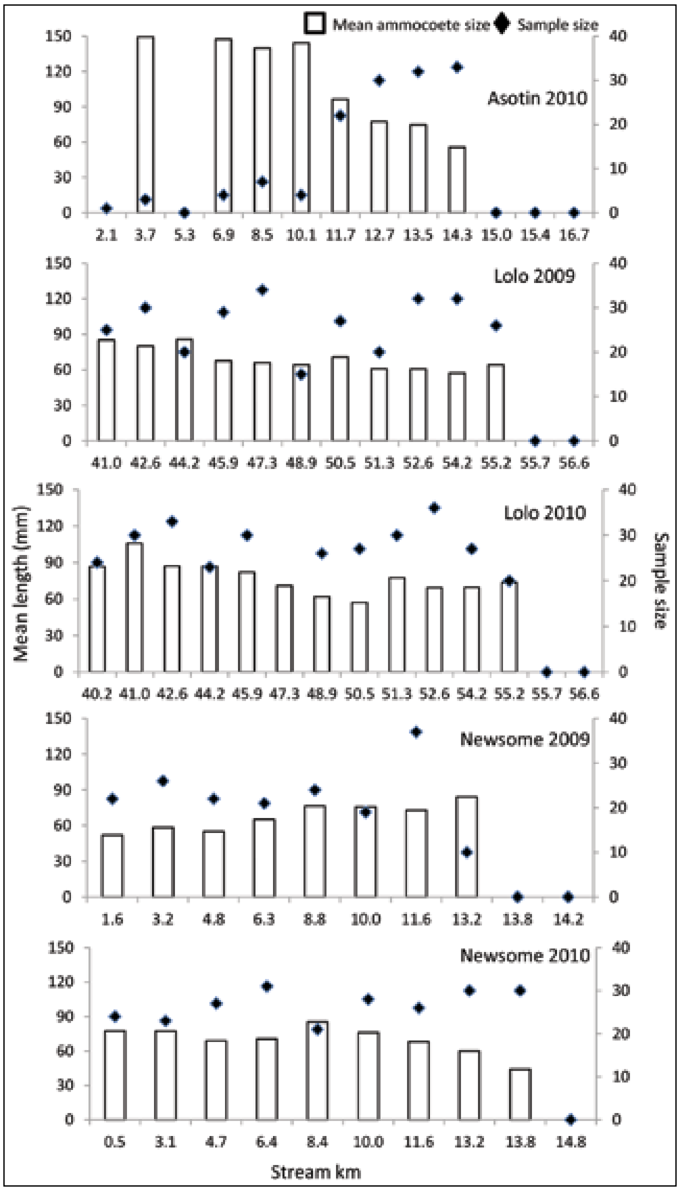

Figure 8. Numbers of juvenile Pacific lamprey ammocoetes (diamonds) and mean size of ammocoetes (millimeters; bars) collected in study streams during 2009 and 2010.

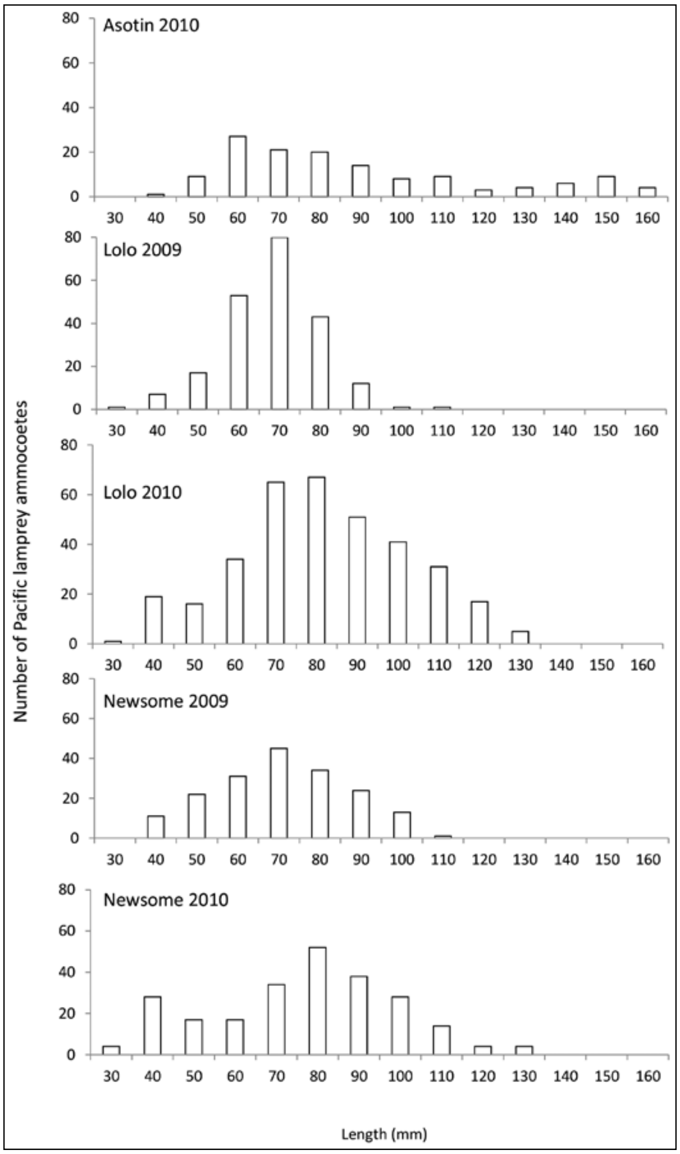

Figure 9. Length frequency distributions for juvenile Pacific lamprey ammocoetes collected from study streams during 2009 and 2010.

have not yet been documented in the Clearwater and Asotin subbasins, because this program is only four years old.

In systems with remnant lamprey populations, assessment of translocation effects can be confounded by even limited natural production. For example, the 2000–2001 increase in ammocoetes and macrophthalmia collected in the Umatilla River was likely due to natural production that occurred before the translocation program began. In subsequent years, numbers returned to low levels and then again increased. We think, based on ammocoete densities measured at index sample sites, that subsequent increases likely included progeny from the translocation of adult lamprey. This result highlights the utility of long-term sampling of index sites following lamprey translocations.

Translocation programs in areas where lamprey have been extirpated allow for direct assessment of production ascribed to specific translocations. Cochnauer and Claire (2009) reported that by 2006, Pacific lamprey no longer utilized Lolo Creek. It is therefore likely that all redds observed in Lolo Creek were from translocated lamprey. The 2009–2010 observations of ammocoetes in all streams in the Clearwater Subbasin receiving adult lamprey, combined with the absence of ammocoetes in all control streams (except for the South Fork Clearwater River), further supports the premise that most production observed was from translocated lamprey.

Assessment of translocation efforts can also be confounded by simultaneous efforts to improve access to and/or quality of lamprey spawning and rearing habitat. For example, the large increase in Umatilla River adult lamprey abundance observed in 2011 (N = 129) may be partially due to installation of a new lamprey-specific fishway at Three Mile Falls Dam (Figure 2). Nevertheless, at least 25 (19%) adults passed the dam via the

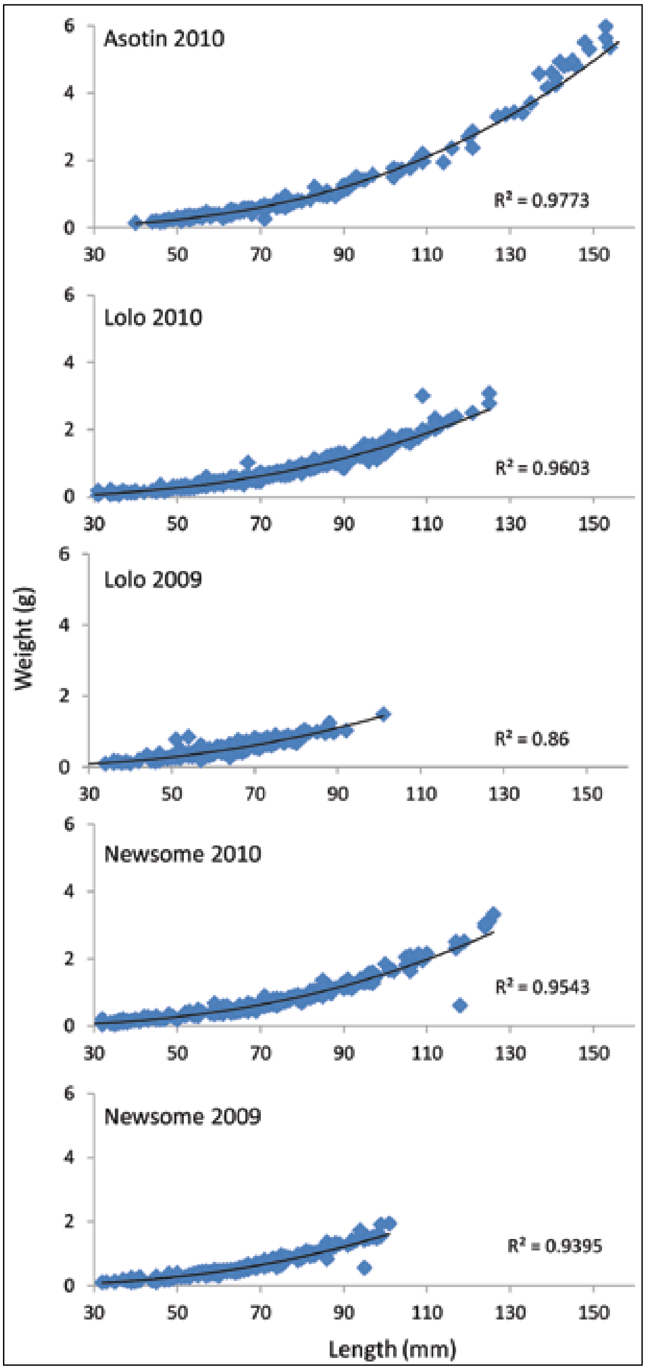

Figure 10. Length–weight relationship for juvenile Pacific lamprey ammocoetes collected from study streams during 2009 and 2010.

fish ladder, continuing the trend of increased adult abundance following translocations.

