



Newsletter of the  
**Early Life History Section**  
of the American Fisheries Society

Lee A. Fuiman, Editor

The following correction appears in the June 2009 issue of STAGES:

## Correction

On page 7 of the previous issue of *SAGES* (volume 30, issue 1), the report on the behavioral effects of low levels of thiamine in salmonine alevins neglected to mention that the work was done by Jeff Allen. This was my fault and I thank Ed Roseman for pointing out the error to me. The work should have been described as follows:

"Recent behavioral studies of salmonine alevins conducted by Jeff Allen, a fishery biologist at the GLSC, suggest that sublethal, long term effects (concerning both prey capture and predator avoidance) are associated with low levels of thiamine. An examination of altered brain histomorphology between thiamine replete and depleted alevins may provide a possible explanation for this altered behavior. The objective of this study is to develop a method to quantify morphological differences of the brain between thiamine-deficient and thiamine-replete swim-up lake trout. 3-D models of alevin lake trout brains are generated using plastic embedded, serial sections that permit high-resolution analysis. The models are constructed using 1-micron-thick sections taken every 10 microns. These 3-D models can then be examined to estimate volumetric and morphological relationships between the two groups of lake trout. 3-D reconstructions may also be applied to specific organs of other larval species to approach various questions, including the effects of contaminants."

My apologiest to Jeff.

— Lee Fuiman, Editor

# STAGES

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**Early Life History Section**  
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Volume 30, Number 1

Lee A. Fuiman, Editor

February 2009

## Inside this issue

President's Message .....	1
News from the Regions .....	2
Section Officers .....	2
Upcoming Events .....	8
Publications .....	9

## ELHS Back Then

**5 years ago:** Don Hoss and Lee Fuiman propose establishment of J.H.S. Blaxter Award for Best Student Poster.

**10 years ago:** Gail Theilacker receives Early Life History Career Accomplishment award at LFC in Seattle

**15 years ago:** First revision of Section by-laws approved.

**20 years ago:** Student travel grants approved by the Executive Committee.

**25 years ago:** ELHS established as an official American Fisheries Society Section.

**30 years ago:** Darrel Snyder circulates the idea for an AFS Section for larval fish work.

**Deadline for material to be included in the next issue of *Stages*:**

**May 1, 2009**

## Leading by Example!

Congratulations to Drs. Sue Sogard and Catriona Clemmesen, the new President-Elect and Secretary-Elect, respectively, of the Early Life History Section! We had four strong candidates, which explains why the voting was very close. Here are brief biographical sketches of our two elected officers.

Sue has been an active contributor to our Section over the years. She served as Western Region representative in 1993-1994 and ELHS Secretary in 2000-2002. She served as program chair for the 27<sup>th</sup> annual Larval Fish Conference, held in Santa Cruz in 2003. Sue is currently the Ecology Investigation Chief for the Fisheries Ecology Division of the Southwest Fisheries Science Center, National Marine Fisheries Service, in Santa Cruz, California. She also heads the Early Life History Team, which conducts research examining environmental factors that influence variability in growth and survival of larval and early juvenile stages of marine and anadromous fishes. Her research interests include life-history strategies, oceanographic effects on larval ecology, parental effects on larval condition, and behavioral trade-offs among competing



**Newly elected officers of the Early Life History Section. Sue Sogard (left) is President-Elect and Catriona Clemmesen (right) is Secretary-Elect.**

*...continued on p. 11*

## President's Message



*In the middle of every difficulty lies opportunity.*

— Albert Einstein.

These are difficult times. Financial markets are in turmoil. Many private universities and research institutions have seen their endowments decline and are implementing hiring freezes, holds on capital projects, and tuition increases. State governments – most of which in the U.S. have balanced budget requirements – are also cutting costs, which are forcing many public universities to make cuts and increase tuition. The endpoint of the global economic crisis is unclear, but to counter this troubled outlook, I will focus here on opportunities for early life stage (ELS) research.

Three factors contribute to creating research opportunities: funding, information needs, and

those willing to pursue funding to provide needed information.

**Funding** - Any current discussion of research funding should start with the American Recovery and Reinvestment Act of 2009 (aka the Stimulus Package).<sup>1</sup> Depending on your political views, you may or may not support the Act, but it has been signed into law and contains funding that could support ELS studies. Information on this Act is still nascent, but the American Association for Advancement of Science (AAAS) estimates it will provide ~\$21.5 billion (yes billion with a “b”) in funding for federal research and development (R&D).<sup>2</sup> A broad brush categorization of this R&D funding is available<sup>3</sup> and more details are sure to

<sup>1</sup> the conference report for the bill is online at: [online.wsj.com/public/page/stimulus-package.html](http://online.wsj.com/public/page/stimulus-package.html)

<sup>2</sup> [www.aaas.org/spp/rd/fy09.htm](http://www.aaas.org/spp/rd/fy09.htm)

<sup>3</sup> [www.aaas.org/spp/rd/stim09ctb.pdf](http://www.aaas.org/spp/rd/stim09ctb.pdf)

*...continued on p. 10*

## News from the Regions



### Northeast Region

**Mark Wuenschel**

*From: University of Maryland, Chesapeake Biological Laboratory*

Jason Edwards is a master's student at the University of Maryland Center for Environmental Science Chesapeake Biological Laboratory (CBL) working with Tom Miller. His master's research focuses on quantifying the productivities of potential nursery habitats for Atlantic menhaden throughout the Chesapeake and Delaware Bays. Because nursery habitat contribution to the menhaden adult spawning stock likely varies both spatially and temporally, recognizing this variability and its causes is important to understanding ecological processes, forecasting population dynamics, and assessing management strategies.

Nursery habitat productivity can be determined from the product of abundance and growth rate. However, growth must be quantified at the same spatial and temporal scale as the abundance estimates in order to accurately determine site-specific productivity. Traditional methods of estimating growth such as size-at-age and otolith-based estimates integrate growth over too long a period to be useful for this application. To overcome this limitation, Jason is attempting to use RNA:DNA to estimate recent growth in juvenile Atlantic menhaden. Research has found RNA:DNA to be a reliable indicator of recent feeding, growth, and condition in larval and

juvenile fish. By determining a predictive relationship between RNA:DNA and growth rate in Atlantic menhaden, estimates of growth from field caught individuals can be combined with abundance estimates to examine spatial and temporal patterns of the relative productivity of nursery habitats in the Chesapeake and Delaware Bay.

This summer, laboratory experiments were conducted to develop an RNA:DNA-based index for estimating growth rate in juvenile Atlantic menhaden. Controlled growth experiments incorporating different ration treatments and temperature regimes were undertaken to elicit a range of growth rates and allow for the investigation of potential temperature-dependency of RNA:DNA in menhaden. Results indicate that RNA:DNA is a reliable indicator of recent feeding in Atlantic menhaden, supporting findings of previous studies. A strong, linear relationship was found between RNA:DNA and growth rate, even without accounting for the potential effects of temperature (Figure 1, p.6), supporting the applicability of this technique to field caught fish. Also, the inclusion of temperature greatly improved the relationship between RNA:DNA and growth rate (Figure 2, p. 6), indicating the advantage of including temperature in the RNA:DNA-based growth index for juvenile menhaden. Finally, stepwise multiple linear regression was conducted to develop a predictive model to estimate instantaneous growth rate as a function of RNA:DNA, temperature, and potential interactions. This model can be applied to measured RNA:DNA of field caught fish to estimate growth rates of juvenile Atlantic menhaden.

