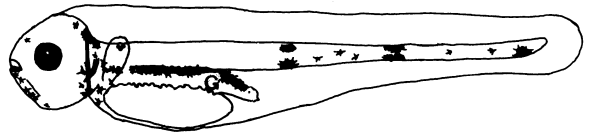


# STAGES



Newsletter of the AFS Early  
Life History Section

Volume 18, Number 2

Sept 1997

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## PRESIDENT'S MESSAGE

The 21st Annual Larval Fish Conference was held in Seattle, Washington from 26 June - 2 July, 1997. More than 200 participants were treated to a diverse scientific program, including symposia on "Juvenile Fish Studies: Contributions to Early Life History and Recruitment Processes" and "Ontogeny of North Pacific Scorpaeniform Fishes" as well as workshops on "Larval Fish Identification," "Preservation and Curation of Early Life History Stages of Fishes, Amphibians, and Reptiles," and "Image Analysis". The ELHS wishes to thank the local organizing committee, especially Art Kendall and Ann Matarese, for a job well done!!!

An award for the best student paper presented at the Larval Fish Conference is given by the ELHS each year in honor of the late Sally Richardson. This year in Seattle, the judges were faced with a difficult

choice among several excellent papers, with votes ending in a tie between two deserving students. The 1997 Richardson Award winners are: Jennifer Caselle, from the University of California, Santa Barbara for a paper titled 'Density-dependent early post-settlement mortality in coral reef fish and its effect on local populations' and Ule Reinhardt from the University of British Columbia for a paper titled 'Size-dependent foraging behaviour and use of cover in juvenile coho salmon under predation risk'. Honorable Mentions go to Jason Rogers, from the University of North Carolina, Wilmington for a paper titled 'Age and growth of larval and pelagic juvenile *Monacanthus hispidus*' and Jay Rooker, from the University of Texas, Austin for a paper titled 'Small-scale variation in recruitment densities of newly settled red drum *Sciaenops ocellatus*: influ-

## Abstract Deadlines:

### AFS, - Jan 23

to be held Aug 23-27, 1998 at the Hartford Civic Center, Hartford, CT



### ASI H

### : March 13

to be held July 13-16, 1998 on the campus of the University of Guelph, Guelph, Ont

**22nd Annual Larval Fish Conference**  
**Ann Arbor, MI**  
**July 9 - July 13, 1998**

## Masthead

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ence of food and predator mediated processes'. Congratulations one and all!!!

In addition to the Richardson Award, the ELHS plans to provide limited Travel Awards (probably \$200-\$300 each) for two students each year to attend the Larval Fish Conference. Criteria for making the awards is currently under consideration by the EXCOM and will be announced in Stages prior to the Ann Arbor meeting. I'm sure that a good time will be had by all.

*Jim Cowan*

## NEWS FROM THE REGIONS

**N**ortheast Region - Ben Letcher, Population Ecology Section Leader, National Biological Service, S. O. Conte Anadromous Fish Research Center, One Migratory Way, P. O. Box 796, Turner Falls, MA 01376. (Phone: (413) 863-8995 ext. 34, E-mail: [bletcher@external.umass.edu](mailto:bletcher@external.umass.edu)).

### Conte Anadromous Fish Research Center, Turners Falls, MA

Research in Dr. Ben Letcher's laboratory focuses on anadromous fish population ecology, with special emphasis on Atlantic salmon and American shad juveniles. The ecology laboratory is one of five sections at the Conte facility, which currently is a field station in the Biological Resources Division of the US Geological Survey. Previous affiliations include the National Biological Service and the US Fish and Wildlife Service. The facility was constructed six years ago in response to information needs specifically on anadromous fishes. The goal of the research in the ecology section is to determine patterns in population numbers and to attempt to identify mechanisms responsible for the patterns. Dr. Letcher and the graduate students he advises through the University of Massachusetts at Amherst conduct a combination of field, laboratory, and modeling studies with both salmon and shad.

Currently, Dr. Letcher is involved in four research projects with Atlantic salmon:

1) genetic stock structure of the highly-managed Connecticut River population,

*(Continued on page 4)*

## ELHS ARRIVES ON THE WEB

As a part of an exploratory project, Darrel Snyder has developed a prototype home page for ELHS. You can visit the site at:

*[www.cnr.colostate.edu/~desnyder/elshome.htm](http://www.cnr.colostate.edu/~desnyder/elshome.htm)*

Currently, the site contains information on the ELHS of AFS in the following categories:

### Description

- History

- Objectives

- Governance

### Membership and Dues

- Joining as a Voting Member

- Joining as an Affiliate Member

### Related Web Links

- Early Life History Section

- American Fisheries Society

- Embryonic, Larval, and Early Juvenile Fish Collections

- Other Early Life History Related Sites

- What's New?

Look for changes in the near future. We anticipate the page will come under new management soon as Darrel hands over the reins to someone else. Already slated for an appearance on the revised web is a searchable membership database. The present web page contains a complete membership listing, but it is not searchable. The revised database will allow us to update information quickly and efficiently and should lead to the production of a membership directory soon. Also look for back issues of STAGES. If you have comments or ideas for the section's web site, please

## See You in Ann Arbor!!

The 22nd Annual Larval Fish Conference, ELHS's official meeting will be held in Ann Arbor on the campus of the University of Michigan from July 9 - July 13. Information for submission of abstracts will be in the next edition of Stages. Several symposia have already been lined up, including ones on otolith microchemistry, freshwater ichthyoplankton studies, use of juvenile indices in recruitment research, and simulation modeling of recruitment. If you are interested in sponsoring a session, please contact Ed Rutherford at [edwardr@umich.edu](mailto:edwardr@umich.edu)

*(Continued from page 2)*

- 2) a study of individual growth and movement rates in the field,
- 3) fry tagging studies and
- 4) field studies designed to evaluate the effects of developmental stage at stocking and broodstock source on growth and survival.