The delay in observing appreciable increases in the number of naturally spawning adults is due at least in part to ammocoetes spending at least 3–6 years in freshwater (Richards 1980). In addition, the concept of "returning adults" as used for Pacific salmonids is likely inappropriate for use with Pacific lamprey. Pacific lamprey likely do not return to natal streams (Hatch and Whiteaker 2009) but are guided to spawning locations by other factors. Yun et al. (2011) demonstrated that adult Pacific lamprey are attracted to odors emanating from ammocoetes. Docker (2010) determined that levels of genetic differentiation among Pacific lamprey from different areas were low, providing support for a lack of population differentiation that would occur with natal homing.

A primary benefit of translocation efforts may therefore be increased production of juvenile lamprey in the augmented watershed, "seeding" underutilized rearing habitat, and increasing pheromone cues to attract adults. Translocation and other restoration programs could therefore have a synergistic effect in breaking the downward cycle of Pacific lamprey abundance and recruitment.

Another potential benefit of translocation is expanded distribution of Pacific lamprey, via occupation of subbasins where they have been severely depressed or extirpated. Until passage is better understood and improved at mainstem dams, translocation from lower dams may also produce an escapement benefit for lamprey. These benefits should help decrease the risk of lamprey extinction by decreasing the overall impact of catastrophic events within a subbasin or even within a larger portion of the Columbia River Basin. For example, the Nez Perce program of outplanting 100 adults in Snake River tributaries would increase the entire Snake River spawner population above Lower Granite Dam by approximately 600%–800% based on 2009 and 2010 counts.

Lamprey translocation may also produce ecosystem benefits. Because ammocoetes are filter feeders and detritivores, increased production may facilitate nutrient cycling in rivers where adult lamprey have been reintroduced. Other potential benefits include increased connectivity of marine with freshwater ecosystems and delivery of marine-derived nutrients into

TABLE 3. Movement by radio-tagged adult Pacific lamprey following release into four study streams as part of a translocation program, the proportion that were known to have left the study streams after release, and number of suspected lamprey spawning redds observed in study streams per year. NA signifies that no fish were released. Data from Peery (2010).

	Pacific Lamprey with Radio Transmitters											
	Mean Distance Moved (km)				Proportion That Left Stream				Redds Observed			
Stream	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2012
Lolo	3.2	1.6	3.6	7.6	0	0	0	0.1	8	3	6	3
Newsome	5.1	2.1	4.3	5.0	0.3	0.2	0.2	0.22	6	8	4	3
Asotin	NA	4.2	3.9	1.4	NA	0.22	0.1	0	NA	5	0	0
Orifino	3.2	NA	NA	NA	NA	NA	NA	NA	2	NA	NA	NA

upper reaches of the Columbia River Basin. Lamprey restoration will also increase the prey base available to native fish and avian predators.

Although the best long-term sustainable option for increasing Pacific lamprey abundance and distribution may be completion of improvements to passage for adults and juveniles, translocation of adults may be the best immediate option to begin the process of rebuilding populations in depressed subbasins. An aggressive program by the U.S. Army Corps of Engineers to improve adult passage is currently underway (USACE 2009) but will take more than 10 years to implement and likely another 10 years to monitor and adjust. Juvenile passage improvements are more challenging and will likely require even longer. As passage problems are addressed and lamprey survival increases, translocation efforts could be downsized or phased out.

Potential risks from lamprey translocation include disruption of population structure and associated genetic adaptations, exposure to survival risks such as pathogens and disease, and decreased abundance in donor areas. These potential risks have been recognized, and steps have been taken to avoid or reduce them by adherence to lamprey translocation guidelines agreed to by the Columbia River Inter-Tribal Fish Commission (CRITFC 2011).

Little evidence exists of broad-scale genetic differentiation among Pacific lamprey sampled along the West Coast of North America (Docker 2010); however, Keefer et al. (2009) and Clemens et al. (2010) found that adult Pacific lamprey body size may be associated with the distance of upstream migration and swimming ability. Although relatively little is known about the heritability of body size in fishes or the relative importance of different factors causing intra- or inter-population variation, work by Thériault et al. (2007) on brook trout (*Salvelinus fontinalis*) suggests that life history tactics may evolve in response to selective pressures acting either directly on the tactic itself or indirectly on body size. Docker (2010) suggested that most Pacific lamprey could be managed as a single unit based on the low amount of genetic variation in nine microsatellite markers examined in samples from nine populations in British Columbia (Canada), Washington, California, and Oregon. However, she did find genetic variation among a few sampled sites that she attributed to small population sizes and sampling effects rather than reproductive isolation. Therefore, though consideration should be given to potential disruption of stock structure and associated genetic adaptations, we feel that the risk of adverse effects on population and genetic structure from translocations is much lower than the risk of losing some of the populations if they are not sustained, at least in the short-term, through translocations.

Although disease transmission is a potential risk with interbasin transfers of lamprey, it has been low. Oregon Department of Fish and Wildlife Fish Health Services used standard fish health diagnostic methods to test Pacific lamprey for pathogens (85 adults and 21 larvae). The primary pathogen of concern was a bacterium, *Aeromonas salmonicida*, the causative agent of furunculosis. Nine (8.5%) of the lamprey tested were found to have systemic *A. salmonicida* infections over the past decade. These fish represent a single sample that died following collection and transfer in June 2005. Since this event, routine oxytetracycline injections (10 mg/kg) have been implemented and appear to be successful. Because *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease, has been found in sea lamprey (*Petromyzon marinus*; Faisal et al. 2006), tests for this bacterium have begun as well. No viral pathogens or parasites have been detected in any lamprey examined to date.

The potential use of pheromones by adult Pacific lamprey for orientation and navigation (Yun et al. 2011) has important implications for lamprey management. Moving lamprey between drainages raises the potential to alter future adult escapement in both the donor and recipient populations. Though the latter may be a desired objective, there is a possibility of shifting spawners from high- to low-productivity watersheds, with a risk of diminished overall productivity for the system. In addition, lamprey translocation programs should not cause a substantial decrease in abundance in any currently occupied subbasin. To date, mainstem Columbia River lamprey collection for the Umatilla program has ranged from 0.1% to 2.0% of the total estimated returns to Bonneville Dam, averaging 0.43%. As the abundance of Pacific lamprey languishes, the urge to translocate an ever-increasing number may compete with other interests in maintaining or increasing numbers in different parts of the Columbia River Basin.

In summary, translocation programs have resulted in some obvious successes (natural spawning of translocated adults, increased production of ammocoetes, etc.); however, important lessons have been learned. As summarized by Close et al. (2009), Pacific lamprey require post-reintroduction management and a well-designed monitoring program. This is in part due to the long life cycle of Pacific lamprey and the likelihood that they do not home to natal streams. Also pertinent is the effect of the suite of potential limiting factors both within and outside of recipient subbasins. Although these factors have not been fully addressed and ameliorated, translocation can serve to prevent further localized extirpations until long-term solutions are implemented.

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Tilapia in South India

Mervin F. Roberts

On the fabled shores of Kerala in western India sits the Malabar Coast and the town of Allaphuzza. Backed by the Western Ghats and facing the Arabian Sea, this place is full of history. Saint Thomas, the famous doubting Thomas, came here as a missionary after Christ died. It is a land of spices like cardamom and pepper, coconuts on sandy shores, and all sorts of edible fishes in the nearby waters.

During the 200 years of British influence, the tidal creeks were furnished with gates and the salinity on the marshes went down, thus making the culture of rice possible.

I got into the act when the Roman Catholic Bishop of Allaphuzza came to Bar Harbor, Maine, rattling the tambourine. He was pleading, "Help me feed my people." Although the spice trade was doing well, the other sources of income were not.

Generous and efficient Norwegians realized that southwest Indian fishing was terribly inefficient. Twenty men would paddle a canoe of lapstrake boards fastened with coir fiber into the Arabian Sea, where they would catch fish with purse seines. They had been doing it this primitive way for thousands of years. Every man who paddled was able to share in the catch. The Norwegians knew that it didn't take 20 men to catch a boatload of fish. A crew of three in a 36-foot, diesel-powered boat with an otter trawl could scrape the bottom and bring home a lot more fish in a lot less time.

The fishermen in Cochin, a nearby city, were given a fleet of these power boats and they caught fish—they really caught fish. The Allaphuzza fishermen couldn't compete and since their caste limited them to just being fishermen, they became both unemployed and unemployable. Many were Catholic but the caste system lingers on. Fishing in that diocese thus became history. It took only a few years for the otter trawls to wipe out that resource. Are you surprised?

Simultaneously, the coconut crop failed due to a depletion of some trace element in the soil—this was eventually corrected, but that took several years. Also, the Indians neglected maintenance of the tidal gates; no one was responsible for those gates. The British Raj built them but the British Raj was gone. Incursion of salt water wiped out the rice culture. Paddy rice and salt are incompatible.

So there you have it. The Bishop needed some real tangible help. His council of laymen in the diocese suggested that they could start a shrimp business in the mangroves (with some American funding).

I was asked to look into the matter and with a group of other Americans I went over there. I saw unemployment. I saw poverty. I saw former workers in coconut and fish and rice who were now breaking stone with small hammers for road repair, because the caste system would not let them do much of anything else. A mechanical stone crusher would have made them unemployed again. I also realized that shrimp culture would not only destroy the mangroves but would not benefit any of these who were in poverty. They were already breaking stone; if they were employed in digging ditches in shrimp farms they would still be underemployed and certainly underpaid. In India there is no trickle-down prosperity. Poor people just can't afford to eat shrimp.

However, the idle retting ponds, previously used for softening coconut husk fiber, could be converted to fish ponds and women could raise fish to feed their children.

"What fish?" the men asked. "Tilapia!" I answered.

"No, that won't work." I was told that these fish are unpopular in the market. After I got to know the local culture better, I found that the African tilapia were already well established there. They were dark skinned, nearly black (*Tilapia nilotica*). People would not buy a dark-skinned fish. But the women would gladly raise them and feed them to hungry children—the small fish were often made into paste, so skin color was not an issue.

What was more important was that they had no value in the marketplace, so no one would steal them. Small unfenced ponds did not need watchmen. So I had 1,000 small home ponds mucked out, limed (remember, they had become acidic from years and years of soaking coconut husks) and stocked with very dark gray Tilapia.

Ducks were introduced. Indian Runners, a popular local variety, would lay up to 250 large eggs a year, and these birds would fertilize the water if they were kept on and fed on the water. Fertilized water and Indian sunlight makes for algae growth, and tilapia eat algae. The duck eggs justify duck food cost and the tilapia get free algae.