The RNA:DNA-based index developed from this research will be applied to fish

...continued on p. 6



### North Central Region

**Jim Garvey**

*From South Dakota State University*

Jeff Jolley, PhD candidate working with Dr. David Willis, recently completed the first 5 years of a 10-year project examining environmental effects on bluegill and yellow perch recruitment through an examination of multiple life stages in Nebraska Sandhill lakes. Mark Kaemingk will continue this research for his dissertation. The long term goal is to assemble a 10-year dataset on larval and juvenile dynamics, along with biotic and abiotic variables (e.g., zooplankton, benthic invertebrates, climate, and physicochemical variables) in Pelican Lake, Nebraska. Preliminary data show



*Jeff Jolley recovers a cloverleaf trap for collecting juvenile bluegill and yellow perch on Pelican Lake, Nebraska.*

...continued on p. 3

## Section Officers

### President

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**HELP US  
UPDATE OUR  
RECORDS...**

*Verify your email and  
postal address with our  
Secretary.*



*North Central Region...cont'd from p. 2*

high variability in larval abundance for both species among years. Size-selective overwinter mortality seems to be the exception and not the rule. Examination of predictions from the match-mismatch hypothesis has been completed. Exact matches in larval production and preferred prey were common. No mismatches in predator and prey production were observed. Based on a low number of observations, correlations between various measures of recruitment (i.e., juvenile abundance, age 1 and age 2 abundance) and biotic and abiotic variables were weak to nonexistent, likely indicating that year-class strength is set after the larval stage. The completion of the 10-year dataset may provide more insight into mechanisms affecting recruitment of these two fishes in Nebraska Sandhill lakes.



*Andy Jansen assesses experimental yellow perch egg skein treatments.*

Research on larval dynamics of yellow perch in eastern South Dakota lakes has been ongoing. Andy Jansen recently completed his thesis on this topic. Using a 10-year dataset from six eastern South Dakota lakes, he investigated climatic relations with yellow perch recruitment across a broad geographical scale. Results indicate that spring wind speed, precipitation, and temperature were related to larval abundance. Climate did not act similarly across all systems, suggesting lake-specific mechanisms may be occurring. Previous observations have suggested that the occurrence of cold fronts during yellow perch spawning, incubation, or hatching may lead to relatively weaker year classes or recruitment failure. Andy conducted a laboratory experiment simulating a cold front and monitored effects on incubating yellow perch eggs. In one experiment, the temperature was lowered 6° in 24 h with no difference in hatching success among treatments and controls. In a second experiment, the temperature was lowered 8° in 45 min and maintained at that level for several days! Again, no difference in hatching success was observed, suggesting



## Western Region

**Dan Margulies**

*From: Early Life History Group, Inter-American Tropical Tuna Commission, La Jolla, California*

Our ELH research group continues studies of the reproductive biology and early life history of tunas. The research is centered at the IATTC's Achotines Laboratory located in Los Santos Province, on the Pacific coast of the Republic of Panama.

At the Achotines Laboratory, broodstock of yellowfin tuna have been spawning almost daily since 1996. The broodstock are maintained in an in-ground, concrete tank (17 m diameter, 6 m depth), and fertilized eggs are hatched and used in a variety of laboratory experiments. Our experimental program has examined important biological and physical factors that influence pre-recruit survival. Since 2000, laboratory investigations have centered on the effects of water temperature, dissolved oxygen, light, microturbulence, and larval density on the survival and growth of yellowfin larvae.

More recent laboratory investigations have begun to focus more on the early juvenile stage of yellowfin. Studies have been conducted on the feeding behavior, growth, and nutrition of post-transformation juveniles. We are also collaborating with Drs. Del Gatlin and Alex Buentello of Texas A&M University on nutritional profiles of larval and early juvenile yellowfin.

The Achotines Laboratory also sponsors the annual Workshop on Pelagics (in its 7<sup>th</sup> year in June 2009). The workshop is held jointly with Dr. Daniel Bennetti of the University of Miami (UM), and includes UM graduate students and professional researchers from around the world. The IATTC's ELH group is also collaborating with Daniel Benetti on studies examining

that the critical time period may be the larval life stage of yellow perch. PhD students Justin VanDeHey and Mark Kaemingk will continue investigations of the effect of simulated cold fronts on the larval life stage of yellow perch.

*From USGS Great Lakes Science Center*

ELH Section member Dr. Ed Roseman and colleagues Dr. Bruce Manny and Greg Kennedy from USGS, and Jim

the feasibility of the collection, transfer, and culture of Pacific sailfin and wahoo at the Achotines Laboratory. These studies are being funded by the Secretaria Nacional de Ciencia y Tecnología e Innovación (SENACYT) of the Republic of Panama.

The IATTC's ELH group has recently reached an agreement with Kinki University of Japan to conduct comparative studies of the reproductive biology and early life history of bluefin and yellowfin tuna. This joint study is being funded as part of Kinki University's grant from the Global Center of Excellence (GCOE) Program in Japan.

The IATTC's ELH research group consists of Dan Margulies, Vernon Scholey, Jeanne Wexler, and Maria Santiago. For more information on our research program and the Achotines Laboratory, go to [www.iatc.org](http://www.iatc.org) and click on Achotines Lab.

### Recent Publications:

Buentello, J.A., C. Pohlenz, D. Margulies, V.P. Scholey, D. Tovar, W.H. Neill, P. Hinojosa, J.B. Wexler, and D.M. Gatlin III. In review. A preliminary study of the ontogenic development of digestive enzymes and amino acid composition of larval yellowfin tuna (*Thunnus albacares*). *Aquaculture*.

Margulies, D., J.M. Suter, S.L. Hunt, R.J. Olson, V.P. Scholey, J.B. Wexler, and A. Nakazawa. 2007. Spawning and early development of captive yellowfin tuna (*Thunnus albacares*). *Fish. Bull.* 105:49-265.

Margulies, D., V.P. Scholey, J.B. Wexler, R.J. Olson, J.M. Suter, and S.L. Hunt. 2007. A review of IATTC research on the early life history and reproductive biology of scombrids conducted at the Achotines Laboratory from 1985 to 2005. *Inter-Amer. Trop. Tuna Comm., Special Report* 16: 63 pp.

Wexler, J.B., S. Chow, T. Wakabayashi, K. Nohara, and D. Margulies. 2007. Temporal variation in growth of yellowfin tuna (*Thunnus albacares*) larvae in the Panama Bight, 1990-97. *Fish. Bull.* 105:1-18. \$

Boase from USFWS Alpena Fisheries Resources Office continued spawning and larval fish assessments in the Detroit River during 2008. Objectives of this work are to assess use of artificial and natural substrates by spawning fish in the Detroit River by collecting eggs during spring and fall spawning periods. In 2008, new spawning habitat was set in place near the upstream end of Fighting Island in the Detroit River. This area was identified as suitable location for the new reefs based

*...continued on p. 6*



## European Region

**Audrey Geffen**

Well, the ELHS and the LFC were certainly treated well in Kiel! The conference organisation was fantastic, the venue was great, the food was plentiful, and the weather was mostly cooperative. Many thanks to Catriona Clemmesen and all of her team for all their efforts – and congratulations on the successful event! The conference programme presented a broad view of larval fish research, and opened our eyes to the problems and progress in studying the early life history stages of cephalopods. The five theme sessions covered ecology, physiology, life history strategies, aquaculture, and taxonomy – with an additional session for contributed papers. Participation by students and post-docs was especially active, with excellent presentations of posters and oral papers. The atmosphere really encouraged discussions and gave everyone the opportunity to meet new researchers and potential colleagues. By now the manuscripts from the conference have been submitted for the special issue of *Scientia Marina*, and many of the reviews are in (see p. 8). (If you have agreed to review a manuscript, but still have not completed your report, please take pity on us and FINISH it!). This will be an excellent issue with a great collection of papers. One of the most striking features of the conference was the role of design and imagination – from logo to conference bags and merchandise. The giant flag marking

the conference venue was auctioned at the last dinner to generate funding for the John Blaxter student poster award. This flag was purchased by a trio of attendees, and will travel halfway around the globe to reach the next Larval Fish Conference in 2009. It began its trip with an official transfer ceremony in Halifax at the ICES Annual Science Conference in September 2008.

Larval herring studies in Europe and internationally were highlighted only a few weeks after the Larval Fish Conference in Kiel – at the Linking Herring meeting in Galway, Ireland. [www.linkingherring.com](http://www.linkingherring.com). This ICES Symposium was also sponsored by PICES and GLOBEC. A selection of the papers presented will be published as a special issue of the *ICES Journal of Marine Science* in autumn 2009.