With Dr. Tim King from the Aquatic Ecology Laboratory, USGS/BRD in Leetown WV, Dr. Letcher has been studying the genetic structure of individuals within the Connecticut River population and among populations. Results from the 1996 sea-run returns indicate that heterozygosities at most loci are about 10% lower than those from donor populations and from populations in Canada and Scotland, suggesting that hatchery practices may have reduced genetic variability somewhat, but not to a large degree. Genetic distances among individual fish within the population were fairly widely spread, also indicating that the population may have not been severely bottlenecked by hatchery breeding protocols.

A major need in the Connecticut River Atlantic salmon restoration program is the ability to determine in which tributaries smolts leaving the river (mainly age 2) and adults returning to the river (mainly age 5) were stocked. This requires some sort of tag. Unfortunately, the stocked fry are too small (25 mm) for physical tags and the population size is too small to allow a tag that requires lethal sampling (e.g. otolith thermal or chemical marks). But, because there is limited natural reproduction and small numbers of returns (200-500/yr), it is possible to use a family-level genetic mark to identify groups of fish. Based on the genetic data collected in 1996 and 1997, we have determined that there is sufficient genetic variability (using microsatellites) in the population to allow unequivocal separation of families using natural genetic variation. If we determine allele values (currently using 12 loci) of the parents in the population, assign parents to each family and track each family through the hatchery to the stocking tributary, we can use the family membership of smolts and adult returns to determine the original stocking tributary. Despite the logistical difficulties, we believe this is a very promising technique

to mark fish in restoration programs like the Connecticut River Atlantic salmon restoration effort. We are currently running a pilot study in a large tributary of the Connecticut River (Farmington River) into which we will stock almost 500,000 fry from known families into 10 tributaries.

With support from the US Forest Service, Dr. Letcher and technician Gabe Gries are conducting an extensive study of the individual growth and movement of juvenile salmon. Because little is known about individual growth and movement rates of Atlantic salmon in the field, we are attempting to PIT tag virtually all of the juvenile salmon in a one-km stretch of stream. After sampling (kick-seine at night) every three weeks this spring and summer, we have about 500 age-1 fish tagged and now capture very few untagged fish. The fish grew rapidly in spring but have stopped growing and most have lost weight during the summer. Ninety-five percent of the fish have been found in the same 20-m sample section and a few have moved more than one km. We will tag age-0 fish this fall and will attempt to sample the fish until they leave the river as two-year-old smolts. By following individual growth trajectories and identifying habitat use, we hope to learn about some of the mechanisms controlling growth, precocious maturation and migration timing.

In addition to genetic marking for use on a large spatial scale, Dr. Letcher and technician Tim Terrick have also been working with thermal marking of salmon otoliths for smaller-scale studies. Techniques for generating thermal banding patterns are well-established for pacific salmonids, but have not been optimized for Atlantic salmon. By varying the timing and the temperature change of the temperature drop that creates the band, we determined that the minimum requirements for a high-quality band were eight hours cold for a 9 C drop and 24 hours cold for a 5 C drop. We used these conditions to generate banding patterns to identify fish from different treatments in two field studies. In the developmental stage study, we raised salmon fry to different developmental stages (using temperature), marked their otoliths with unique thermal banding patterns and placed them together into study sections in three rivers. The purpose of the study was to determine if the fixed

developmental stage that managers currently use for picking spring stocking dates provided optimal growth and survival. Results indicated that a fairly wide range of developmental stages produced equal survival and equal fish sizes in the fall, suggesting that a single, fixed developmental stage for stocking is not necessary. This result allows managers to be more flexible in allocating fish for stocking.

A second study is underway using thermal banding patterns of otoliths to identify fish from different treatments. In this case, the 'treatment' is different types of mothers. The Connecticut River Atlantic salmon restoration effort uses female broodstock that are either sea-run returns, reconditioned kelts (previous returns) or domestic fish raised from progeny of previous year's returns. Sea-run mothers are much smaller and younger and produce eggs of almost one-half the volume of the other types of mothers. Because the difference in egg size and other possible differences among mothers may produce variable growth and survival rates, we are currently conducting a field study where fry from the three mothers were marked, stocked and will be recovered this fall. Results will suggest upon which type of mother emphasis should be placed.

Graduate student Matt O'Donnell is studying the variability in hatch dates and growth of American shad and blueback herring along a productivity gradient in the Connecticut River. Bi-weekly samples provide fish for otolith, growth rate and size structure analysis. Results will indicate whether there is any systematic spatial structuring to hatch dates and growth rates of these two clupeids and whether the along-river productivity gradient influences spawning location or subsequent growth rates.

Graduate student Melissa Grader is evaluating the effect of drop distance on incidence of predation on outmigrating American shad juveniles and Atlantic salmon smolts passing hydroelectric facilities. Many studies have explored the direct mortality effects of dams on migrating fish, but fewer have tested the indirect, delayed effects. One particularly important indirect impact many be increased susceptibility to predators as a result of disorientation, disruption of schooling and

crowding. Predators, especially striped and smallmouth bass, tend to congregate in the outfalls of east coast, US dams and may have a substantial impact on numbers of migrating fish. Melissa's study, conducted in the flume building of the Conte laboratory, will provide information on the range of mortality rates due to predators and should help engineers modify or design bypass structures that minimize mortality due to predation.