Snakeheads were used to control the population of tilapia, and snakehead flesh was also a popular food, harvested annually.

An annual dry period of one month was enough to get rid of predators and parasites in the ponds. A few fish were carried over in jugs or tanks to restock the ponds. Women traded fish and duck eggs over their fences with neighbors. No tilapia got into the market.

The fishermen eventually got smart; they went out with their paddle canoes and drove the crews off the Norwegian diesel boats and then proceeded to burn the boats to their waterlines. In a few years the Malabar Coast recovered its abundant fish and the traditional fishermen resumed what they had been doing for 2,000 or more years.

The World Bank did frustrate the restoration of rice farming in south India. I was told that it had become too labor intensive. This is a euphemism for "We can get rice for free from Thailand with loans from the World Bank that we will never repay."

So, as an aquaculture consultant, what did I learn that is worth passing on? I learned that the aquaculture component of my job was duck soup. Muck out the ponds, lime them, use animals that are already established locally, and employ polyculture (snakeheads and ducks). The most critical part of my job was to understand and work within the culture of the people.

Mervin F. Roberts served as a consultant on various aquaculture projects; chaired the Connecticut Governor's Council on Marine Resources, and the Connecticut Shellfish Commission; and he served as president of the Connecticut Association of Conservation Commissions and Wetland Agencies. He is the author of over 30 publications. The tilapia project described in this article occurred in the 1980's.

AMERICAN FISHERIES SOCIETY
www.fisheries.org

Fisheries Networks: Building Ecological, Social, and Professional Relationships

2011 ANNUAL REPORT

MISSION

The mission of the American Fisheries Society (AFS) is to advance sound science, promote professional development, and disseminate science-based fisheries information for the global protection, conservation, and sustainability of fisheries resources and aquatic ecosystems. The Society adopted a Strategic Plan *AFS 2020 Vision* for 2010-2014 with three overarching goals: (1) Global Fisheries Leadership — AFS will be a global leader providing information and technical resources for the sustainability and conservation of fisheries resources; (2) Education/Continuing Education — AFS will facilitate lifelong learning through world-class educational resources at all academic levels and provide training for practicing professionals in all branches of fisheries and aquatic sciences; and (3) Value of Membership — AFS will serve its members and fisheries, aquaculture, and aquatic science constituencies to fulfill the mission of the Society. The members of AFS are drawn together by a common interest in pursuing this mission and the goals of the Society. Our challenge is how to carry out the mission in an ever-changing world.

GLOBAL FISHERIES LEADERSHIP

THEME FOR THE YEAR

The theme for the 2011-2012 year and the 2012 Annual Meeting in Minneapolis/St. Paul was "Fisheries Networks: Building Ecological, Social and Professional Relationships." A network is an interconnected system of people or things. Networks are pervasive throughout AFS and in fisheries science. For example, AFS has a large organizational network consisting of an executive director and staff of 16 people, 5 society officers, a 36-member governing board, 35 committees, 22 sections, 4 geographical divisions, 47 state chapters, 58 student subunits, and over 9,000 members. This network interacts at local, regional, continental, and global scales through various forms of communication, including scientific publications, meetings, newsletters, websites, and many, many conversations. The result of these communications and interactions are social relationships, many of which started when we were students, and which have lasted throughout our professional career. As fisheries scientists, we have studied networks, such as food webs, throughout our history, and continue to do so using more sophisticated analytical tools. An emerging area of fisheries science involves social networks. These networks range from small group interactions to large social groups that include fishing villages, fishers, fishing industries, and consumers. The challenge for us as a society is to continue to build and strengthen these networks in the face of mounting fiscal challenges and social changes.

ANNUAL MEETING

The 2012 Annual Meeting addresses this year's theme in many ways. The Plenary Session kicks off with welcoming remarks by the Minnesota Department of Natural Resources Commissioner. There will be three plenary speakers, each addressing one aspect of the theme. Dr. Villy Christensen from the University of British Columbia will speak about ecological networks from a food web perspective; Dr. Barbara Knuth from Cornell University will address the importance of understanding social networks for fisheries science and management; and Dr. William Taylor of Michigan State University will discuss fisheries sustainability and the integration of ecological and social systems. Also, the society's most prestigious awards will be presented during the session. The Plenary Session is followed by a large and varied program of oral and poster presentations. The program includes 96 sessions, including 46 symposia, for 1028 oral presentations and 174 poster presentations on topics of local, regional, national, and international interest.

WORLD FISHERIES CONGRESS AND WORLD COUNCIL OF FISHERIES SOCIETIES

The AFS actively participated in the 6th World Fisheries Congress in Edinburgh, Scotland in May 2012 — where the theme was "Sustainable Fisheries in a Changing World" — and continues to be an active member of the World Council of Fisheries Societies. The Congress attracted over 1300 delegates from 65 countries. AFS Second Vice President Bob Hughes and Fish Physiology Section President Mark Hartl co-organized a session on anthropogenic challenges, with speakers addressing the impacts of land use, eutrophication, ocean acidification, mining, and dams and diversions on fisheries and aquatic systems. The World Council of Fisheries Societies elected a new president, AFS member Doug Beard, and the Council selected South Korea's bid to host the 7th World Fisheries Congress in Busan in 2016.

COMMUNICATION AND OUTREACH

The AFS website was completely updated in 2012. The Electronic Services Advisory Board, led by Jeff Kopaska, and AFS webmaster, Farasha Euker, orchestrated and implemented the update following many of the recommendations that came from a business technology services firm. Improvements were made to the layout and content of *Fisheries*, following the ideas of Managing Editor Sarah Gilbert Fox and Senior Editor Gus Rassam, making our highest impact publication more interesting and appealing.

POLICY STATEMENTS

Policy statements, along with resolutions, are the principal instruments used by AFS in addressing environmental issues. These are statements of principle about resource topics that explain and justify the Society's perspective or attitude in largely philosophical terms. Policy statements are developed through an arduous vetting process guided by the Resource Policy Committee and approved by both a vote of the Governing Board and AFS members. This year the Society approved a policy statement entitled *Need for an Immediate-Release Anesthetic/Sedative for Use in the Fisheries Disciplines*. Jesse Trushenski and Jim Bowker, past and present presidents of the Fish Culture Section, respectively, led a delegation to Washington, D.C. in April 2012 to meet with leaders at the FDA Center for Veterinary Medicine to present the newly adopted policy. We are currently working on policy statements involving lead in sport fishing tackle, as well as revision of several policy statements previously approved.

EDUCATION/CONTINUING EDUCATION

NATURAL RESOURCE EDUCATION AND EMPLOYMENT CONFERENCE

The Coalition of Natural Resource Societies, a partnership of the American Fisheries Society, The Wildlife Society, the Society of American Foresters, and the Society for Range Management, organized the Natural Resource Education and Employment Conference in Denver, Colorado in September 2011. The conference brought together 35 leaders from state and federal resource agencies, universities, professional societies, industry, and nongovernmental organizations to review issues about 1) the training and supply of natural resource professionals and 2) the changing employment scene, and to make specific recommendations for action. The conference report, which was released in April 2012, provided a series of recommendations for adapting natural resource education to changing demographics, workplace needs, and global environmental challenges.

RECRUITING NEW PROFESSIONALS

We continued the Hutton Junior Fisheries Biology Program, a summer mentoring program for high school students, particularly students underrepresented in the fisheries profession. We are continuing a program for Native Peoples Undergraduate Students, which has been funded by the U.S. Fish and Wildlife Service and administered by AFS, and which will enable attendance at our Annual Meeting. The growth in student subunits at universities has led to greater communication with fisheries students and increased opportunities for recruitment into the fisheries profession.

CONTINUING EDUCATION

The Society continues to offer an array of continuing education courses in conjunction with its meetings. These courses provide not only educational opportunities for practicing professionals, but also continuing education credit for those seeking renewal of AFS certification as fisheries professionals. The Society provides a myriad of continuing education courses delivered at Chapter, Division, and Society annual meetings. These courses support the life-long learning needs of fisheries professionals, including those required to maintain professional certification by AFS.

VALUE OF MEMBERSHIP

PROFESSIONAL SALARY SURVEY

AFS has been conducting a survey of salaries of fisheries professional biologists since the late 1970s. However, it has been over ten years since AFS last conducted such a survey. In 2012, AFS contracted with the firm Responsive Management to conduct a salary and compensation survey of fisheries professionals both from the public and private section. The results of that survey will be released this fall. Certified Fisheries Professionals

PROMOTING DIVERSITY

With the changing demographics in society, AFS needs to be a leader in promoting diversity within the fisheries profession. To help track and promote diversity in AFS, the Equal Opportunity Section led by Robin DeBruyne has proposed that AFS voluntarily collect ethnic and demographic information from members when they join or rejoin.

VIRTUAL ATTENDANCE AT MEETINGS

AFS recognizes that most members are unable to attend meetings, particularly Annual Meetings. While nothing can replace physical attendance at meetings, technical advances make it possible for members to engage in virtual attendance. Technology is making it possible for members to see the Plenary Session, Business Meeting, and real-time participation in the Leading at All Levels workshop at the 2012 Annual Meeting.

MEMBERSHIP

AFS is the oldest and largest professional society for fisheries professionals. We have a vibrant society with a stable membership of over 9,000 people. However, AFS has many more members who belong to chapters or sections but not the parent society, which we have termed affiliate members. A special committee evaluated the constitutional, procedural, operational, and economic consequences and opportunities of affiliate membership in chapters. The committee made several suggestions on how we can better account for and include affiliate members in AFS activities. Students and young professionals represent the growing sectors of AFS membership. This recruitment and retention trend is encouraging as it provides the potential for future growth of the society. The society is on firm financial footing and ready to tackle future challenges as we continue our pursuit of the AFS mission.

William A. Fisher
President

Gus Rassam
Executive Director

BRAVO SEATTLE – HELLO TWIN CITIES!