Back in the laboratory, I am pleased to report that our herring experiments have finally begun. We started in 2007 to work on a new project, funded by the Norwegian Research Council: “Study of the long-term effects on Atlantic Herring (*Clupea harengus*) exposed to an oil-polluted *Calanus finmarchicus* diet.” This ambitious project is led by Sonnich Meier, a researcher in the environment and water quality group at the Institute of Marine Research (IMR) in Bergen, Norway. There are many groups around the country cooperating in the project, including those of us working on fish larvae at the University of Bergen ([www.uib.no/rg/fea](http://www.uib.no/rg/fea)). This project is based on the scenario of an oil spill in the Barents Sea, and the exposure of herring through consumption of contaminated zooplankton. Herring have been maintained in large tanks and fed with pellets produced from *Calanus*, with oil additives. After one failed attempt in early 2008, we finally established healthy populations, showing good feeding behaviour and successful uptake of oil compounds. We thought that we had autumn-spawning herring, and then winter-spawning herring, and now finally, it appears that they are really Norwegian Spring Spawning herring after all! These fish have finally read the proposal and have agreed to mature and produce viable gametes. We have begun our first offspring experiment, examining the effects on hatching, larval size, and feeding behaviour. Our hypothesis is that eggs with more yolk may deliver higher exposures to developing larvae and thus compromise any advantage of larger eggs for larval survival.

The University of Bergen is hosting a summer school on Nursery Ground Ecology in August

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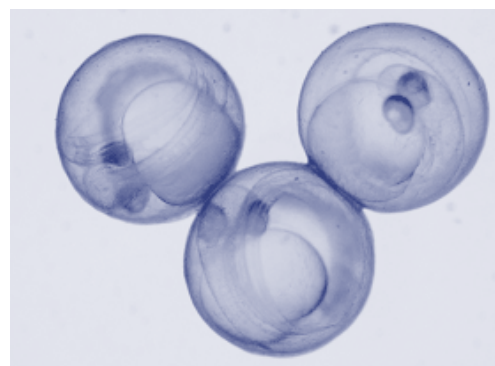
## Pacific Rim Region

**Iain Suthers**

*From: Greg Jenkins, Melbourne, Australia*

The University of Melbourne and the Marine and Freshwater Fisheries Research Institute, Queenscliff, have recently received a grant from the Australian Research Council to study the dispersal, growth, and mortality of pink snapper, *Pagrus auratus*, larvae. The work will be undertaken in Port Phillip Bay which is the primary spawning area for snapper in Victorian waters. Monitoring of larval snapper over the past 4 years indicates that the high recruitment variability seen in this species is set at a very early stage, around the time of first feeding. The new project will investigate the dispersal, feeding, growth, and mortality of larvae. A detailed, 3-dimensional hydrodynamic model is already in place and has recently been augmented with a primary productivity module. This hydrodynamic model will form the basis of a biophysical model that will allow predictions of recruitment to be made based on climate and productivity and compared with actual recruitment. Climate change scenarios for Port Phillip Bay will be modelled to provide medium-term predictions in relation to recruitment trends. Further information is available from Greg Jenkins or Steve Swearer.

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*Herring eggs, fertilized in February 2009. Adult fish were transferred from the wild to large indoor tanks in August 2008 at the Matre Research Station (IMR). The adults were fed with oil-contaminated pellets of *Calanus* to mimic the scenario of an oil accident in the Barents Sea. Gonad maturation has progressed under all treatments, and the effects of exposure on offspring quality are currently being studied at the University of Bergen (Photo by E. Perez-Solheim).*



*At the ICES Annual Science Conference in Halifax NS in September 2008, Elizabeth North and Mark Dickey-Collas prepare to transfer the flag from the Kiel Larval Fish Conference from the “old world” to the “new.”*



Pacific Rim...cont'd from p. 4

From: Lynnath Beckley, Murdoch University, Perth, Australia

Larval fishes of the Leeuwin Current and its associated meso-scale features are still the focus of Lynnath Beckley's lab at Murdoch University in Western Australia. PhD student, David Holliday, is writing up his thesis on cross-shelf transport of larval fishes induced by Leeuwin Current eddies. This study is based on extensive sea time spent during the evolution of an eddy and used repeated sampling with a multiple opening and closing EZ net to examine the mixing and transport processes.

Identification of larval fish material collected during a four-week cruise in May/June 2007 off the west coast of Australia, which covered the area from Cape Leeuwin 34°S to North West Cape 22°S, is progressing well and preliminary analyses have been completed. This study is part of the first comprehensive latitudinal study of the biological oceanography of the Leeuwin Current and we have been able to study both alongshore and cross shelf connectivity between larval fish assemblages over nearly 1,400 km of coastline. Honours student Natalie Millar is analysing larval fish data from the northern part of the study area and David Holliday is including the southern latitudes in his PhD as a comparison with the eddy field of the previous year.

Dr M. Pilar Olivar of the Marine Science Institute in Barcelona paid another visit to Western Australia in 2008 to assist with identification of the many myctophid larvae from the Leeuwin Current. Building on her earlier work in the Agulhas Current with Lynnath Beckley, she is now developing a comprehensive understanding of the early life history stages of these meso-pelagic fishes in both poleward flowing boundary currents of the South Indian Ocean.

A new project in collaboration with the Western Australian Department of Fisheries has been started in 2009. It focuses on the ichthyoplankton associated with spawning aggregations of the seabream *Pagrus auratus* (Sparidae) in coastal embayments near Perth. Honours student Nick Breheny is examining the larval fish assemblages and associated hydrographic retention mechanisms.

The Indo-Pacific Fish Conference is being held in Fremantle, Western Australia at the end of May 2009 and we are looking forward to welcoming international larval fish researchers to our home port.



## Southern Region

Claire Paris

Claire Paris' Physical-Biological Interactions (PBI) lab in the Division of Applied Marine Physics ([www.rsmas.miami.edu/divs/amp](http://www.rsmas.miami.edu/divs/amp)), Rosenstiel School of Marine and Atmospheric Science (RSMAS) opens new opportunities of interdisciplinary research, bringing together disciplines as contrasting as larval ecology and ocean acoustics and optics, coastal dynamics and turbulence, and numerical modeling techniques. The PBI lab is currently involved in several lines of research encompassing the continuous development of a coupled physical-biological and individual-based modeling system for larval dispersion, migration, and population connectivity. This Connectivity Modeling System (CMS), designed with the high performance computing expertise of Ashwanth Srinivasan from the Center for Computational Science, University of Miami, is intended to become an open-source community biophysical code with on-the-fly data assimilation and nesting capabilities between coastal regional models and ocean circulation models while tracking individual larval trajectories ([www.rsmas.miami.edu/personal/cparis/cms/description.html](http://www.rsmas.miami.edu/personal/cparis/cms/description.html)). Numerical modeling is also used to gain a mechanistic understanding of biophysical processes, predict larval patchiness and transport, and investigate the formation of genetic structure in marine populations. Examples of the wide use of the biophysical larval dispersal model can be found in 11 abstracts of the 11<sup>th</sup> International Coral Reef Symposium, July 7-11, 2008 (Mini-Symposiums of Reef Connectivity, Progress in Understanding the Hydrodynamics of Coral Reef Systems, and Reef Management). Biophysical modeling in Paris' lab is currently funded by NSF-OCE through a study of larval linkages of coral reef fishes along the Florida Keys with colleagues Su Sponaugle (PI), Robert Cowen, and Villy Kourafalou from RSMAS, and Collaborative Research with Howard Lasker at the University of Buffalo to investigate the recruitment dynamics and population connectivity of Bahamian octocorals.