Two new graduate students, Nate Henderson and Marco Nicoli, are also conducting studies with Atlantic salmon. Nate is evaluating the impact of trout predation on salmon fry both in the field and in artificial streams. As a piece in the puzzle of trying to identify major population bottlenecks for Atlantic salmon, Nate's field studies will provide an estimate of trout predation rate as a function of trout density and species (brooks and browns). The artificial stream study will estimate the effect of substrate variability (extent of pools vs. riffles) of predation rates. Marco is currently running a laboratory study to estimate the effect of early growth rate differences (in the first eight weeks after emergence) on the incidence of precocious maturation of male juveniles. Precocious maturation is a prevalent life history strategy in Connecticut River Atlantic salmon; up to 70% of the age-1 males are mature and from 5 to 80% of the age-0 fry mature. Marco's study will help sort out when the 'decision' to mature precociously is made and what effect temporal variation in growth has on maturation.

### **Be a Part of A Success Story Contribute to STAGES**

STAGES is recognized as one of the best newsletters within AFS. The regional reviews are the foundation of STAGES, bringing you updates on ELH research. If you have not submitted anything for STAGES, or have not talked to your regional rep, please contact them. They will be delighted to hear from you.

**W**estern Region - Dan Margulies, Inter-American Tropical Tuna Commission, Scripps Institute of Oceanography, 8604 La Jolla Shores Drive, La Jolla, CA 92037. (Phone: (619) 546-7120, Fax: (619) 546-7133, E-mail: dmargulies@iattc.ucsd.edu).

**Coastal Fisheries Division, Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, California.**

The following contributions summarize some of the current research on early life history conducted by staff at the center:

***Identification Guide to the Early Stages of Fishes***

The Ichthyoplankton Ecology program at the Southwest Fisheries Science Center recently completed a book entitled, "The Early Stages of Fishes in the California Current Region." This is a comprehensive guide to the eggs, larvae, and juvenile fishes of the California Current and adjoining regions, including shorefishes, oceanic, midwater,

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species. The area covered in the book is from the Pacific Northwest to Cabo San Lucas, Mexico and seaward to the outer margin of the California Current. This monograph is the culmination of six years of work by staff members of Dr. H.G. Moser's research group. Principal authors of the book are William Watson, H.G. Moser, David A. Ambrose, Sharon R. Charter, and Elaine M. Sandknop. Dr. Moser served as editor for the book, which was published as Atlas 33 in the California Cooperative Oceanic Fisheries Investigations (CalCOFI) Atlas Series. The volume includes chapters on 158 families of fishes in 25 orders and treats a total of 586 species (467 with full descriptions and another 119 summarized in the chapter introductions; the early stages of about 27% of the species are described for the first time). Chapter introductions summarize information on taxonomy, zoogeography, morphology and ecology of adults, spawning modes, general features of the eggs and larvae, and include tables listing fin-ray counts and other meristic features useful in species identification. The book contains more than 2500 total illustrations of eggs, larvae, and juveniles; there are approximately 1170 original, previously unpublished illustrations by Nancy Arthur, Barbara Sumida MacCall, George Mattson, Henry Orr, Mary Vona, Robert Walker, and William Watson. The book contains 1505 pages, 167 tables in the text, and 925 morphometric meristic tables in the species descriptions. There is an extensive bibliography of 1375 titles and indexes of scientific and common names.

The extensive research advances made during this project greatly expanded our knowledge of the early stages of fishes and scientists now can identify the larvae and juvenile stages of most species of fishes that occur in the California Current Region. Because of the broad taxonomic coverage of the book, its usefulness extends beyond the California Current Region and is a fundamental resource for scientists studying fishes in all oceans. The book may be ordered from

*Allen Press,  
P.O. Box 1897,  
Lawrence, KS 66044-8897,  
U.S.A.*

***CalCOFI Ichthyoplankton Data***

A major research activity of the Ichthyoplankton Ecology group continues to be the identification of fish eggs and larvae from CalCOFI survey cruises. Identification of samples are now complete for the period from 1951 to 1996. The group is working cooperatively with Richard Charter, CalCOFI Data Manager, to incorporate this new data into the CalCOFI database. Our goal is to develop a web page for the CalCOFI data base and Richard Charter has recently begun the planning phase of this project.

CalCOFI ichthyoplankton data for the period from 1951 to 1984 is currently available in a series of data reports and the data from this period is summarized in CalCOFI Atlases 31 and 32. The data reports and atlases can be obtained from Dr. H. G. Moser.

***DNA Damage and Repair in Pelagic Fish Eggs and Larvae***

Most marine fishes produce small, buoyant, transparent eggs that float at or near the surface of the ocean. This allows the larvae at hatching to be in the upper mixed layer of the ocean where prey items such as phytoplankton and small zooplankton are abundant. One consequence of this life strategy is the exposure of eggs and larvae to high levels of solar radiation including the ultraviolet portion of the spectrum which can cause direct and indirect photochemical damage. Since most fish species have existed in their present habitats for hundreds of millions of years we generally assume that they have found ways of ameliorating the detrimental effects of UV damage. These adaptive responses can take the form of individual biochemical adaptations to prevent or repair UV damage, or the overproduction of eggs and larvae such that UV mortality is compensated for in the overall population dynamics of the species. Both may happen in a particular species. It is anticipated that eggs and larvae from tropical areas where solar irradiance is high should have strong adaptive responses, but that all pelagic

*(Continued on page 8)*

**Available Now  
from Chapman and Hall**

**Early Life History and Recruitment in Fish Populations  
R. C. Chambers and E. A. Trippel (Eds.)**

This edited volume contains papers presented at the 18th Annual Larval Fish Conference, held in St. Andrews, NB in May 1994. Preceded by a prologue on the history of fisheries recruitment studies within ICES, the book has four main sections. Section 1 contains four chapters on parent-progeny relations. Section 2 contains 8 chapters on selective processes in early life history. The 3rd section focuses on contributions of early life history research to our understanding of recruitment. The final section offers some conclusions and identifies challenges that remain. In so doing, the final section builds upon the 19 previous chapters which each end with a statement of unanswered questions and directions for future research. The book provides a clear statement of the state of ELH research as it relates to fisheries recruitment.