Kudos to the Washington-British Columbia Chapter, host of the AFS 141st Annual Meeting, held at the Washington State Convention Center in Seattle on September 4-8, 2011, and the team who helped break the AFS record for attendance, with over 4,000 attendees. The theme for the meeting was "New Frontiers in Fisheries Management and Ecology: Leading the Way in a Changing World," and the plenary session began with an invocation by the Muckleshoot Tribe, with welcoming remarks by Dow Constantine, King County Executive. Plenary speakers included Randall Peterman (Professor at Simon Fraser University), Billy Frank, Jr. (member and elder of the Nisqually Indian Tribe and Chairman of the Northwest Indian Fisheries Commission), Robert Lackey (Professor at Oregon State University), and Jesse Trushenski (Assistant Professor at Southern Illinois University). Peterman discussed possible solutions to the challenges facing fisheries scientists and managers, including recognition of uncertainties and risks, changes in productivity of aquatic systems, complex management objectives, and intricate quantitative models. Frank discussed Native American leadership in management of Pacific salmon. Lackey discussed the role of science in decision making and policy in fisheries management. Trushenski described the needs of educating future fisheries scientists, fish culturists, and fisheries managers. We look forward to our next meeting, to be held this month in the Twin Cities, where over 1,200 papers will be presented. (Visit afs2012.org for information.)

POLICY STATEMENT ON SEDATIVES

AFS' newest policy statement, shepherded by Jesse Trushenski and Jim Bowker, on fish sedatives did exactly what it was supposed to do – kick-start the dialogue with regulators, including discussion of immediate-release options. As Trushenski stated, "The take home message is that our policy statements are not written to be put on a shelf, but rather to get the ball rolling for change." Fisheries professionals in the US have long needed legal access to a sedative where sedated fish can be immediately returned to the environment. Currently, the only legal option is to use a compound that requires sedated fish to be held for 21 days before they can be released and potentially captured for human consumption. The lengthy withdrawal period jeopardizes virtually every fisheries research project in which catchable-sized fish need to (or should) be sedated or anesthetized and then released into public waterways. The AFS Resource Policy Committee drafted the new policy statement on the need for an immediate-release anesthetic/sedative for use in the fisheries disciplines, calling attention to the need for better options for sedating fish during handling. In late 2011, the AFS Governing Board and membership adopted the new policy statement: http://fisheries.org/docs/policy_statements/policy_34f.pdf

MAGAZINE AND WEBSITE REDO

AFS continues to reinvigorate *Fisheries* magazine. Last year we focused on the content, and in 2011, we updated our cover. As well, we've added new sections, such as AFS Section Updates and Headliners. The magazine continues to be what it has always been – AFS' flagship publication: a science journal/magazine with high-quality scientific content, plus a vehicle for member communications. It's everything it was, but now it's more.

The AFS website was redone in early 2012 to present a more modern look. Planning for the redo was primarily achieved in 2011 with the help of the AFS Electronic Services Advisory Board (ESAB).

AFS EXTENDS CONDOLENCES AND OFFERS OF SUPPORT TO JAPAN

Sadly, in 2011, a magnitude 9.0 earthquake hit Tōhoku, Japan, followed by a powerful tsunami, which left coastal communities, many of which consider fisheries as their main source of economic and social activities, to bear a heavy ecological and socioeconomic burden. The cost in lives and livelihoods lost is incalculable and long in duration.

The Governing Board decided to send condolences to our Japanese members and colleagues, and to the Emperor of Japan who is an honorary member of AFS. The board also voted to contribute a modest amount of funds to help the Japanese Society of Fisheries Science in its efforts at mitigation of the effects of the tsunami.

St. Paul Skyline. Photo credit: Nattapol Pornsalnuwat

PUBLICATIONS

AFS WEB SITE: WWW.FISHERIES.ORG

Visit www.fisheries.org for the latest on fisheries science and the profession.

AFS MAGAZINE: *FISHERIES*

The AFS membership journal, *Fisheries,* offers up-to-date information on fisheries science, management, and research, as well as AFS and professional activities. Featuring peer-reviewed scientific articles, analysis of national and international policy, chapter news, job listings, interviews with prominent professionals (as well as new members), archived content dating back to the beginning of AFS, and more. *Fisheries* gives AFS members the professional edge in their careers as researchers, regulators, and managers of local, national, and world fisheries. *Fisheries* is available to members online at www.fisheries.org.

AFS JOURNALS

- TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY,
  bimonthly, Volume 141
- NORTH AMERICAN JOURNAL OF AQUACULTURE,
  quarterly, Volume 74
- NORTH AMERICAN JOURNAL OF FISHERIES MANAGEMENT,
  bimonthly, Volume 32
- JOURNAL OF AQUATIC ANIMAL HEALTH,
  quarterly, Volume 24
  (Journals are also available to subscribing members online at http://afsjournals.org)
- MARINE AND COASTAL FISHERIES: DYNAMICS, MANAGEMENT, AND ECOSYSTEM SCIENCE, yearly, Volume 4 . Online-only, open access

The Fisheries InfoBase now includes all AFS journals back to 1872, including the complete contents of all issues of *Fisheries*.

AFS BOOKS: RECENT AND UPCOMING TITLES

- *Fisheries Techniques, Third Edition*
- *Telemetry Techniques: A User's Guide for Fisheries Research*
- *Scientific Communication for Natural Resource Professionals*
- *Advances in Fish Tagging and Marking Technology*
- *Advancing an Ecosystem Approach in the Gulf of Maine*
- *Common and Scientific Names of Fishes from the United States, Canada, and Mexico, Seventh Edition*
- *Conservation, Ecology, and Management of Catfish*
- *Small Impoundment Management in North America*
- *Striper 2009: Inland Striped Bass and Hybrid Striped Bass Management*
- *Fish Habitat Management: Policy, Science, and Practice*

SOCIETY AWARDS

AWARD OF EXCELLENCE
Fred W. Allendorf, Regents Professor, University of Montana

PRESIDENT'S FISHERY CONSERVATION AWARD
AFS Member Category: James Franks, Mississippi Department of Marine Resources
Non-Member Category: Trout Unlimited's Eastern Abandoned Mine Program

WILLIAM E. RICKER RESOURCE CONSERVATION AWARD
Joseph S. Nelson, Professor Emeritus, University of Alberta

CARL R. SULLIVAN FISHERY CONSERVATION AWARD
Congressman Norm Dicks

MERITORIOUS SERVICE AWARD
David W. Willis, distinguished professor, South Dakota State University

EMMELINE MOORE PRIZE
Ambrose Jearld, Jr., Northeast Fisheries Science Center

EXCELLENCE IN PUBLIC OUTREACH AWARD
Randall Claramunt, Michigan Department of Natural Resources

DISTINGUISHED SERVICE AWARD
Colleen Caldwell, New Mexico Cooperative Research Unit
Jesse Trushenski, Southern Illinois University
The Tennessee Chapter of AFS

OUTSTANDING CHAPTER AWARD
Large: **Oregon Chapter**
Small**: Indiana Chapter**

OUTSTANDING STUDENT SUBUNIT AWARD
North Carolina State University Student Subunit

EXCELLENCE IN FISHERIES EDUCATION
Scott Hinch, professor, University of British Columbia

GOLDEN MEMBERSHIP AWARDS: THE CLASS OF 1962

James Burns	Gerald Jacobi	Lee Redmond
John Edgington	Harold Klaassen	Kenneth Roberts
Douglas Fletcher	John Musick	Richard Roe
John Fortune	Wesley Orr	W. Sable
Robert Hayden	James Peck	Richard Schaefer
Raymond Hubley	Bert Pierce	Robert Wiley
Gene Huntsman		

SKINNER AWARD
Recipients:
Paul Damkot, University of Maine
Dan Dembkowski, South Dakota State University
Cari-Ann Hayer, South Dakota State University
Daniel James, South Dakota State University
Rebecca Krogman, Mississippi State University
Brianne Lunn, University of Alberta
Hilary Meyer, South Dakota State University
Bonnie Mulligan, Southern Illinois University – Carbondale
Amy Spencer-Alford, Mississippi State University
Samantha Wilson, Carleton University

Honorable Mention:
Lindsay Glass-Campbell, North Carolina State University
Kristen Homel, Montana State University – Bozeman
Robert Parker, Humboldt State University
Claire Stouthamer, Cornell University
Shannon White, Virginia Polytechnic and State University

J. FRANCES ALLEN SCHOLARSHIP
Winner: Neala W. Kendall, University Of Washington
Runner-up: Robyn DeBruyne, Cornell University

STEVEN BERKELEY MARINE CONSERVATION FELLOWSHIP
Winner: Valentina Di Santo
Honorable Mention: Lewis A.K. Barnett and Pablo Granados-Dieseldorff

STUDENT WRITING CONTEST
Winner: Zachary L. Penney, University of Idaho, "Live to Spawn Another Day: Understanding the Fuel Efficiency of Snake River Steelhead"
Runner-up: Emily Cornwell, Cornell University**,** "Students Develop New Sampling Methods for Deadly Fish Virus"
Runner-up: Tamara Pandolfo, North Carolina State University, "Living on the Edge: Freshwater Mussels on the Brink of Extinction"
Honorable Mention: Steve Midway, University of North Carolina Wilmington, "Filth, Flows, and Family: Pressures Mount on a Rare Stream Catfish"

2010 BEST PAPER AWARDS

MERCER PATRIARCHE AWARD FOR THE BEST PAPER IN THE NORTH AMERICAN JOURNAL OF FISHERIES MANAGEMENT
Janice Brahney, Richard Routledge; Darren G. Bos, and Marlow G. Pellatt.
Changes to the productivity and trophic structure of a sockeye salmon rearing lake in British Columbia. North American Journal of Fisheries Management 30(2):433-444.