Another line of research is focussing on fish larval behavior using new concepts for in-situ monitoring of individual larvae or a group of larvae as they interact with environmental cues. The innovative research tool, a drifting behavioral arena equipped with a camera and environmental sensing

system, was designed by Claire Paris with the help of Senior Research Associate Cedric Guigand through an NSF Small Grant for Exploratory Research. The device is deployed at sea and drifts while the larval movement is recorded together with the surrounding conditions (see photo). This allows researchers to observe larva(e) in

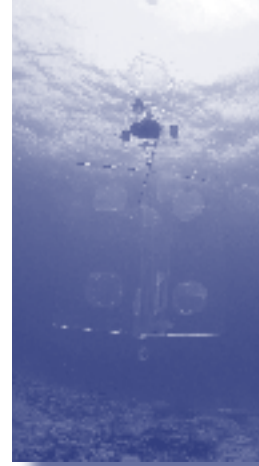


Photo by M. Kingsford.

open waters, day and night, and manipulate signals in a semi-natural environment. Field work has been supported so far by several overseas sources such as a series of fellowships from the Australian Museum, a research grant from The Hermon Slade Foundation in collaboration with Jeff Leis from the Australian Museum, and by Mike Kingsford's Reef and Ocean Ecology Laboratory at James Cook University, with colleagues Gabriele Gerlach, a geneticist at Odenburg University, and Jelle Atema, a sensory biologist from Boston University. Two summer seasons of field work have been completed at the Lizard Island Research Station on the Great barrier Reef (GBR) to compare Paris' drifting device with Leis' visual following methods on two species of damselfish larvae (*Pomacentrus lepidogenys* and *Chromis atripectoralis*). Results will be presented at the 8<sup>th</sup> Indo Pacific Fish Conference, 31 May-5 June 2009, and at the 33<sup>rd</sup> Annual Larval Fish Conference, 22-27 July 2009. This February 2009, a newer version of the instrument was tested at One Tree Island, a small reef in the Capricorn/Bunker group of the southern GBR. There, the goal was to investigate the behavior of larval fish when embedded in turbidity plumes that leak reef odor to the ocean during ebb tides. This study is a follow-up of the wonderful findings by Gerlach et al. (2007) that settling larvae can recognize the smell of the natal reef.

Jean-Olivier Irisson (co-Advised by Serge Planes, University of Perpignan, Claire Paris) recently defended his dissertation in June of 2008 on "Behavioral approach to larval dispersal in marine systems," where he evaluated the impact of larval behavior of coral reef fishes, which sensory and swimming capabilities are particularly high. A series of approaches, from experimental to oceanographic campaigns and novel modeling framework were utilized to quantify fish larval swimming behavior and orientation, the ontogeny of fish larval

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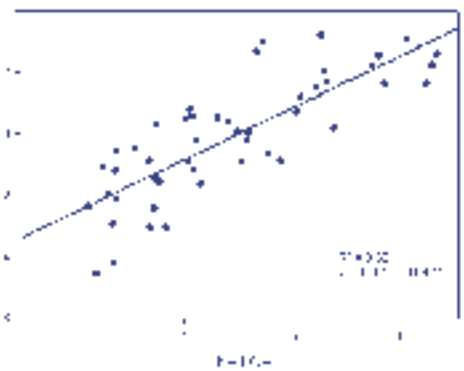


Figure 1. Relationship between tank mean RNA:DNA and instantaneous growth (g) in juvenile Atlantic menhaden

#### Northeast Region...cont'd from p. 2

collected from fishery-independent surveys in the Chesapeake and Delaware Bays. By determining the product of RNA:DNA-based measures of individual growth and abundance estimates, habitat-specific production from these areas can be quantified. Spatial and temporal patterns of the variability in relative nursery habitat productivity can then be examined. Identifying the sources, patterns, and consequences of this variability in production will allow us to more fully understand variability in annual recruitments in Atlantic menhaden.

#### From: Northeast Fisheries Science Center

The Oceanography Branch at the Northeast Fisheries Science Center continues working on various aspects of the early life stages of fishes. Larval fish researchers in the Branch include Betsy Broughton, Jon Hare, Greg Lough, Katey Marancik, and David Richardson.

Long term monitoring of zooplankton and ichthyoplankton on the northeast U.S. shelf continues. Funding for the ichthyoplankton part of the monitoring program has been limited, but we continue to make progress in developing the long term data set. David Richardson started as a National Research

Council post-doc from Rosenstiel School of Marine and Atmospheric Sciences (RSMAS). He is developing a larval index of Atlantic herring for use in the stock assessment. This will be the first such application of early life stage information in the northeast region. Dave has also been looking at changes in the distribution of larvae over the time series.

Katey Marancik is working primarily with Joanne Lyczkowski-Shultz at the Southeast Fisheries Science Center on larval identification associated with the SEAMAP program. Katey and Dave and a several other co-authors recently submitted a paper contributing to the identification of larval grouper in the southeast based on traditional analyses of the SEAMAP samples and larvae identified using cytochrome oxidase I. Katey is also spending some time on larval identification of material from the northeast.

Jon Hare is working with Bob Cowen (RSMAS) on a project to evaluate the In Situ Ichthyoplankton Imaging System in fisheries applications. ISIIS is a system that images approximately 140 L s<sup>-1</sup>. They deployed ISIIS in October south of Block Island Sound. Bob's group is working on the image analysis, and the image data will be compared with net-tow data that were collected at the same time. The purpose is to evaluate ISIIS in quantifying the abundance of common larval fishes and if successful, the data could be used in the stock-assessment process.

Jon has also been working to link fish population models with climate models. Building from the work with Ken Able (Rutgers University) examining recruitment processes in Atlantic croaker, Jon and several co-authors have coupled a mechanistic recruitment hypothesis to a population model and then linked this model to the output of global climate models to forecast changes in the croaker population over the next century. This work has been submitted for publication.

Greg Lough continues to collaborate with Trond Christiansen, our GLOBEC 4b Norwegian postdoc, on coupled biological-physical models of larval fishes that have become a widely-used tool for studying recruitment variability. A behavioral foraging component based on prey size and behavior was added to the larval cod biophysical model (IBM) to provide a more dynamic approach for investigating larval fish ecology. The IBM includes a bioenergetics component for incorporating metabolic parameters and growth, and a mechanistic prey selection component that depends on larval development and behavior, prey size and behavior, depth, light and physical oceanographic conditions. Simulations

indicate that the copepod *Pseudocalanus* is the preferred prey species for larval cod on Georges Bank because of their abundance and large image area. Several papers have been submitted to journals and are in revision.

Betsy Broughton continues to work with Greg and they are using the Video Plankton Recorder to provide detailed data on the prey field of larval fishes in the Georges Bank region. This work has led to several publications (Lough and Broughton 2007 Development of micro-scale frequency distributions of plankton for inclusion in foraging models of larval fish, results from a video plankton recorder. *Journal of Plankton Research* 29: 7-17; Broughton and Lough 2006 A direct comparison of MOCNESS and video plankton recorder zooplankton abundance estimates: Possible applications for augmenting net sampling with video systems *Deep Sea Research Part II: Topical Studies in Oceanography* 53: 2789-2807). Several other manuscripts have been submitted or are in preparation.

Greg Lough also is working with Colleen Petrik, a WHOI PhD student, to develop a haddock foraging and growth models which will be implemented in 3-D coupled biophysical IBM's of larval haddock on Georges Bank. These models are the first to describe haddock and cod foraging with different species-specific prey behaviors. Using Chesson's preference index as a measure, both larval haddock and cod demonstrated positive selection of *Pseudocalanus* and negative selection of *Calanus finmarchicus*, with differences in escape abilities affecting selection more than encounter rate.

There are a number of other activities going on with collaborators and students. Please contact Jon Hare (jon.hare@noaa.gov) or specific individuals for more information. §

#### North Central Region...cont'd from p. 2

on adult fish use of the area by native fishes such as walleye, lake sturgeon, and lake whitefish and suitable hydrologic and substrate conditions. Initial assessment of the Fighting Island reef for use by spawning fish began in fall 2008 and will continue in 2009. The scientists will use egg mats to assess spawning activity and egg viability on the newly constructed reef.

A second objective of the assessment work in the Detroit River is examination of larval fish distributions and transport in the river and into western Lake Erie. From 2006 through 2008, sampling effort focused on assessing river-wide distributions of fish larvae and their spatial distribution upon entering western Lake Erie. Dr. Ed Roseman and his team identified presence of eighteen

...continued on p. 7



**North Central Region...cont'd from p. 6**

native and four nonindigenous species in the river. This includes larvae of deepwater sculpin and burbot that likely drifted down from Lake Huron. Results also suggest that the level of spawning and production of native fishes in the Detroit River system is greater than previously thought. 2009 will mark the fourth consecutive year of larval fish sampling in the Detroit River when efforts will focus on quantifying habitat connectivity and use of riparian wetlands by larvae and juveniles.