(Continued from page 7)

species exposed to sunlight should show some adaptation. Recent changes in ozone thickness and other aspects of climate change that affect cloud cover, water clarity, and mixing patterns, have raised concerns that fish eggs and larvae in areas such as polar environments may be exposed to higher levels of UV than they have historically experienced. Higher irradiances could lead to population declines if adaptive responses are not fully effective.

We have been conducting experiments to develop methods of measuring the extent of present day UV related damage and the mechanisms and capacities of different species to ameliorate the damage. We are working in the temperate waters of the California Current off southern California, and in Arctic waters on the cod spawning banks of northern Norway. We have focused primarily on measurements of UVB specific DNA damage in the form of thymine dimers. Under present day light conditions all species tested experience DNA damage when exposed to full solar irradiances typical of the latitudes they inhabit. However, most species also exhibit active mechanisms of DNA repair. Since the typical method of thymine dimer repair is photoenzymatic repair, the observed amount of DNA damage at any time of day is the net result of damage rates and repair rates. As the sun rises and sets the typical diel pattern of DNA damage resembles a dose-rate meter rather than a cumulative dose meter, i.e. DNA damage increases during the morning, reaching a peak level of damage near solar noon, followed by a period of rapid repair in the afternoon when UVB is decreasing but the visible light necessary for photorepair is still abundant. Appreciating this diel cycle of damage and repair is important in interpreting correlations between solar irradiance and levels of DNA damage in field samples because

samples collected at sunset have experienced the highest cumulative dose but often have DNA damage levels that are much less than at solar noon.

Although exposure to full solar irradiance always leads to DNA damage, and often leads to acute mortality, most eggs and larvae are not confined to the upper few centimeters of the water column where such exposures occur. Rather, the populations of eggs and larvae are typically distributed throughout the upper mixed layer (about 0-50 m). Since UVB is rapidly attenuated in sea water by plant pigments and dissolved organic matter, it is important to know the vertical attenuation of UVB and the vertical attenuation of DNA damage in order to describe the risk to the entire population of eggs and larvae. We have done this by incubating eggs and larvae *in situ* at different depths in the water column. Off California we have studied northern anchovy, *Engraulis mordax*, California halibut, *Paralichthys californicus*, and white seabass *Atractoscion nobilis*. In Norway we have studied arcto-Norwegian populations of cod, *Gadus morhua*. For California species we found the expected diel pattern of damage and repair. In anchovy the damage was sufficient to cause acute mortality at one meter. The amount of DNA damage declined rapidly between 1 and 5 m but was measurable down to 20 m. There were large differences between species in the amounts of damage, with anchovy the most sensitive and white seabass the least. In Norway the incident irradiance and optical properties of the water were such that damage was only detectable down to 5 m. However, damage in cod was not repaired as rapidly leading to an accumulation of damage. These results underscore the need to consider the sensitivity of each species independently, and warns against broad generalizations regarding potential UVB effects. Further, it shows

## Editorial Deadlines for STAGES

STAGES is published three times a year, in January, May and September. To enable me to collate the material I request the regional representatives to submit their material to me 2 weeks prior to publication. Thus if you want to submit material for the next edition of STAGES, which will be published in September, please submit your material to your regional rep, or if appropriate, directly to me by

**January 15, 1998**



that if the population of eggs and larvae contains a significant portion of its biomass deeper (below 20 m for anchovy), then the contribution of UVB related mortality will be a small part of total mortality. In the *in situ* incubations, eggs and larvae are constrained to remain at a given depth throughout the day. In natural populations we must also consider wind mixing which moves eggs and larvae throughout the light field, exposing them to periods of higher or lower irradiance. We have collected stratified samples of natural populations. These samples show the expected species differences and the diel and depth related changes in DNA damage patterns, but with greater scatter due to mixing. Generally, the field-collected specimens do not contain levels of damage that would lead to acute mortality, although in some cases they would be expected to result in impaired cell division and growth.

To empirically measure the effects of ozone depletion at the level of trends in fish abundance is quite likely impossible due to variability in UV dose (e.g. variable cloud cover), and variable alternative sources of egg and larval mortality (e.g. predation and starvation). However, we can make some conservative observations.

- (1) To date, no larvae seem to be completely adapted to the maximum UVB conditions of their respective habitats (i.e. the highest present day dose rates occurring near the surface cause DNA damage and mortality). This means that UVB related mortality is occurring today and enhanced UVB will likely cause increased mortality. The extent to which this is a problem will depend greatly on the vertical distribution and mixing patterns of the eggs and larvae of each species.
- (2) Since there are vast differences in UVB sensitivity between species, enhanced UVB will likely favor resistant species over sensitive species. This could lead to imbalances at the ecosystem level.
- (3) Ozone related UVB effects are most likely to be detected when they coincide with other climate factors such as low cloud cover, high water clarity, and low wind mixing that maximize UV exposure.