ROBERT L. KENDALL BEST PAPER IN TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY
Laurie Weitkamp.
Marine Distributions of Chinook Salmon from the West Coast of North America Determined by Coded Wire Tag Recoveries. Transactions of the American Fisheries Society 139(1): 147-170

BEST PAPER IN THE JOURNAL OF AQUATIC ANIMAL HEALTH
V. S. Blazer, L. R. Iwanowicz, C. E. Starliper, D. D. Iwanowicz; P. Barbash; J. D. Hedrick, S. J. Reeser, J. E. Mullican, S. D. Zaugg, M. R. Burkhardt and J. Kelble
Mortality of Centrarchid Fishes in the Potomac Drainage: Survey Results and Overview of Potential Contributing Factors. Journal of Aquatic Animal Health 2010; 22(3): 190 – 218

BEST PAPER IN THE NORTH AMERICAN JOURNAL OF AQUACULTURE
Ashlee N. Horne, Nathan Stone and Carole R. Engle
Development of New Intensive Hatchery Methods for Rosy Red Fathead Minnow. North American Journal of Aquaculture 2010; 72(3): 237-251

SECTION AWARDS
The following AFS Sections announced award recipients at the Annual Meeting in Seattle, Washington:

BIOENGINEERING SECTION
Ned Taft Student Travel Award: Sara Maribeth Turner

CANADIAN AQUATIC RESOURCES SECTION
Peter A. Larkin Award: Erika Eliason
Peter A. Larkin Award, Runner-up: Michael Donaldson and Peter Westley

EARLY LIFE HISTORY SECTION
Elbert H. Ahlstrom Career Achievement Award: Edward D. Houde

EQUAL OPPORTUNITIES SECTION
Mentor Award: William Taylor, Michigan State University
Native People's Travel Award recipients: Duane Fredric Noddin, University of Alberta; Alichia Sunflower Wilson, University of Arkansas at Pine Bluff;
EOS Travel Award winners:
- Ingrid Biedron, Cornell University
- Elissa Buttermore, North Carolina State University
- Courtnee DePass, University of Maryland Eastern Shore
- Marie Fujitani, Arizona State University
- Jason Hwan, University of California Berkeley
- Katherine Pierson, North Carolina State University
- Michaela Satter, Clark and Lewis College
- Adam Tulu, University of Maryland Eastern Shore

EDUCATION SECTION
AFS Best Student Poster Award at the 2010 Annual Meeting In Pittsburgh, Pennsylvania
- Winner: Michael Porta, Oklahoma State University

AFS/SEA Grant Best Student Paper at the 2010 Annual Meeting In Pittsburgh, Pennsylvania
- Winner: Ben Wallace, North Carolina State University
- Honorable Mentions: Lindsey Pierce, University of Toledo and Renee Reilly, Old Dominion University

ESTUARIES SECTION
Student Travel Award:
- Christy Pavel, Savannah State University
- Lynn Waterhouse, Virginia Institute of Marine Science
- Christina Kennedy, University of Massachusetts

FISHERIES AND INFORMATION TECHNOLOGY SECTION
Best Student Poster Award: Ryan Lokteff, Utah State University

FISH CULTURE SECTION
Fish Culture Section Hall of Fame Inductees: Robert Rucker and Howard Clemens
Student Travel Award winners for Aquaculture America 2011:
- Matt Dawson (Best Abstract)
- Er Hu (Joint FCS-USAS Best Abstract Award)
- Walker David Wright-Moore (Best Abstract)

Student Travel Award winners for AFS 2011:
- Zack Penney (Best Abstract)
- Mick Walsh (Best Abstract)

FISHERIES MANAGEMENT SECTION
- Award of Merit: Adam Kaeser and Thom Litts
- Award of Excellence: Ken I. Cullis and Wes Porak
- Hall of Excellence: Jeff Boxrucker

GENETICS SECTION
James E. Wright Award: Caroline Storer and Emily Lescak
Stevan Phelps Memorial Award: Steven L. Schroder, Curtis M. Knudsen, Todd N. Pearsons, Todd W. Kassler, Sewall F. Young, Edward P. Beall & David E. Fast for their paper "Behavior and breeding success of wild and first-generation hatchery male spring Chinook salmon spawning in an artificial stream" in Transactions of the American Fisheries Society 139:989-1003.

INTRODUCED FISH SECTION
Student Travel Award: Larry Lawson, University of Florida

MARINE FISHERIES SECTION
Steven Berkeley Marine Conservation Fellowship: Valentina Di Santo, Boston University
Honorable Mentions: Lewis A.K. Barnett, University of California–Davis
- Pablo Granados-Dieseldorff, Texas A & M

Oscar E. Sette award: Brian J. Rothschild, University of Massachusetts – North Dartmouth
Student Travel award: Megan Nims, University of Texas at Austin
- Tim Ellis, North Carolina State University

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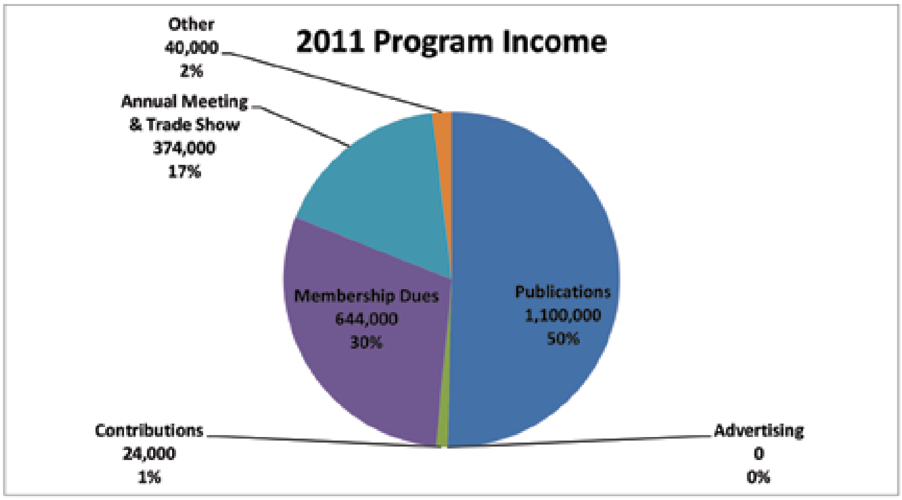
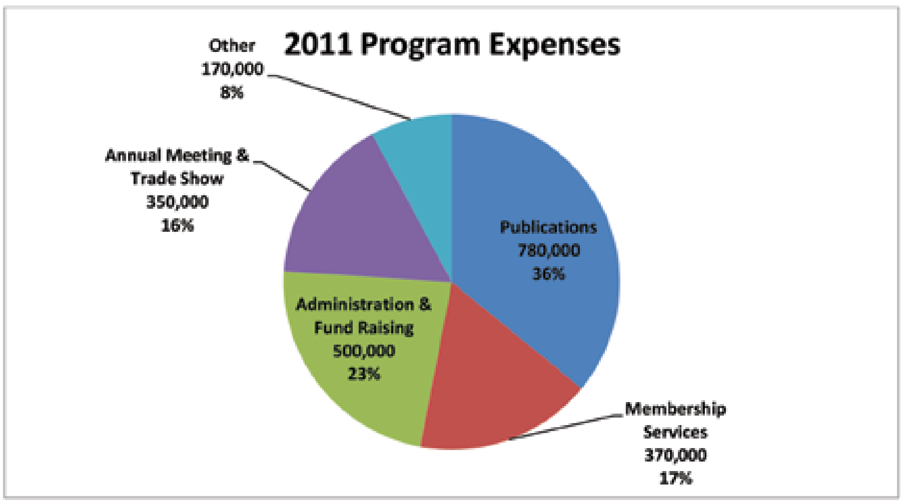
Gus Rassam, Executive Director

AMERICAN FISHERIES SOCIETY 2011 FINANCIALS (UNAUDITED)

REVENUE		
Description	Amount	%
Publications	1,100,000	50.41%
Advertising	0	0.00%
Contributions	24,000	1.10%
Membership Dues	644,000	29.51%
Annual Meeting & Trade Show	374,000	17.14%
Other	40,000	1.83%
TOTAL	2,182,000	100
EXPENSES		
Description	Amount	%
Publications	780,000	35.94%
Membership Services	370,000	17.05%
Administration & Fund Raising	500,000	23.04%
Annual Meeting & Trade Show	350,000	16.13%
Other	170,000	7.83%
TOTAL	2,170,000	100

ASSETS	
Cash	1,200,000
Investments	2,519,000
Accounts Receivable	160,000
Prepaid Expenses	30,000
Property and Equipment	1,744,000
Inventory	294,687
TOTAL	5,653,000
LIABILITIES	
Accounts Payable	618,000
Deferred Revenue	1,231,000
New Assets	3,804,000
TOTAL	5,653,000





Twin Cities 2012 Annual Meeting Planner

Photo: Bruce Kluckhohn

SUNDAY, AUGUST 19

10 am – 1 pm
Historic Mississippi River Sites Tour, RiverCentre

1 pm – 4 pm
Kid's Fishing Event, Thompson Park

7 pm – 10 pm
"Welcome to the Twin Cities" Social, Great River Ballroom, Crowne Plaza Hotel

MONDAY, AUGUST 20

8 am – 12 noon
Plenary Session featuring:
Dr. Bill Fisher, AFS President
Dr. Villy Christensen, University of British Columbia
Dr. Barbara A. Knuth, Cornell University
Dr. William W. Taylor, Michigan State University

11:30 am
Trade Show opens, Exhibition Hall, RiverCentre

6:00 pm – 8:30 pm
Trade Show with Poster Presenters Social, Exhibition Hall

TUESDAY, AUGUST 21

4 pm – 6 pm
Student Career Fair, Meeting Rm 9, RiverCentre

WEDNESDAY, AUGUST 22

7 am – 10 am
AFS Spawning Run, Harriet Island

6 pm – 11:55 pm
"A Taste of Minnesota" Social, Nicollet Island Pavilion

THURSDAY, AUGUST 23

6 pm – 9 pm
"Goodbye Twin Cities, Hello Little Rock" Social, Harriet Island

FRIDAY, AUGUST 24

9 am – 11:30 am
Tour of Saint Anthony Falls Laboratory, RiverCentre

9 am – 12 pm
Bike tour along the Mississippi River with a National Park Service guide, RiverCentre

Registration
Main floor, RiverCentre

Sunday	8 am – 7 pm
Monday	7:30 am – 6 pm
Tuesday	7:30 am – 5 pm
Wednesday	8 am – 5 pm
Thursday	8 am – 12 pm

Here are some highlight events of this year's meeting. Plan to reconnect with colleagues and friends, meet new people, learn about exciting research in fisheries and aquatic sciences, and enjoy all that the Twin Cities have to offer.

Hosted at the RiverCentre along the Mississippi River in St. Paul, the meeting is within walking distance of the Crowne Plaza host hotel.

Visit **www.afs2012.org** for more about the conference, including registration for the Spawning Run or tours and suggestions for fun things to do locally. At the website you can also browse (and download!) the complete conference program.

The 2012 Annual Meeting promises to be a conference "where waters meet, people greet, and networks are born." Come join us!