Ed also continues to lead a project examining larval fish ecology in northern Lake Huron with an emphasis on rainbow smelt ecology and recruitment. Tim O'Brien, a fisheries technician at the GLSC and master's candidate at Michigan State University is working with Ed and Dr. Bill Taylor from Michigan State University to assess the importance of the larval stage to rainbow smelt recruitment in northern Lake Huron. Larval fish collections were made in 2008 at nearshore areas adjacent to tributaries used by spawning rainbow smelt. Preliminary examination of catch results suggest that the 2008 rainbow smelt year class was small compared with previous year classes. The small rainbow smelt year class was expressed in GLSC's fall bottom trawl survey where few age-0 smelt were collected.

Recent behavioral studies of salmonine alevins suggest that sublethal, long term effects (concerning both prey capture and predator avoidance) are associated with low levels of thiamine. An examination of altered brain histomorphology between thiamine replete and depleted alevins may provide a possible explanation for this altered behavior. The objective of this study is to develop a method to quantify morphological differences of the brain between thiamine-deficient and thiamine-replete swim up lake trout. 3-D models of alevin lake trout brains are generated using plastic embedded, serial sections that permit high-resolution analysis. The models are constructed

using IMOD® freeware with 1-micron-thick sections, taken every 10 microns. These 3-D models can then be examined to estimate volumetric and morphological relationships between the two groups of lake trout. 3-D reconstructions may also be applied to specific organs of other larval species to approach various questions, including the effects of contaminants.

Recent ELH publications from scientists at the GLSC include:

Zhao, Y., M.L. Jones, B.J. Shuter, and E.F. Roseman. 2009. A biophysical model of Lake Erie walleye explains inter-annual variations in recruitment. *Canadian Journal of Fisheries and Aquatic Sciences* 66:114-125.

Roseman, E.F., W. Stott, T.P. O'Brien, S.C. Riley, and J.S. Schaeffer. in press. Heritage strain and diet of wild young of year and yearling lake trout in the main basin of Lake Huron. *Journal of Great Lakes Research*.

More information on these projects and others can be found on the USGS Great Lakes Science Center's web page: [www.glsc.usgs.gov](http://www.glsc.usgs.gov).

### **From: Southern Illinois University – Carbondale**

A multi-tiered study examining the early life history of *Scaphirhynchus* sturgeon is being undertaken at Southern Illinois University. Specifically, Dawn Sechler is quantifying diets of young-of-year (YOY) sturgeon (total length (TL) range: 15-200 mm). One-way ANOVA ( $p=0.0946$ ) suggests that season does not influence foraging behavior ( $p=0.0007$ ), macrohabitat does influence foraging behavior, ( $p=0.0003$ ) and total length of sturgeon influences foraging behavior.

Quinton Phelps is currently investigating YOY *Scaphirhynchus* sturgeon habitat use and early life dynamics in the Middle Mississippi River. Overall, this research suggests that specific habitat features in

the Middle Mississippi River are important for YOY sturgeon. Additionally, Quinton has determined that a potential bottleneck may occur during the early life stages which may be regulated by abiotic factors. He is also actively using pectoral fin ray microchemistry to analyze origin of YOY *Scaphirhynchus* sturgeon. Quinton analyzed fin rays from

YOY sturgeon from the Missouri River and the Mississippi River using LA-ICMPS. The cross-sectional Sr:Ca concentrations of the rays for fish from each location differed, suggesting that river-specific signatures exist. Furthermore, he found virtually no variation in the concentrations of Sr:Ca among the Mississippi River fish. Statistically, this suggests that the Mississippi sturgeon spent a long time in the Mississippi River. Quinton will continue to look at variation among sturgeon at different sizes and years. He also will explore whether location (upriver in the MMR near the Missouri versus downriver MMR) influences Sr:Ca ratios.

Ryan Boley is investigating the frequencies of larval pallid sturgeon to larval shovelnose sturgeon, and possibly hybrids in the Middle Mississippi and Missouri Rivers. He has found 1 larval pallid sturgeon, 401 shovelnose sturgeon, and 21 hybrids. Ultimately these early life history studies will provide new information to assist scientists and managers in sustaining the *Scaphirhynchus* sturgeon populations of the Mississippi and Missouri Rivers.

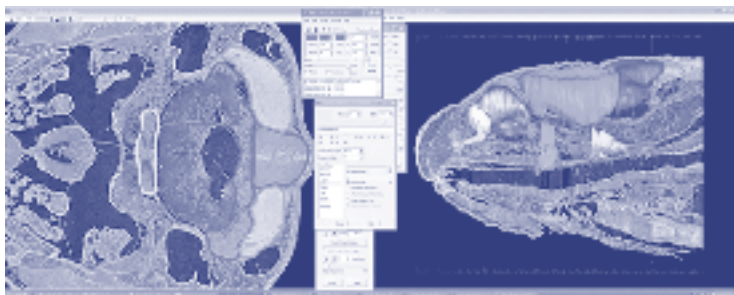
### **From: University of Michigan Larval Fish of the Great Lakes Abyss**

Relatively little is known about fish spawning and larval fish ecology in the abyssal regions of the Great Lakes compared with the knowledge base for fishes inhabiting warmer, shallower habitats. Larval fishes were collected while conducting surface ichthyoplankton net tows and vertical net tows of the entire water column during April and August 2007 and 2008 in association with the U.S. EPA Biological Monitoring Program on all five Great Lakes. We have identified larval burbot, deepwater sculpin, lake whitefish, rainbow smelt, bloater, and alewife, and we are in the process of aging them and performing diet analyses to better elucidate their origins, diets, and prey preferences, since we have concurrent zooplankton collections for comparison.

### **Recruitment Bottlenecks for Walleye in the Muskegon River Estuary, Lake Michigan**

The walleye population of eastern Lake Michigan and Muskegon Lake was historically supported almost entirely by fish spawned in the Muskegon River Estuary system. This population crashed in the 1960s, and stocking efforts using hatchery-raised YOY stocked directly into Muskegon Lake have been employed to rehabilitate the population since the late 1970s. This has created a put-and-take walleye fishery in Muskegon Lake. Nearly 50,000 adult walleyes migrate approximately 80 river-

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Screen capture from IMOD® software showing the 3-D model reconstruction of transverse serial sections from a lake trout alevin. (IMOD® 1994-2007, Boulder Laboratory for 3-Dimensional Electron Microscopy of Cells and the Regents of the University of Colorado. <http://bio3d.colorado.edu/imod/index.html>.)



## Upcoming Events

### 33<sup>rd</sup> Larval Fish Conference

Greetings friends! We are glad to invite you to the 33<sup>rd</sup> annual Larval Fish Conference (LFC) to be held in conjunction with the Joint Meeting of Ichthyologists and Herpetologists (JMIH) this July 22 – 27 in Portland, Oregon. The meeting will be held at the Hilton Portland & Executive Tower in the center of downtown Portland. The LFC has met several times before (e.g., Seattle 1997, Austin 1993) with the group of sponsoring societies of the JMIH – the American Society of Ichthyologists & Herpetologists, Society for the Study of Amphibians & Reptiles, The Herpetologists League, and the American Elasmobranch Society – and we look forward again to the synergism afforded by this opportunity. Here we want to briefly describe our plans for this very special LFC.

**OVERVIEW.** The LFC will begin Thursday afternoon, 7/23, and end with the Joint Banquet on the evening of Monday, 7/27. Other JMIH events precede the LFC and attendees should check the 'Daily Meetings/Schedules' on the JMIH website ([www.dce.k-state.edu/conf/jointmeeting](http://www.dce.k-state.edu/conf/jointmeeting)). All of the LFC contributed papers, theme sessions, and workshop will be held in our own room at the Hilton. Our poster session will be concurrent with that of the JMIH. All oral presentations and posters will follow JMIH guidelines.