For more information on any of the projects summa-

rized above, please contact:

*H. Geoffrey Moser,*  
*Southwest Fisheries Science Center,*  
*P.O. Box 271,*  
*La Jolla, CA 92037;*  
*e-mail: gmoser@ucsd.edu*

*or*  
*Russel D. Vetter,*  
*Leader Genetics and Physiology Program,*  
*Southwest Fisheries Science Center,*  
*P.O. Box 271,*  
*La Jolla, CA 92037;*  
*e-mail: rvetter@noaa.gov*

### **Larval Fish Laboratory Survives Flood**

As many of you may be aware, via national news media, Fort Collins and Colorado State University (CSU) experienced torrential rains and flooding during the evening and night of 28 July. Many buildings on campus including the library were devastated (over 425,000 books and bound journals were damaged, many beyond useful recovery). University damages alone are estimated to exceed \$100 million, not including losses of personal and professional property associated with teaching and research by students, faculty and staff. Fortunately there were no associated deaths or critical injuries on campus.

The Larval Fish Laboratory Collection of over three million specimens was spared and staff suffered only the inconvenience of replacing collection storage boxes and drying salvageable literature stored in boxes on the floor. Our Aquatic Research Laboratory (housed in the basement of another building), however, was truly a "wet" lab; one meter of water submerged substantial amounts of equipment and supplies, but no research was lost.

### **Larval Fish Laboratory--New Director, Current Personnel, Web Site**

As of July, Dr. Kevin R. Bestgen took over the reins of the Larval Fish Laboratory (LFL) as it's new Director. As Colorado State University (CSU) graduate student, Kevin was associated with LFL from 1981 to 1986. He returned to CSU and LFL as

a Research Associate and Ph.D. student in 1989 and in the last couple years he served as Assistant Director of the lab. He replaces Dr. Robert T. Muth who has left for a position with the U.S. Fish and Wildlife Service in Salt Lake City, Utah. Bob joined the LFL staff in 1980, served as Assistant Administrator of LFL from about 1985 to 1992, and served as Director of LFL following Dr. Clarence Carlson's retirement as professor and LFL Administrator in 1992.

Current regular staff of LFL, mostly Department of Fishery and Wildlife Biology Research Associates, are:

Kevin R. Bestgen, Ph.D. -- LFL Director

Daniel W. Beyers, Ph.D. -- Aquatic Research Laboratory Manager

C. Lynn Bjork -- Illustrator

Jay M. Bundy

John A. Hawkins

Diane L. Miller -- LFL Collection Manager

Darrel E. Snyder -- LFL Collection Curator.

Temporary staff typically includes one or more graduate students (currently Steve M. Meismer), one or more student or non-student hourly employees (currently Koreen Zelasko), and, during fall and spring semesters, a half dozen or more work-study students.

For information on LFL research interests, capabilities, services, facilities, special resources, personnel, and published contributions and reports, we have posted a version of our laboratory resume on the web at <http://www.cnr.colostate.edu/~desnyder/lfl97.htm>.

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**Southern Region - Jon Hare,  
NOAA National Marine Fisheries Service, Beaufort Laboratory, 101 Pivers Island Road, Beaufort, NC 28516. (phone: (919) 728-8732; email: [jhare@hatteras.bea.nmfs.gov](mailto:jhare@hatteras.bea.nmfs.gov)).**

**Southeast Fisheries Science Center/University of Miami Larval Fish Group.**

The cooperative program between the National Marine Fisheries Service and the University of Miami currently centers on a project investigating recruitment of fishes, shrimps and lobsters from offshore reefs to tropical lagoons. A sampling program was initiated in July using channel nets and light traps with a focus on dark moon phase events. Two different channels are being sampled in the Florida Keys to evaluate the effect of differences in channel flow on recruitment. Bill Richards and Maria Criales are the Co-P.I.'s and are assisted by Dr. Cynthia Yeung, and graduate students Elizabeth Maddox and David Jones plus several volunteers.

The work is funded by the NMFS as part of the Florida Bay project.

Several other projects are also underway. Dr. John Lamkin had been working with Bill Richards on larval bluefin tuna, but was reassigned to command a NOAA research vessel in Hawaii; John is also a NOAA Corps officer. He plans to return to Miami in a few years to continue this work. Elizabeth Maddox has almost completed her field work channel netting in Biscayne Bay and Australia and will soon be analyzing her data to complete her Ph.D. David Jones has been collecting data and rearing unidentified labroids for his dissertation research on labroid early life history systematics. Bill Richards is continuing work on his book "Identification guide to the early life history stages of fishes from the western central North Atlantic Ocean". This book is planned for completion before the end of the century.

The Miami group was very saddened by the death of Sharon Kelley. Sharon had fought a long struggle with cancer. Richards plans to complete her identification work on chaetodontid larvae for her.

For more information, please contact:

*Bill Richards*

NMFS's Southeast Fisheries Science Center in Miami, FL



*NOAA National Marine Fisheries Service  
Miami Laboratory  
75 Virginia Beach Drive  
Miami, FL 33149  
Email: Bill.Richards@noaa.gov*

## **Rosenstiel School of Marine and Atmospheric Science**

Ivan Lima is a graduate student at RSMAS. His primary research interests are in fisheries oceanography and ecosystem modeling, more specifically on how physical processes in the ocean affect the dynamics and distribution of plankton and early life stages of fish. Physical processes are the primary determinants of the dynamics of marine ecosystems. They provide the conditions and the physical structure within which biological processes occur and also influence distribution and rates of biological processes.