Symposia and Contributed Papers
RiverCentre

Monday	1:15 pm – 5:15 pm
Tuesday	8 am – 3 pm
Wednesday	8 am – 5:15 pm
Thursday	8 am – 5:15 pm

Fisheries Networks: Building Ecological, Social, and Professional Relationships

Congratulations to the Hutton Junior Fisheries Biology Program Class of 2012!

Hutton Scholars	Location	Hutton Mentors	Host Organizations
Shannon Amiot	Columbia, MO	Bob DiStefano	MO Dept. of Conservation
Jake Baldwin	Clayton, NY	Chris Barry Brandeis Brown John Farrell	SUNY-ESF, TIBS SUNY-ESF, TIBS SUNY-ESF, TIBS
Oshawun Chalmers	Milwaukee, WI	Joseph Ewing John Rothlisberger	Discovery World USDA Forest Service
Katie Dankovic	Spanish Fort, AL	Andy Ford Jennifer Pritchett	U.S. Fish and Wildlife Service U.S. Fish and Wildlife Service
Colby DePalermo	Seguin, TX	Lee Gudgell Debbie Magin	Guadalupe-Blanco River Authority Guadalupe-Blanco River Authority
Kiyana Ellenwood	Lapwai, ID	Miranda Main Justin Peterson	Nez Perce Tribe Fisheries Nez Perce Tribe Fisheries
Geoff Gerdes	Prineville, OR	Mike Harrington Jennifer Luke	OR Dept. of Fish and Wildlife OR Dept. of Fish and Wildlife
Zach Goeden	Fairbanks, AK	Andres Lopez	University of AK, Fairbanks
Selena Gregory	Mackay, ID	Bart Gammett	USDA Forest Service
Joanna Lynch	Seattle, WA	David Glenn	Seattle Aquarium
Marisha Mosley-Reavis	Florence, OR	Paul Burns	USDA Forest Service
Eric Smith	Fayetteville, NC	Kris Smith	N.C. Wildlife Resources Commission
Shaina Villalobos	Morganville, NJ	Chris Chambers	NOAA Fisheries Service
Zixuan Wang	Flagstaff, AZ	Chuck Benedict Matt Rinker Scott Rogers	AZ Game and Fish Dept. AZ Game and Fish Dept. AZ Game and Fish Dept.
Rennie Winkelman	Fort Collins, CO	Chris Myrick	Colorado State University

Mentor and Student Applications for the 2013 Hutton Program will be available online in October. For more information about the Hutton Program, please visit the AFS website: www.fisheries.org, or contact Kathryn Winkler at 301-897-8616 ext. 213 or via e-mail: hutton@fisheries.org.

Oregon Chapter Annual Meeting

Jeff Yanke
Oregon Chapter President

Allison Evans
Piscatorial Press newsletter editor

The Oregon chapter's annual meeting drew over 460 people—including more than 50 students—to Eugene this past February 28 to March 2. The meeting theme, entitled "Weaving Fish into Our Social Fabric," emphasized the connections our fishery resources have with the broader needs of society.

Over 90 members attended the three workshops that preceded the meeting program. The Introduction to R for Fisheries Professionals workshop, organized by Kris Homel (Oregon Department of Fish and Wildlife [ODFW]) and Kevin McDonnell (Oregon State University [OSU]), provided an introduction to the budget-friendly R platform with fisheries-specific examples. The Endangered Species Act (ESA) Permitting workshop, organized by Shivonne Nesbit (ODFW/U.S. Fish and Wildlife Service), discussed the intricacies, complexities, and challenges surrounding research permits for ESA-listed species. The PIT-Tagging workshop, organized by Chris Jordan (National Oceanic and Atmospheric Administration), provided practical advice about the design, construction, and maintenance of Passive Integrated Transponder (PIT) tag sites.

The plenary session kicked off the technical program with three presentations that addressed our meeting theme from several unique perspectives, including impacts of climate change on marine and freshwater ecosystems, fisheries restoration in a first foods context, and successful ecological restoration that considers the human context in which restoration occurs. The technical program that followed included more than 160 oral presentations and 36 posters. The 19 technical sessions both complemented the meetings theme and focused on current resource management and research challenges.

The awards luncheon recognized the accomplishments of professionals, students, and others who contribute to chapter goals and objectives. Awards of Merit went to Denise Hoffert-Hay and Tara Davis (Calapooia Watershed Council) for work leading to the removal of dams on the Calapooia River; Jennie Logsdon-Martin for her efforts to create and grow ifish.net; and Jim Grano for watershed stewardship education in the Siuslaw School District. The fishery team of the year award was awarded to the Bandon Dunes National Wildlife Refuge Ni-les'tun Restoration team for restoring over 400 acres of pasture land to tidal salt marsh and mudflat habitat. The Past President's award was presented to Demian Ebert (AECOM) for his leadership and service to the chapter. Finally, the Broken Oar Award went to Adam Storch and the Lower Columbia River Team (ODFW) for demonstrating how not to anchor boats in shallow water during wind-driven seiches at high tide.

The chapter awarded four student scholarships: Amber Wimsatt (A.A., Mount Hood Community College), April Smith (M.S., OSU), Matt Sloat (Ph.D., OSU), and the prestigious Carl Bond Scholarship went to Amy Jo Linsley (M.S., OSU) in support of her work on the recruitment of juvenile rockfishes in Oregon estuaries. Best Student Paper awards went to Allison Evans and Susan Benda (runner-up), both of OSU. Best Student Poster awards were presented to Briita Orwick (Portland State University) and Christy Fellas (runner-up; OSU).

President Colleen Fagan called the business meeting to order after the awards luncheon. The first order of business was celebrating the Oregon chapter's 2011 Chapter of the Year award for both Western Division and the Parent Society. President Fagan also announced that the Oregon chapter will host the 2015 Parent Society meeting in Portland. Megan McKim and Michelle Scanlan (OSU) reported on the Oregon Chapter American Fisheries Society (ORAFS) student subunit activities, including the great news that they received the 2012 Western Division American Fisheries Society (WDAFS) Best Student Subunit award. The business meeting wrapped up with Executive Committee elections, where we welcomed Todd Buchholz (U.S. Forest Service) as President Elect, Garth Wyatt (Portland General Electric [PGE]) as Secretary/Treasurer, and Michele Weaver (ODFW) to the Internal Director position.

Thanks for everyone's participation and the Oregon chapter looks forward to reconvening in Bend in February of 2013!

The 2011–2012 Oregon Chapter Executive Committee. Clockwise from top left: Jason Kent, Demian Ebert, Jeff Yanke, Bill Brignon, Colleen Fagan, Michele Weaver, and Shivonne Nesbit.

Diversity in Natural Resource Science Professions

Using Feminine Attributes to Broaden Diversity

Christine M. Moffitt

US Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID 83844-1141.
E-mail: cmoffitt@uidaho.edu

I read and re-read Aldo Leopold's *Sand County Almanac*, but never felt the connection that others in my natural resource classes seemed to find. Perhaps it was because I was not from the Midwest; it was perhaps because I was female; or perhaps because I did not grow up in a hunting household. On the other hand, when I read Rachel Carson I was inspired and I gained environmental awareness, especially through her books *Under the Sea-Wind* and *Silent Spring*. Carson became my conservation heroine; perhaps this was because I spent my early youth near the ocean. All connections we make to our environment have some basis in establishing our comfort zones. However, two well-educated people of European descent wrote these books. How then, do we motivate and bring others of different backgrounds to join an inclusive democracy of science and management of natural resources? We aspire to make the fisheries and natural resource sciences and management look more representative of our national and international human populations. Unless we achieve this goal, we will risk the future of our global natural resources to be socially, economically, and environmentally sustainable.

I propose several approaches that may be useful tools to encourage increased awareness and engagement of multi-cultural issues and societies. By improving our own understanding and sensitivity to other points of view, we can be more successful in achieving a diversity of cultures, values, and approaches in natural resource sciences. For me as a woman scholar of natural resources, I am especially interested in increasing the diversity of women of other cultures and ethnic backgrounds to join natural resource sciences. The ecofeminism movement provides insights that may assist us to explore different philosophical and spiritual approaches that empower a multicultural and more community centric view of leadership and resources. Ecofeminism origins are with the French feminist Francoise d 'Eaubonne. Her book *Le Feminisme au la mort* published in 1974, urged women to take power from patriarchal dominated cultures and rethink our role on the earth. The strident nature of some writings polarized readers, and although laying blame never assists a dialog, many tenants of the movement are helpful in understanding and respecting roots of multicultural differences and origins.

I pose several paradigms using feminine attributes to help us broaden all human concern for the importance of natural resources. My thoughts and resources for this come from direct experience with 1) members of some Latin and Native American cultures, 2) readings and browsing of authors such as Karen J. Warren and Mary Mellor, who provide books, keynotes, and 3) journal articles on environmental ethics, and social and political history.

1. The nurturing female role can open the door to understanding values and contributions of cultures outside of traditional European western cultures.

Traditional knowledge should be valued more by all of us. Women are often critical keepers of cultural and spiritual ties, and these bonds help us connect with our own history. Across the globe, celebrations, dances, festivals, and music often include food and drink prepared by women and children. Kinship forms social, spiritual, and political organization within indigenous communities. The sense of place generally engenders more responsibility for it; however, within our dominant Western society, increased mobility has reduced our innate understanding and responsibility for "our place." In addition, the loss of this social and historical perspective creates a viewpoint biased only on our contemporary reference point. Traditional knowledge of natural resources often includes a mix of cultural and environmental philosophy, and although it is critical to many indigenous peoples, this knowledge is not included into much of our contemporary culture.

One influential modern indigenous female leader who places together the importance of respect for place, social, and natural resources is Rigoberta Menchú Tum, a K'iche'-Mayan from Guatemala. In 1992, she received the Nobel Peace Prize for her work to recognize the indigenous peoples of Latin America. Over the years, Menchú has become a leading advocate for Native Indian rights and ethno-cultural reconciliation in Guatemala and throughout the Western Hemisphere. Her approach to human relationships and the earth is rather simple but elegant. She quoted a Mayan philosophy "every human being occupies a small piece of time. Time itself is much longer, and …we must care for this earth while we are on it because it will be part of our children and the children of our grandchildren."

Another influential female spiritual and environmental teacher and scholar is Rosemary Ruether. She has written widely about ecology and its relation to art, religion, gender, and spirituality. A recent book, *Integrating Ecofeminism, Glo-*

balization, and World Religions, provides insight and commentary regarding ways to understand globalization, and the need for understanding the economic and social consequences of such movements. She is optimistic that through faith based groups people can connect to principles of sustainability in their approach to living.