**PRESENTATION SCHEDULE.** After the first morning's JMIH plenary (7/23), the LFC will kick-off in the afternoon with the first half of a workshop on 'Temperate-tropical differences in connectivity – real and perceived'. This workshop, hosted by Jeff Leis ([jeff.leis@austmus.gov.au](mailto:jeff.leis@austmus.gov.au)), Bob Warner ([warner@lifesci.ucsb.edu](mailto:warner@lifesci.ucsb.edu)), and Jenn Caselle ([caselle@msi.ucsb.edu](mailto:caselle@msi.ucsb.edu)), will continue through the morning of 7/24 and will feature over a dozen invited presentations by researchers who are actively engaged in this important research front. There will be two theme sessions. One will be associated with the population connectivity theme of the above-mentioned workshop and will be convened by the workshop hosts. The other theme session, 'Hypoxia and fish early-life stages', will be hosted by Lorenzo Ciannelli ([lcianelli@coas.oregonstate.edu](mailto:lcianelli@coas.oregonstate.edu)) and Denise Breitburg ([breitburgd@si.edu](mailto:breitburgd@si.edu)). Both theme sessions are open to oral contributions from the community at large from authors who wish their abstracts to be considered for either of these. Further details for workshop and theme sessions are on the websites for JMIH (above) and LFC, [www.larvalfishcon.org](http://www.larvalfishcon.org) (sidebar to 33<sup>rd</sup> LFC then to 'Theme Sessions').

**REGISTRATION AND ABSTRACT SUBMISSION.** All registration and abstract submission will be through the JMIH website. Note that ELHS members can register as a "Professional Society Member"

(fee of \$330 before 3/31) or a "Student Society Member" (early fee of \$230). The base registration charge does not include the LFC social (7/26), the JMIH reception (7/23) or the JMIH banquet (7/27); these can be added when you register online.

Abstract submission is thoroughly described in a pdf on the JMIH website.

Note that LFC contributors must check 'LFC' in Step 6 of the submission process in order for your paper or poster to be properly captured as an LFC contribution. Students who wish to be considered for best paper or poster – the Richardson and Blaxter awards, respectively – must select the appropriate choice in Step 7 of the abstract submission process. Additional details on the ELHS student awards can be found at the LFC website (sidebar to 33<sup>rd</sup> LFC then to the award of interest). Abstracts are due March 31.

**SOCIALS.** The ELHS / LFC attendees will have their own social on Sunday evening, 7/26, which will be a separate ticketed event (please add this LFC Social when you register online so that we can plan accordingly). The LFC Flag auction, with funds directed towards the Blaxter student poster endowment, will occur at this social. Plan on attending this special ELHS / LFC function. We are also welcome to participate in the JMIH reception on the first evening (7/23) and the joint banquet on the last (7/27); each is a separate ticketed event. Note that the ELHS awards – Richardson best student paper, Blaxter best student poster, and the Ahlstrom Career Achievement awards – will be presented at the JMIH joint banquet.

**RAFFLE.** Items for the ELHS / LFC raffle, in support of the Sally Richardson Award endowment, will be on display throughout the LFC. Please contact Doug Markle ([douglas.markle@oregonstate.edu](mailto:douglas.markle@oregonstate.edu)) and let him know what you plan on bringing and if you need to ship your raffle item(s).

**ACCOMODATIONS.** The most convenient accommodations for the meeting are at the Hilton Portland & Executive Tower. There are many other hotels nearby ([www.allgetaways.com/hotels/hotel-city.asp?state=OR&city=Portland](http://www.allgetaways.com/hotels/hotel-city.asp?state=OR&city=Portland)) and most have rates similar to the Hilton. Better values can be found further from the city center.

**BEFORE AND AFTER.** Why not take advantage of your visit to Portland to vacation in one of our country's most beautiful playgrounds. Urban or rural, mountains or ocean – we have it all. Please check the JMIH website for suggestions.

Looking forward to seeing you in Portland!

— The LFC 2009 Local Committee  
(contact: Doug Markle [douglas.markle@oregonstate.edu](mailto:douglas.markle@oregonstate.edu))

### 32<sup>nd</sup> Larval Fish Conference Publication Status

The editors for the publication marking the LFC 2008 received 27 manuscripts for consideration. The final product will appear in a special issue of *Scientia Marina*. Contributions were quite international in flavor (e.g., USA, Canada, Germany, Spain, Israel, Norway, Egypt). Revised contributions are due back from authors by mid-April, and the journal is expected to go to press shortly thereafter. Free copies of the special issue will be distributed to conference participants within the next 9

months. The editors are excited about the issue and would like to thank all of the reviewers for their time and effort!

**THIS WILL BE YOUR  
LAST ISSUE OF STAGES...**  
unless you've paid your 2009 dues.  
Check the expiration date on the  
mailing label of this issue.

### Southern Region...cont'd from p. 5

vertical migration, and self-recruitment. In a final chapter, cost minimization techniques allowed to integrate larval behavior and Lagrangian models of larval dispersal. Ichthyoplankton sampling (576 MOCNESS samples, yielding 47,800 fish larvae, >10,000 reef fish larvae) was carried out around the small atoll of Tetiaroa in the Society archipelago, French Polynesia. Work has been presented at the ASLO 2009 Aquatic Sciences Meeting in Nice and submitted for publication. Irisson is now a two-year postdoctoral Fellow in Paris' lab. §



**Available now: *Early Life History of Marine Fishes***

By Bruce S. Miller & Arthur W. Kendall, Jr.

Published by University of California Press. 2009.

The life cycles of fishes are complex and varied, and knowledge of the early life stages is important for understanding the biology, ecology, and evolution of fishes. In *Early Life History of Marine Fishes*, Bruce S. Miller and

Arthur W. Kendall Jr., bring together in a single reference much of the research available and its application to fishery science — knowledge increasingly important because, for most fishes, adult populations are determined at the earliest stages of life. Clear and well written, this book offers expert guidance on how to collect and analyze larval fish data and on how this information is interpreted by applied fish biologists and fisheries managers.

Available at [www.ucpress.edu/books/pages/9317.php](http://www.ucpress.edu/books/pages/9317.php) with a 20% discount. §

## Other Recent Publications of Interest

*Early Stages of Fishes in the Western North Atlantic Ocean: Davis Strait, Southern Greenland and Flemish Cap to Cape Hatteras.* Michael P. Fahay. Published by North Atlantic Fisheries Organization.

*Early Development of Four Cyprinids Native to the Yangtze River, China.* Edited by D.C. Chapman. U.S. Geological Survey Data Series 239. 2006. accessible online at [pubs.usgs.gov/ds/2006/239](http://pubs.usgs.gov/ds/2006/239)

*Recent Advances in the Study of Fish Eggs and Larvae.* Edited by M.P. Olivar and J.J. Govoni. Published in *Scientia Marina*, Volume 70S2 Supplement 2. ISSN: 0214-8358. 2006.

*Eggs and Larvae of North Sea Fishes.* P. Munk and J.G. Nielsen. Published by Biofolia Press. ISBN 0849319161. 2005.

*Early Stages of Atlantic Fishes: An Identification Guide for the Western Central North Atlantic.* Edited by W.J. Richards. Published by CRC Press. ISBN 0849319161. 2005.

*Developmental Biology of Teleost Fishes.* Y.W. Kunz. Published by Springer Press. ISBN 1-4020-2996-9. 2004.

*Early Life History of Fishes in the San Francisco Estuary and Watershed.* Edited by F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi. Published by the American Fisheries Society. ISBN 1-888569-59-X. 2004.

*Freshwater Fishes of the Northeastern United States - A Field Guide.* R.G. Werner. Published by Syracuse University Press. ISBN 0815630204. 2004.

*The Development of Form and Function in Fishes and the Question of Larval Adaptation.* Edited by J.J. Govoni. Published by the American Fisheries Society. ISBN 1-888569-58-1. 2004.

*The Larvae of Indo-Pacific Coastal Fishes: An Identification Guide to Marine Fish Larvae.* (2<sup>nd</sup> edition). J.M. Leis and B.M. Carson-Ewart. Published by Brill Academic Publishers. ISBN 90-04-13650-9. 2004.



**Available now: *Fish Larval Physiology***

By Roderick Nigel Finn & B.G. Kapoor

Published by Science Publishers. 2008.