Ivan's Ph.D. research involves simulation modeling techniques to explore the relations between ocean circulation and patterns in the distribution and abundance of plankton and early life stages of fish determined from field studies. A three-dimensional, primitive equation, numerical ocean model (the Princeton Ocean Model), is being coupled with a mullet-species, size-structured food chain model and individual based models of larval fish to investigate the effects of variable ocean circulation features on the distribution and dynamics of plankton and early life stages of fish in the Straits of Florida.

Coupled physical-biological models are a developing tool in biological oceanography. These coupled models can be used to synthesize the knowledge available about a given ecosystem to simulate its behavior and ultimately forecast its dynamics under different environmental conditions. In addition, in such models, the effects of different parameters or processes can be isolated to test different hypotheses.

Ivan's goal is to produce a realistic representation of the pelagic ecosystem of the Straits of Florida that can be used to better understand and ultimately, forecast patterns in plankton production and distribution and fish recruitment resulting from variations in the ocean and atmosphere,

Ivan is also interested in the application of dynamical systems theory to population dynamics. For more information please contact:

*Ivan Lima  
Rosenstiel School of Marine and Atmos. Science  
Division of Marine Biology and Fisheries  
4600 Rickenbacker Causeway,  
Miami, FL 33149  
Email: ivan@nauplius.rsmas.miami.edu*

## **Gulf Coast Research Laboratory/University of Southern Mississippi**

The Ichthyoplankton Section at the Gulf Coast Research Lab (GCRL), which is located in Ocean Springs, MS and is now part of the Univer-

sity of Southern Mississippi, is keeping busy. Bruce Comyns recently completed his Ph.D. in the Department of Oceanography and Coastal Sciences at Louisiana State University and during his dissertation research found striking between-station differences in the growth rates of both Atlantic bumper (a carangid) and vermilion snapper larvae in the north-central Gulf of Mexico. Of most interest were differences in growth rates that were caused by factors other than temperature, and that were capable of causing order of magnitude differences in the cumulative survival of larvae.

Interest in determining changes in stock size of red drum in the northcentral Gulf using indices of larval abundance continues. Comyns will conduct a larval survey in mid-September with the help of his technician Pam Scott and several enthusiastic student volunteers. A second survey will be conducted by Joanne Lyczkowski-Shultz and personnel from the National Marine Fisheries Service in Pascagoula, MS (see the previous Stages to find out about other larval fish research at the NMFS Pascagoula Laboratory).

The Gulf Coast of Mississippi is currently

experiencing a population explosion, fueled primarily by rampant growth of the casino industry. Interest in the effects of development upon shallow estuarine habitats has provided funding for some inshore research. Comyns is currently working with GCRL colleague Mark Peterson to quantify the relative importance of various types of habitat for postlarval/juvenile fishes and decapods, with interest focussing on both impacted and non-impacted areas. Comyns is also working with Peterson and Chet Rakocinski to correlate the variability in daily growth rates of juvenile fishes collected in marsh-edge habitats with a suite of environmental parameters recorded hourly with fixed Datasondes.

For more information please contact

*Bruce Comyns*  
*Gulf Coast Research Laboratory*  
*Ocean Springs MS 39564*  
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## INTERNATIONAL SECTION

**P**acific Rim Region - Iain Suthers, School of Biological Sciences, University of New South Wales, Sydney, Australia, (Phone: +61 2 385-2065, E-mail: I.suthers@unsw.edu.au).

### **Fish Section, Division of Vertebrate Zoology, The Australian Museum**

Jeff Leis reports that the reviewers were favourable on his application for funding to continue the work on larval behaviour, so he is optimistic that ARC will fund us next year. Jeff expects the decision shortly.

Jeff has a paper on larval fish swimming speed is now in press in MEPS. He will be presenting papers on swimming performance and 'unplanned observations' of larval behaviour at the

Indo-Pacific Fish Conference in Noumea in November. He will also speaking on this work at the International Larval Biology Meetings in Melbourne in January (see upcoming meetings). In the meantime, you might want to check out the 13 Sept issue of NewScientist which has an article on the work on larval reef fish behaviour going on in Australia, including our work and that of Peter Doherty, Eric Wolanski and Ilona Stobutzki.

For more information contact Jeff at

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## ELHer's IN THE NEWS

### Ed Houde

Dr. Ed Houde was awarded the Beverton Medal by the Fisheries Society of the British Isle, during its recent meeting held Galway, Ireland (see meeting reviews). The award, named in honour of the late Ray Beverton, recognizes outstanding contributions to fisheries science. Ed was presented this prestigious award in recognition of his contributions in the fields of larval ecology and fisheries management. In his remarks during the award ceremony, Dr. John Blaxter noted the varied and important contributions that Ed has made in the areas of larval feeding, bioenergetics, recruitment and life history. A quick search of any citation index will reveal quite how influential Ed's research has been on our field. Following the award, Ed presented the J. W. Jones Lecture on "Patterns and Trends in Larval Stage Growth and Mortality in Teleost Fishes."

### Bill Leggett

Bill was this year's recipient of the American Fisheries Society's Award of Excellence at the AFS meeting in Monterey, CA. The citation recognizes Bill's commitment to teaching, research and the advancement of marine biology, oceanography and aquatic sciences. Bill's research, from his pioneering work on American shad, his work on biological-physical coupling in capelin recruitment, to his more recent work on small-scale turbulence has been extremely influential. Bill is equally committed to education, and one only has to begin to

trace the web of Leggett graduates to begin to realize how influential this aspect of Bill's career has been.