2. Overcoming and understanding linkages between human domination of the environment and domination of females are critical to overcome the global oppression of females, and indigenous peoples.

Gender has been a relevant factor in determining access and control to natural resources. Across civilizations, the metaphor of female has connotation of environmental attributes. The Nature is often a feminine noun, and destruction is referenced in sexual or controlling terms, such as nature has been raped, mastered, conquered, controlled, mined. Land held unfarmed has been called barren. Ecofeminists argue that a strong parallel exists between degradation of nature, and the oppression and subordination of women in families and society. In addition to values of feminism, oppression of indigenous peoples through colonial and undemocratic political systems has maintained oppression of entire indigenous cultures through resource and economic dominance. These injustices and socio-economic forces are key factors in understanding how to readdress and achieve successful global natural resource conservation and management.

3. Motherhood places higher risks on females toward their children, especially in third world countries.

Environmental health, costs, and opportunities directly and indirectly affect our families and society. We can use this information to catalyze understanding of the importance of the environment to everyone. In both developing and developed countries, mother's milk has been found to contain concentrated toxic compounds, such as poly chlorinated biphenyls (PCBs), dioxin, trichloroethylene, perchlorate, mercury, lead, benzene, arsenic, and brominated flame retardants. Nursing babies are inadvertently exposed to high levels from milk stemming from their mothers' own body burden. Even at low levels, compounds impair attention, learning, memory, and behavior. PCBs accumulate in fat cells of all animals, especially those top carnivores in the ocean or lakes where food chains are longer. Thus, consumption of fish and mammals from contaminated systems can put the populations at risk. People from cultures that consume a greater proportion of top carnivores place themselves and their children at even higher risk.

4. Females have dual roles in society as nurturant and rational achiever, and the tension should be recognized and embraced.

Finally, in our efforts to engage more women and men, leadership attributes should include the nurturant component along with the achiever. This natural and dynamic balance has a different set point for everyone, but the capacity to understand others should be praised in leaders of both genders. Women can help encourage men to aspire to a more nurturant approach. In recent decades, our US and Canadian cultures have increasingly valued and promoted paternity leave, shared child rearing, and improved laws that provide more equitable treatment for both parents.

In summary, we need to improve our understanding and highlight ways to engage women and men of all cultures in the Americas and elsewhere to join leadership in natural resources sciences. We need to educate ourselves of the interconnections of the environment, and social, and economic factors associated with achieving sustainability of global natural resources.

JOURNAL HIGHLIGHTS

North American Journal of Aquaculture
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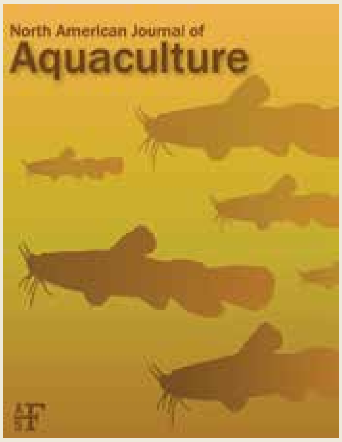

[Communication] Effect of Stocking Density on Walleye Performance in Ponds Lined with Ethylene Propylene Diene Monomer. *Matthew J. Ward, Justin Stane, Garret Schrock, and Clayton Funk. 74: 127–131.*

Effects of Trout Farm Effluent on Water Quality and the Macrobenthic Invertebrate Community of the Zayandeh-Roud River, Iran. *N. Mahboobi Soofiani, R. Hatami, M. R. Hemami, and E. Ebrahimi. 74: 132–141.*

Effects of Feeding Rate and Frequency on Production Characteristics of Pond-Raised Hybrid Catfish. *Menghe H. Li, Edwin H. Robinson, Daniel F. Oberle, and Penelope M. Lucas. 74: 142–147.*

Effects of Dietary Fiber Concentrations Supplied by Corn Bran on Feed Intake, Growth, and Feed Efficiency of Channel Catfish. *Menghe H. Li, Daniel F. Oberle, and Penelope M. Lucas. 74: 148–153.*

[Communication] Efficacy of 35% PEROX-AID (Hydrogen Peroxide) in Reducing an Infestation of *Gyrodactylus salmonis* in Freshwater-Reared Rainbow Trout. *James D. Bowker, Daniel Carty, and Miranda M. Dotson. 74: 154–159.*

Effects of Abrupt pH Increases on Survival of Different Ages of Young Channel Catfish and Hybrid Catfish. *Charles C. Mischke and Nagaraj Chatakondi. 74: 160–163.*

[Communication] Effects of Exhaustive Exercise on Lipid Peroxide and Hydroxy Lipids in Yellowtail *Seriola quinqueradiata.* *Ryusuke Tanaka and Takashi Nakamura. 74: 164–168.*

A Review of the Use of Ultrasonography in Fish Reproduction. *Noel D. Novelo and Terrence R. Tiersch. 74: 169–181.*

Fish Handling and Ultrasound Procedures for Viewing the Ovary of Submersed, Nonanesthetized, Unrestrained Channel Catfish. *Amy M. Guitreau, Bruce E. Eilts, Noel D. Novelo, and Terrence R. Tiersch. 74: 182–187.*

Effects of Rearing Environment and Strain Combination on Heterosis in Brook Trout. *Amélie Crespel, Céline Audet, Louis Bernatchez, and Dany Garant. 74: 188–198.*

Egg Disinfection to Improve Conservation Aquaculture of Leatherside Chub. *Eric J. Wagner, Matthew S. Bartley, and Randall W. Oplinger. 74: 199–207.*

Weaning Ages of Bluegill and Redear Sunfish Fry in Indoor Recirculating Aquaculture Systems. *Gregory A. Dudenhoeffer, James E. Wetzel, and Thomas R. Omara-Alwala. 74: 208–213.*

Induction, Recovery, and Hematological Responses of Largemouth Bass to Chemo- and Electrosedation. *Jesse T. Trushenski, James D. Bowker, Bonnie L. Mulligan, and Brian R. Gause. 74: 214–223.*

[Communication] Changes in Freshness during Frozen Storage of Farmed Coho Salmon: Effect of Replacement of Synthetic Antioxidants by Natural Ones in Fish Feeds. *Jaime Ortiz, Juan P. Vivanco, Vilma Quitral, M. A. Larraín, Gabriela Concha, and Santiago P. Aubourg. 74: 224–229.*

[Technical Note] Inhibitory Effects of Rosemary Oil on the In Vitro Growth of Six Common Finfish Pathogens. *Susan L. Ostrand, Richard A. Glenn, Ann L. Gannam, and Kyle C. Hanson. 74: 230–234.*

Rainbow Smelt Weaning and the Effects of Temperature and Salinity on Juvenile Growth. *Heidi R. Colburn, Abigail B. Walker, and David L. Berlinsky. 74: 235–240.*

Primary and Secondary Responses of Juveniles of a Teleostean, Pikeperch *Sander lucioperca*, and a Chondrostean, Persian Sturgeon *Acipenser persicus*, to Handling during Transport. *Bahram Falahatkar, Sobhan R. Akhavan, Iraj Efatpanah, and Bahman Meknatkhah. 74: 241–250.*

Replacement of Menhaden Fish Meal Protein by Solvent-Extracted Soybean Meal Protein in the Diet of Juvenile Black Sea Bass Supplemented with or without Squid Meal, Krill Meal, Methionine, and Lysine. *Md Shah Alam, Wade O. Watanabe, Katherine B. Sullivan, Troy C. Rezek, and Pamela J. Seaton. 74: 251–265.*

Effects of Shading on the Reproductive Output and Embryo Viability of Gulf Killifish. *C. T. Gothreaux and C. C. Green. 74: 266–272.*

Impact of Minimum Dissolved Oxygen Concentration on Grow-Out Performance of Blue Catfish with Comparison to Channel Catfish. *Les Torrans, Brian Ott, and Brian Bosworth. 74: 273–282.*

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is vital to our profession, and incoming president John Boreman has made it the theme of his presidency in 2012–2013.

GOAL 3 - Value of Membership:
AFS committees and sections implemented several new initiatives and continued some existing ones. Past President Wayne Hubert and I led a governing board retreat at the 2011 annual meeting to evaluate the affiliate membership issue; that is, those members who belong to a chapter or section but not the society. Wayne chaired a special committee to further evaluate the constitutional, procedural, operational, and economic consequences and opportunities of this issue at the chapter level, and the committee provided several suggestions for helping to resolve this issue. As well, it has been over 10 years since AFS last conducted a salary survey of fisheries professionals. In 2012, AFS contracted with the firm Responsive Management to conduct a salary and compensation survey of fisheries professionals from both the public and private section. The results of that survey will be released this fall. To help track and promote diversity in AFS, the Equal Opportunity Section led by Robin DeBruyne has proposed that AFS voluntarily collect ethnic and demographic information from members when they join or rejoin. AFS launched Fisheries Reports, a database archive of unpublished agency and other reports that is available through the AFS website. Finally, Dirk Miller led a Society Governance special committee to evaluate the size and structure of our 35-member governing board. This is not a new issue, as the committee pointed out, and reflects the history of growth and diversity of specialties that have evolved in fisheries and the society. To address the changes our society is experiencing and anticipating, the governing board retreat “Reimagining AFS” was led by Mary Byers, coauthor of the Race for Relevance: 5 Radical Changes for Associations, and facilitated by AFS member Dale Burkett. We need to make sure that AFS remains relevant and a value to our current and future members.

I am convinced that the strength of our Society is in the diversity of our membership, richness of our activities, and the commitment and dedication of our members. Based on my observations and experiences this past year, the AFS network is diverse, complex, and strong. To ensure that our Society is well functioning and relevant, we must continually evaluate what we do and why we do it. This will help us maintain the health of our Society and advance our mission “to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science and promoting the development of fisheries professionals.” I thank each and everyone one of you who served as an AFS leader and participated in an AFS activity this past year. It was a pleasure and honor to serve you.