This book specifically addresses the larval stages of fish, and is intended as a resource for students and researchers interested in physiology, developmental biology, fisheries science and aquaculture. It is the first basic physiological textbook

to deal with the earliest stages of this important and diverse group of vertebrates. The text provides detailed mechanistic information on emerging genomic models, but is also broad with physiological processes described for more than 270 species from the cold dark depths of the oceans to the highly caustic environments of alkaline lakes. It is written by 38 international experts in their fields, and is divided into 20 chapters within 7 sections. The book aims at providing a single-volume treatise that explains how fish larvae develop and differentiate, how they regulate salt, water and acid-base balance, how they transport and exchange gases, acquire and utilise energy, how they sense their environment, and move in their aquatic medium, how they control and defend themselves, and finally how they grow up.

The book contains 7 parts: Ontogeny; Respiration & Homeostasis; Nutrition & Energy; Sensory Physiology; Movement; Control and Defense; Functional Changes in Form. Each of these contains several chapters. §

## Early Larval Fish Conference Proceedings Available Online

The ELHS-funded project to digitize the proceedings of the first five annual Larval Fish Conferences has been completed. Lee Fuiman arranged for The University of Texas Libraries to create searchable PDF files of the five conference proceedings from his personal copies of those documents. The University of Texas Libraries has now made those documents available to everyone through its Digital Repository at [repositories.lib.utexas.edu/handle/2152/6](http://repositories.lib.utexas.edu/handle/2152/6).

Bookmark this site now so that you can access the early conference proceedings when you need them. The files are also available on the ELHS website: [www.elhs.cmast.ncsu.edu](http://www.elhs.cmast.ncsu.edu). §

*The Big Fish Bang. Proceedings of the 26<sup>th</sup> Annual Larval Fish Conference.* Edited by H.I. Browman and A.B. Skiftesvik. Published by the Institute of Marine Research, Bergen, Norway. ISBN 82-7461-059-8. 2004.

*Reproductive Biology and Early Life History of Fishes in the Ohio River Drainage: Ictaluridae - Catfish and Madtoms, Volume III.* T.P. Simon and R. Wallus. Published by CRC Press. ISBN 0849319196. 2003.

*Fishery Science: The Unique Contributions of Early Life Stages.* Edited by Lee A. Fuiman and Robert G. Werner. Published by Blackwell Publishing. ISBN 0-632-05661-4. 2002. §



*President's message...cont'd from p. 1*

follow. An annotated list of all appropriations in the Act is also available<sup>4</sup>. Below are some highlights that are of particular relevance to ELS researchers.

- A primary item is a \$3-billion addition to the National Science Foundation budget. Much of this funding (\$2.5 billion) is slated for research, with the remainder going to large equipment, facilities and education. Most of the stimulus funds need to be "spent" by September 30, 2010, so now would be a good time to submit a proposal to NSF.
- Other items of interest include \$400 million to NASA and \$230 million to NOAA for climate research, \$650 million for remediation and restoration efforts including projects related to fish habitat, \$280 million for wildlife refuge and fish hatchery construction and maintenance, and a host of funding lines for flood control and watershed rehabilitation. It is not clear how this funding will be dispersed, but if you are interested, now is the time to contact your favorite federal agency or congressional representative.
- In addition to funding R&D-related topics, the Act provides \$53 billion in a state stabilization fund, which includes support for primary, secondary and post-secondary education. The support for higher education is meant to mitigate the need of public universities to raise tuition and fees. This should mitigate the budgetary pressures on public universities over the next year and half.

In addition to the American Recovery and Reinvestment Act, Fiscal Year 2009 appropriations have not been completed. The U.S. federal government runs on annual appropriations with a fiscal year from 1 October to 30 September. For FY09, like most other fiscal years, the appropriation bills have not yet been passed and the government has been running on a continuing resolution that expires March 6, 2009. This continuing resolution keeps spending at or below FY08 levels. Congress is expected to start work on an FY09 Omnibus budget bill now that they have finished the stimulus package, which will contain funding for all federal agencies, except Defense, Homeland Security, and the Veterans Administration whose budgets were passed in September. AAAS provides a good summary of the appropriations process relative to R&D<sup>2</sup>. Many federally funded programs are dependent on these annual appropriations so we must wait and see what the complete outlook is for 2009. That said, 2009 and 2010 are shaping up to be banner years for science funding in the U.S.

Research Needs - Information developed by research is usually classified into two broad categories: basic and applied. In ELS studies, these two categories are often tightly coupled – basic information about fish biology and ecology immediately can be used to improve aquaculture and sustainable management. Aquaculture research is closely tied to improving yields from culture either for food or for hobbyists. There continues to be a need to improve the culture of fishery, research, and ornamental species, which requires both basic and applied research.

A lot of ELS research is cast as contributing to sustainable management. However, much of this work is ultimately not used in stock assessments or management advice. That said, there is a growing appreciation for the use of ELS studies in stock identification, estimation of spawning-stock biomass, development of recruitment forecasts, and defining habitat needs and bottlenecks. Although ELS information can be used, we need to make more of an effort to see that ELS information is used in assessments and management advice.

An exciting opportunity for ELS research involves application to Ecosystem-Based Management (EBM). Some have claimed that EBM is ill-defined and too complex. In one sense it is. Single-species management has a 40+-year history and the process is well defined. In contrast, efforts to implement EBM are relatively new so the processes are simply not as well defined. Also, treating interactions among ecosystem components is by definition more complex than treating components in isolation. The basic elements of EBM have been outlined and there is clearly a role for ELS studies. There are many "definitions" for EBM, but Wikipedia provides a convenient start.

"Ecosystem-based management ... looks at all the links among living and nonliving resources within an ecosystem, rather than considering single issues in isolation. ... This system of management considers human activities, their benefits, and their potential impacts within the context of the broader biological and physical environment. Instead of developing a management plan for one issue ..., ecosystem-based management focuses on the multiple activities occurring within specific areas that are defined by ecosystem, rather than political boundaries. Because of the connection between land-based activities and ocean conditions, an appropriate geographic boundary for ecosystem-based management of ocean areas might combine all or part of a large marine ecosystem with the basins [watersheds] that drain into it."<sup>5</sup>

This definition provides insight for the role of ELS information. First, the approach examines links between living and non-living resources – for example between fisheries and energy. Energy-issues have come to the forefront, with offshore drilling on the table for much of the U.S. continental shelf, proposals for liquefied natural gas terminals that use heat from the ocean to convert liquid to gas, large-scale wind projects well along the path to construction, and wave and current energy projects not far behind. These energy-related activities will have effects on fish populations through ELS, but the techniques for assessing these effects and for assessing their cumulative impacts need to be updated and applied.

Second, ELS provide a tool for tracking fish and invertebrate biodiversity. One of the goals of EBM is to maintain biodiversity and since most marine species have pelagic ELS, sampling these stages can provide a more comprehensive view of biodiversity than sampling adult stages in discrete habitats. This builds on the use of ELS as a measure of spawning-stock biomass, but applies the idea to all species with pelagic stages in a given region. To completely assess biodiversity using ELS will require additional taxonomic work using both with traditional and newer (e.g., genetics) techniques. There have been several studies using ELS in assessing biodiversity, but the approach is still not widespread.

Third, ELS studies are critical to the design and implementation of Marine Protected Areas (MPAs) for fisheries and ecosystem-based objectives. One proposed benefit of MPAs is to serve as a spawning source from which ELS can be dispersed and recruit to non-protected areas. In this role, an understanding of where pelagic stages go and what happens to them is needed. Further, the fate of pelagic stages is often species and location specific, which equates to a tremendous research need.