### Dave Conover

The College of Arts and Sciences and the Department of Biological Science at The Florida State University, in concert with the Mote Marine Laboratory of Sarasota, are pleased to announce the first Mote Eminent Scholar, made possible by the generosity of Mr. William R. Mote. Dr. David Conover will serve as the first holder of the William R. and Lenore Mote Eminent Scholar Chair in Fisheries Ecology.

Dave Conover, a Professor of Marine Science and Assistant Dean at the State University of New York, Stony Brook, is an expert on the life history of fishes and the importance of integrating knowledge of life histories into fishery management. His most well-known work concerns how the growth rate and development of fishes responds to temperature variation at different latitudes. His work, which has been supported continuously by the National Science Foundation and other funding agencies, represents the integration of innovative basic research and critical applied knowledge that the Mote Chair was designed to encourage. Conover will bring his scientific expertise and his teaching skills to both FSU and the Mote Marine Laboratory through this one-year, visiting appointment, which began in July, 1997.

## Going to A Meeting?

If you are going to a meeting this summer, write a review for STAGES. Given the number of meetings, it is impossible to attend them all. It is often impossible to attend all of the sessions one would wish to even within a single meeting. For these reasons, it helps if there are reviews of meetings of interest to ELHS members within STAGES. Your opinion and review of sessions you have attended will be appreciated by all. If you want to submit material, contact: Tom Miller, Phone:(410) 326-7276, E-mail miller@cbl.umces.edu

## MEETING REVIEWS

## Fisheries Society of the British Isles

From July 8-11, 1997 almost 200 researchers from all over the world gathered in Galway on the west coast of Ireland to hear 42 oral presentations and read 64 posters. Together with the larval fish conference in Sydney two years ago, this conference represented one of the largest gatherings of larval fish researchers since the ICES sponsored conference in 1988 in Bergen. All submissions were organized around five separate themes: (1) advances in methodology, (2) modelling of larval fish dynamics, (3) distribution, transport and stock discrimination, (4) growth, mortality and recruitment, and (5) feeding ecology. Each session was organized around its own keynote address. The oral presentations were organized in five sequential sessions, with plenty of breaks between each session which allowed for a great deal of discussion among conferees.

One highlight of the conference was Ed Houde's delivery of the 1997 J. W. Jones Lecture. Ed discussed his recent research on the dynamics of growth and mortality in early life history. He identified the contrasting patterns in rates of instantaneous mortality (M) and growth (G) during ontogeny. Early in life history M exceeds G and thus cohort biomass declines. After some period of time G exceeds M, and thus cohort biomass increases. Ed define the point at which M and G are equal as the **Transition size.** In his lecture Ed compared population and cohort specific estimates of M, G,

and the transition size for several common fish, including cod, herring and striped bass.

There were a great many interesting papers and posters delivered during the conference, and I will highlight only a few here. Several presentations used modeling frameworks to tease mechanistic interpretations out of empirical data. Mike Heath discussed the potential for coupling of individual-based data and models to spatially explicit descriptions of the environmental at meaningful spatial and temporal scales. Together with a companion presentation by Gallego and Heath, Heath presented compelling evidence of the advantages of the individual-based approach. Bez et al. also discussed coupling between spatial variation and distribution of mackerel eggs and larva. Picquelle and Mier used Monte Carlo simulations to examine sampling strategies to estimate vital rates from heterogeneously distributions populations of walleye pollack. Jenkins and Black used a coupled physical-biological model to determine the forces that regulate recruitment to sea grass beds in a south Australian estuary. It was interesting to see the wide diversity of approaches used to examine common research questions.

Several presentations focused on new techniques. Checkley et al. presented data on the spawning distribution of sardine in South African waters using an optical egg counting system developed as part of the Sabre programme. This exciting technol-

### FUTURE LARVAL FISH CONFERENCES

Year	Location	Contact
1998	Ann Arbor, MI	Ed Rutherford E-mail: edwardr@umich.edu
1999	Beaufort, NC - to celebrate the centenary of the Beaufort Lab	Jeff Govoni jgovoni@hatteras.bea.nmfs.gov
2000	Your choice!!	You

September 1997

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The impressive facade of the Martin White Marine Science Institute on the campus of University College Galway in Ireland. The Institute was host to the FSBI Ichthyoplankton Ecology Conference. Meetings were actually held in a lecture hall a short distance from the Institute.

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ogy is now be deployed in several areas world wide and has the potential to lead to considerable insights into basic and applied issues of fisheries oceanography. Jones et al. examined the potential for elemental fingerprinting of otolith microconstituents to quantitatively predict fish movements. Jones presented data that clearly identified the ability of the technique to determine stock structure and times of key life history events in Atlantic croaker. Kristiansen et al. reported on the results of studies aimed at estimating survival of larval Atlantic cod by the release of genetically marked individuals.

A third theme of the conference was on distribution, transport and stock discrimination. I have already mentioned Cynthia Jones= presentation on the use of otolith microchemistry in this light.