NEW AFS MEMBERS

Jesse Allen
Roger Anderson
Mery Armijos
Aaron Baumgartner
Jason Baumgartner
Mike Bosko
Jeffrey Buckingham
Andrew Butler
Chelsey Campbell
Carl Cardini
Patrick Ceas
Christopher Cochran
Daniel Cooper
Alison Coulter
David Coulter
Neeti Dahal
Luke Ferguson
Alissa Ganser
Harrison Gatch
Cory Goldsworthy
William Hafner
Ryan Hastings
Keith Henderson
Courtney Hisey
Cho Dong Hwi
Daniel Jang
Lisa Jones
Scott Jones
Lauren Lansdowne
Andrew Leakey
Aaron Lensing
Dalton Lewis
Kerri McCabe
Joshua McNeil
Christopher Mitaly II
Christopher Naus
Brandilynne Ogden
Kimberly Orren
Lisa Peterson
Joy Phelan
Chris Pickering
James Quick
Jeffrey Reed
Jaclyn Rodo
Robert Romaire
Wendy Rose
Brandon Rowan
Josh Sakmar
Nicholas Schlesser
Steven Scyphers
Stephanie Shelton
Cameron Sinclair
James Skipper
Cody Speight
David Stormer
Aaron Stroud
Carmen Tattersfield
Isabel Thibault
Nicole Williamson

CALENDAR
Fisheries Events

To submit upcoming events for inclusion on the AFS web site calendar, send event name, dates, city, state/province, web address, and contact information to sgilbertfox@fisheries.org.

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

More events listed at www.fisheries.org

DATE	EVENT	LOCATION	WEBSITE
August 19–23, 2012	AFS 142nd Annual Meeting of the American Fisheries Society – Fisheries Networks: Building Ecological, Social, and Professional Relationships	Minneapolis-St. Paul, MN	www.afs2012.org
August 24–26, 2012	Ninth International Conference on Recirculating Aquaculture	Roanoke, VA	www.recircaqua.com/icra.html
September 1–5, 2012	AQUA 2012	Prague, Czech Republic	www.was.org/WasMeetings/meetings/Default.aspx?code=Aqua2012
September 17–21, 2012	ICES Annual Science Conference 2012	Bergen, Norway	www.ices.dk
November 5–9, 2012	International Symposium on Fish Passages in South America	Toledo-Paraná, Brazil	www.unioeste.br/eventos/sympass/
December 4–5, 2012	13th Flatfish Biology Conference	Westerbook, CT	http://mi.nefsc.noaa.gov/flatfishbiology-workshop
December 9–12, 2012	73rd Midwest Fish and Wildlife Conference	Wichita, KS	http://www.midwestfw.org/html/call.shtml
February 21–25, 2013	Aquaculture 2013	Nashville, TN	www.was.org/WasMeetings/meetings/Default.aspx?code=AQ2013
April 8–12, 2013	7th International Fisheries Observer and Monitoring Conference (7th IFOMC)	Viña del Mar, Chile	www.ifomc.com/

ANNOUNCEMENTS
August 2012 Jobs

Employers: to list a job opening on the AFS online job center submit a position description, job title, agency/company, city, state, responsibilities, qualifications, salary, closing date, and contact information (maximum 150 words) to jobs@fisheries.org. Online job announcements will be billed at $350 for 150 word increments. Please send billing information. Listings are free (150 words or less) for organizations with associate, official, and sustaining memberships, and for individual members, who are faculty members, hiring graduate assistants. if space is available, jobs may also be printed in *Fisheries* magazine, free of additional charge.

Fisheries Interviewer
QuanTech, Inc.
Permanent

Salary: Hourly rate plus mileage reimbursement.

Closing: Until filled

Responsibilities: Northeast and Mid-Atlantic Commercial Fishing Ports. QuanTech is conducting a survey of commercial fishing crew for NOAA Fisheries. The survey will provide information on socio-economic aspects of the commercial fishing industry in the Northeast and Mid-Atlantic. Data will be collected on a variety of topics, including profitability and productivity, employment trends, conservation ethic, participation, and job satisfaction. Potential work locations include, but are not limited to, Portland & Vinalhaven (ME), Portsmouth (NH), Gloucester, Chatham, New Bedford, & Fall River (MA), North Kingstown (RI), Stonington (CT), Montauk (NY), Cape May (NJ), Chincoteague & Newport News (VA), Beaufort (NC) and other NC cities.

Qualifications: Fluency in Spanish/Portuguese is a plus. Familiarity with the Android operating system is also a plus. Candidates must be authorized to work in the U.S.

Link: http://www.quantech.com/SEASapp.html

Senior Biologist
Grant Public Utility District's (PUD)
Permanent

Salary: $2,573- $3,603/Bi-Weekly (DOE)

Closing: Until filled

Responsibilities: Position headquartered in Beverly WA or Upper Columbia Basin – Location TBD. The Senior Biologist works under the direction of the Fish, Wildlife and Water Quality Department's Hatchery/Habitat Program Supervisor to design, coordinate, implement and monitor programs required by the terms and conditions of Grant Public Utility District's (PUD) 2008 Federal Energy Regulatory Commission License Order, including fish, wildlife and water quality provisions within in the 401 Water Quality Certification, National Marine Fisheries Service Fisheries Biological Opinion, USFWS Biological Opinion, Priest Rapids Salmon and Steelhead Settlement Agreement, Hanford Reach Agreement, and other programs/settlements.

The Senior Biologist must effectively and efficiently strategize and manage hatchery and habitat programs and projects associated with Grant PUD's Federal Energy Regulatory Commission license requirements to protect, mitigate and enhance the aquatic and terrestrial resources of the Priest Rapids Project. The Senior Biologist designs and implements robust monitoring and evaluation studies; conducts technical analyses; prepares, reviews and presents technical reports and peer-reviewed publications; develops and manages program budgets and contracts; and effectively interacts with internal project teams and external agency and technical representatives.

Link: http://www.appone.com/applinkportal.asp?R_ID=608712&AdCode=SR00267768

Natural Resource Analyst
At-sea Processors Association, WA
Permanent

Salary: Negotiable; competitive salary based on experience and qualifications; benefits include health insurance and participation in a 401(k) plan.

Closing: Until filled

Responsibilities: Review, summarize, and critique research reports and analyses that support management of the Alaska pollock and groundfish fisheries. Conduct and-or coordinate industry and cooperative industry-government applied research. Interact with NMFS Alaska Fishery Science Center, International Pacific Halibut Commission, University of Washington, University of Alaska, and Alaska Department of Fish and Game researchers, among others.

Contact: Stephanie Madsen, Executive Director, At-sea Processors Association, P.O. Box 32817 Juneau, Alaska 99803; (907) 523-0970 or (907) 723-7744

Aquatic Specialist / Technician
ATAC llc "Pond Management Specialists"
Permanent

Salary: $30,000 to $40,000 – dependent on experience and education

Closing: Until filled

Responsibilities: Apply Aquatic herbicides and algaecides

Assist biologist in solving aquatic weed problems

Assisting customers pond side

General maintenance of equipment, facility and land

Water analysis (DO, pH, Ammonia etc.)

Completion of daily log sheets

Assist other departments as needed cleaning fountains and aeration maintenance as well as the fish hatchery, and any other assigned duties

Good people/communication skills

Knowledge in basic pond management, and fish production a plus

Qualifications: AS / Aquaculture, Fish Management, Aquatic Biology, Ag science. Horticulture, Biology, Zoology or similar Natural Resource Major. Or 2 years experience as an aquatic applicator. Must obtain a pesticide license with in 90 days.

Contact: Richard A. Rogers, President, 1-888-998-7663 or fax resumes to 1-513-932-9706 or email below or mail to P.O. Box 1223, Lebanon, OH 45036.

Email: rick@atac.cc

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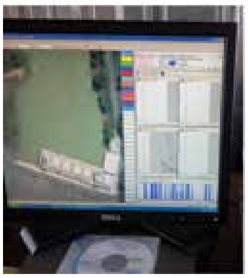
Tracking Acoustic Tags in Noisy Tailraces: Real-World Monitoring at Brazil's Três Marias Dam



An unprecedented fisheries research project is underway in Brazil's São Francisco River studying fine-scale fish behavior at a hydro-electric dam. Here, the Federal University of Lavras' Dept. of Biology (UFLA), the Companhia Energética de Minas Gerais (Cemig), one of Brazil's largest power generators and distributors, and HTI are all working together tracking fish to improve fisheries management downstream from the Três Marias Dam.

The Três Marias Dam is a 2,700 m (8,900 ft) long and 75 m (246 ft) high embankment with a reservoir surface area of 1,040 km2 (400 sq mi) and a capacity of 21 km3 (5.0 cu mi). This dam plays a central role in power production and flood control for the region.

HTI's Senior Scientists Sam Johnston and Colleen Sullivan worked with the team on-site to help with telemetry deployment and system testing. Around 200 curimba (*Prochilodus costatus*) and mandi (*Pimelodus maculatus*) were tagged with HTI *Model 795 Acoustic Tags*. The tag weights and tag life were ideal for study requirements, in addition to permitting numerous tags to be present at one time without any tag data collisions or false positives. To cover the tailrace area, 11 hydrophones were installed in fixed locations. Each hydrophone was attached to a simple fabricated housing on a metal rod and submersed in a specific location. Tags were simultaneously detected and identified in real-time at a distance up to 100 m (328 ft) in the turbulent, white water of the dam's tailrace. Each fish was tracked in two dimensions (2D).

By the end of the project the group will have data with correlated animations (visualizations via HTI's *AcousticTag* data acquisition and analysis software) that will accurately illustrate how fish approach the plant. This vital information will significantly help managers improve the regulation of fish that accumulate near generating units during various stages of operation. This work will also produce a PhD thesis for researcher and student, Fabio Suzuki.

According to biologist Dr. Luiz Gustavo Martins da Silva, "This technology will help us elucidate the behavior of fish below Três Marias Dam increasing our knowledge to develop management actions for conservation...our team (Fabio Suzuki, Paulo Pompeu and Carlos Alves) is very proud of that." HTI is pleased to contribute and support this study undertaken under the Peixe Vivo Program, a Cemig conservation initiative. To learn more about the equipment or methods used, contact Sam or Colleen at (206) 633-3383 or consulting@HTIsonar.com.

> **"This technology will help us to elucidate the behavior of fish below Três Marias Dam increasing our knowledge to develop management actions for conservation... our team (Fabio Suzuki, Paulo Pompeu and Carlos Alves) is very proud of that."**

Dr. Luiz Gustavo Martins da Silva, Biologist - Federal University of São João Del Rei

HTIsonar.com