Finally, EBM requires an understanding of the connection between life stages and habitats. Activities in one habitat can affect an exploited stage in another habitat. The classic example is marine fishes with estuarine juvenile habitats. Activities that affect juvenile habitat quality (e.g., coastal development, removal of water for cooling power plants, pollution) can affect adult populations. There are other examples. Anadromous species are affected by dams, river flow, pollution, deforestation, and by-catch. Marine species are affected by energy activities, land-based eutrophication, and hypoxia. To assess these effects and to contribute to EBM, we need to take a whole life cycle approach and evaluate the anthropogenic and natural factors

<sup>4</sup> [online.wsj.com/article/SB123458384689487271.html](http://online.wsj.com/article/SB123458384689487271.html)

<sup>5</sup> [en.wikipedia.org/wiki/Ecosystem-based\\_management](http://en.wikipedia.org/wiki/Ecosystem-based_management)

*President's message...cont'd from p. 10*

influencing the distribution, abundance, growth, mortality, survival and ultimately production of different life stages in different habitats.

Clearly there is a need for ELS studies. I have focused on applied science for aquaculture, single species management and ecosystem-based management. I have emphasized applied science because funding follows need, particularly in environmental and natural resource sciences. Also, I have focused on applied aspects of ELS studies, because this is what I am most familiar with. With increased funding to NSF and NIH, there are also more opportunities for basic science questions related to ELS.

Scientists - The third leg of opportunity is scientists willing to pursue funding to fulfill research needs. Hopefully within our membership, the desire to study ELS is strong. My view is U.S.-centric, but my agenda is that we as members of the ELHS will work to have others understand the importance of and support ELS studies. This will come through basic and applied research that is viewed as valuable by those who make funding available to provide answers to important questions.

In conclusion, the economy is "troubled," but there are opportunities for funding and interesting and important research questions. Hopefully, as a group we can use available funding to address these questions and in so doing promote the goals of our section. I end where I started - *In the middle of every difficulty lies opportunity.* §

— Jon Hare, President

*European Region... cont'd from p. 4*

2009. The course will cover four modules: 1. Sampling and analytical methodology, 2. Nursery ground dynamics, 3. Manipulative experimentation, and 4. Fish nursery ground management. This is primarily designed for PhD students, and will include contributions from K. Able (North American perspective plus the use of tracking systems for behaviour), Howard Browman (fish behaviour), Mike Burrows (Statistical modeling, modeling and behaviour – primarily flatfishes), Audrey Geffen (otolith techniques, larval and juvenile fish ecology), Geir Huse (oceanographic supply to nursery areas), Hans Høie (otolith techniques), Arne Johannessen (fish biology, ecology and field sampling), Richard Nash (Course coordinator, nursery ground ecology), Leif Pihl (Swedish flatfish and shallow water gadoid nursery grounds), Torstein Pedersen (predator and prey relationships), Josianne Støttrup (restocking programmes), and Henk van der Veer (flatfish nursery grounds

*New officers...cont'd from p. 1*

ecological requirements. Current projects include evaluation of life-history variation in steelhead trout among Central Valley and central coast populations in California, essential fish habitat for newly settled juvenile rockfish, and maternal effects on reproductive strategies in rockfish. She received her M.Sc. degree from the University of Miami and her Ph.D. from Rutgers University.

Catriona has participated in a number of Larval Fish Conferences dating back to 1992. She most recently organized the 32<sup>nd</sup> annual Larval Fish Conference in Kiel in August 2008. Catriona is currently a research Fishery Biologist at the Leibniz Institute of Marine Science in Kiel, Germany where she is in charge of several projects dealing with the effects of climate driven changes on the early life stages of fishes and recruitment success. Her job also involves teaching at the M.Sc. and Ph.D. level and focuses on: i) biological and physical processes that drive the dynamics of early life stages of fishes, and ii) analysis of spatial and temporal variability due to, for example, climate change and ocean acidification. She is a specialist in the field of biochemical indicators and otolith/statolith analysis to determine growth and nutritional condition of plankton organisms (larval fishes, juvenile fishes, zooplankton and cephalopods). She uses field, laboratory, and mesocosms methodologies in her analysis of nutritional condition and growth of fish larvae from the North Sea and Baltic Sea, but has also conducted work in the Indian Ocean and the Mediterranean Sea. Catriona is a member of the ICES working group on recruitment processes and has been involved in several international research projects within the European Union. She received her B.Sc. degree from the University of Washington in Seattle, USA, specializing on aquaculture of salmonids, her German diploma degree from the University of Kiel, and her Ph.D. from the University of Hamburg, Germany. In 2005, Catriona received a fellowship from and sampling, dynamic energy budgets).

The course is sponsored by the Nordic Marine Academy and more details are available at [armauer.uib.no/nma/default.asp?k=16&id=79&aid=82](http://armauer.uib.no/nma/default.asp?k=16&id=79&aid=82). "Nursery ground ecology: methods of study and analysis" 1 - 10 August, 2009. Espegrend Marine Biological Station near Bergen, Norway. Coordinated by Richard Nash.

And finally, I would like to encourage members in the European Region to send me (Audrey.geffen@bio.uib.no) news of early life history research from your institutes. Abstracts of projects and pictures are always welcome! §

the German Research Council and spent the following year at the Graduate School of Oceanography, Narragansett, Rhode Island, USA.

Thank you ladies for enthusiastically embracing this opportunity! Our Section is indebted to you. Thanks also to our other nominees for their willingness to serve.

ELHS voting demographics. The ballot was distributed on 2/02/09 via email to all individuals listed as full ELHS members (i.e., AFS and ELHS memberships). The listing used was one provided to me by AFS on 1/30/09. Voting remained open until 2/13/09. Of the 263 full members on the reference list at the time of mailing, 262 ballots were emailed (one was sent a ballot by post). We received responses (votes) from 71 members (27%).

A note about our elections. First, this is a volunteer-based society and we need all of your contributions! To see the responsibilities of each office on our Executive Committee (i.e., President, President-Elect, Secretary, Secretary-Elect, and Treasurer), and the listing of appointed and ad hoc committee memberships, please go to our Section website and browse the Section bylaws and rules under 'About ELHS' ([www.elhs.cmast.ncsu.edu](http://www.elhs.cmast.ncsu.edu)). Our five elected officers have voting rights on Executive Committee matters. Each officer serves for two years with the exception of a four-year term by our Treasurer. The Executive Committee meets at least annually at the LFC and communicates more frequently by emails and conference calls. Once again, we need your support and involvement, so step up! §

— Chris Chambers, Elections Committee Chair

*North Central Region...cont'd from p. 11*

km each year to spawn below Croton Dam, but the population is still not self-sustaining. Larval walleyes were collected in 2003-04 during May. Most of these larval walleyes were collected in the Muskegon Lake nursery area and recent otolith ageing has shown nearly all larvae to be no more than 1- day old. Since larvae hatched below Croton Dam would take at least 2 days to drift downstream, our larval fish research indicated that naturally produced walleye are not likely coming from adults that are spawning below Croton Dam. Walleyes in this system have shown strong homing instincts, which may have been interrupted by releasing hatchery-reared fish directly into Muskegon Lake. Thus, we have recommended a change in stocking methods (e.g., streamside rearing, stocking fertilized eggs in downstream locations) to aid production of adults that home to spawning sites which appear to be more favorable for larval walleye survival. §



## Newsletter Production Team

**Stages** is published in February, June, and October each year. It is assembled by the Newsletter Editor with contributions from several Regional Representatives and other individuals. Please send any articles, announcements, or information of interest to Early Life History Section members or affiliates to your local Regional Representative or to the Editor.

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## Join ELHS

Membership in ELHS is open to all persons or organizations interested in furthering ELHS objectives, regardless of membership in the American Fisheries Society (AFS). If you are an AFS member, simply add ELHS membership when you pay your Society dues.

Affiliate membership is open to persons or organizations who are not members of AFS. Affiliate members are encouraged to participate in Section meetings, committee work, and other activities, but they cannot vote on official Section matters, run for or hold an elected office, or chair standing committees. All members receive **STAGES**.

To become an affiliate member, go to <https://www.larvalfishcon.org/ELHSAffiliate/affiliate-triage.asp> or mail your name, institutional affiliation (if appropriate), mailing address, telephone and fax numbers, e-mail address, and dues (US \$15 per year) for the current and/or upcoming year(s) to the ELHS Treasurer (see page 2).

Please specify the membership year(s) for which you are paying dues. Make checks or money orders payable to "AFS-ELHS."

**Remember to check the mailing label for your membership expiration date and renew, if necessary.**

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