However, other approaches were also presented at the conference. Mosegaard presented evidence from otolith morphology to indicate stock structure in North Sea herring. Hay and colleagues used the pattern of larval dispersal to infer stock structure in herring populations in the Pacific northwest. Finally, White explored the paradox of recruitment patterns in Antarctic fishes to suggest the need for finer stock discrimination in this suite of fishes. Several authors focused on patterns and processes of larval dispersal. The number of authors who combined knowledge of the physics of the system under study and the biology was especially noteworthy (Ekau et al, Kingsford and Finn, Bjorkstedt et al., and Dickey-Collas et al., and Hoss et al.). The fourth theme, estimating growth and

## Affiliate Members!

We are busy updating our database of affiliate members to make sending out reminder notices more timely and efficient. Until we have a complete list we will continue to send STAGES to all on our list. This process will likely be completed in September. After that we will stop sending the newsletter if dues are not renewed. Please submit your dues to Kathy Lang, the section treasurer. Kathy is continuing to find ways to ease payment for our foreign affiliates, until that time, cheques and money orders only please.

condition, was addressed by several authors. Somarakis and colleagues presented a paper that focused on the potential for asymmetries in otolith morphology to index growth. Several authors presented information on the use of nucleic acid based indices to assay condition (Clemmensen and Ferron, Gronkjaer et al., Buckley et al.). Two papers used protein and lipid biochemistry as the basis for assessment of condition.

The final theme was feeding ecology. Several papers addressed this topic. Peter Munk gave the keynote address on the feeding ecology of larval gadids. Munk's detailed study of the diet contents of larval cod focused on the importance of incorporating information on the size-spectra of potential prey in different water masses when estimating selectivity. Miller et al. used a random encounter model to determine whether diet selectivity in larval and juvenile fishes resulted from the same mechanism. They suggested that physical processes and considerations drive a great deal of the patterns we infer as selectiv-

ity. Finally, Geffen et al. integrated the feeding ecology of fish larvae with the dynamics of their prey to explain the pattern of variability in larval abundances.

The talks were supported by a great many very strong posters. Sufficient time was provided to enable attendees to read and discuss all of the presentations. In fact, the FSBI Ichthyoplankton ecology conference was one of the most enjoyable conferences I have attended for quite a while, specifically because of the amount of time that was available for informal discussions. One did not feel harried, or guilty for not attending another session. Julie Fives and her organizing committee should be congratulated on an excellent conference.

*Tom Miller*

## ICES Recruitment Symposium

*Overview of ICES International Symposium:*

### **Recruitment Dynamics of Exploited Marine Populations: Physical-Biological Interactions**

Scientists from over twenty countries assembled on the campus of the Johns Hopkins University, September 22-24 1997, to exchange new ideas and findings in recruitment research with emphasis on the interaction between physical and biological processes. The symposium was dedicated to the memory of Professor R.J.H. Beverton in recognition of his seminal contributions to the field of recruitment studies. The meeting, which attracted over 230 participants, featured an exciting blend of research conducted on a broad spectrum of spatial and temporal scales in systems ranging from the tropics to polar seas. One hundred and four papers were presented during the course of the meeting and 42 posters were contributed.

The symposium was organized by co-conveners Thomas Osborn, Harald Loeng, John

Shepherd and Michael Fogarty with the able guidance of the Scientific Steering Committee -- Robert Dickson, Ransom Myers, Thomas Powell, Brian Rothschild and Daniel Ware. Financial support was generously provided by the U.S. Office of Naval Research and the Scientific Committee on Oceanic Research.

David Cushing presented the opening address, co-authored with Joseph Horwood, where the interplay between population regulation and environmental variability in recruitment dynamics was nicely illustrated. The remainder of the first day of the meeting was devoted to a sequence of highlight talks in which the broad themes to be explored later in the meeting were presented. The following two days featured sessions on Trophodynamics; Population Regulation and Environmental Forcing; Transport, Retention, and Loss; Life History Strategies in Variable Environments; Spatial Processes; Reproductive Dynamics; and Predation Processes.

Collectively, the contributions to the symposium traced the importance of basic biological processes starting with the production of viable fertil-



ized eggs, the role of larvae as both predators and prey, and continuing through factors affecting the growth and survival of the juvenile and adult life stages. The papers and posters presented at the meeting demonstrated how spatial and temporal variation in biological and physical environmental factors (ranging from the influence of microscale turbulence to basin-scale circulation patterns on the physical side to changes in food availability and/or concentration and predator densities on the biological side) can influence these processes.

Broad progress was evident along of number of fronts, reflecting advances in technology (remote sensing, oceanographic instrumentation, and biotechnology), modelling capability, enhanced understanding of both physical and biological processes, and the development of time series and analytical tools for comparative analyses across taxa and ecological domains.

Advances in computing power have substantially changed the modelling landscape within the last several years and this was clearly evident at the symposium. For example, individual-based biological models coupled with numerical hydrodynamic models have enhanced our understanding of pathways affecting trophodynamics and transport/retention mechanisms. These computationally intensive approaches were not generally feasible or widely available less than a decade ago and now provide a framework for synthesis for physical and biological oceanographic studies.

Our understanding of the interaction between population regulatory mechanisms and physical forcing has benefited from a joint attack on the problem using both empirically-based retrospective studies and process-oriented research. By focusing on the outputs of a system (e.g. recruitment levels) and inputs or forcing factors, retrospective analyses can be used to infer the underlying causes of population variability in ways which complement process studies that are necessarily conducted on smaller spatial and temporal scales but which provide the insight into underlying causal mechanisms.

The importance of spatial processes and patterns has emerged as an important theme in much of the recent research in recruitment dynamics. This work depends in no small part on recent advances in modeling hydrodynamic transport processes in

which dispersal patterns can be quantified to develop models of linked subpopulations. The importance of understanding habitat constraints and requirements for different life history stages is deeply related to the question of spatial distribution and structure. It has also become apparent that subtleties in density-dependent processes can often only be understood by consideration of spatial structure.

Dedicated efforts toward the compilation and interpretation of recruitment and adult population estimates over many decades throughout the world now offer opportunities for synthesis and integration in meta-analyses of the recruitment problem. Such studies, presented at the symposium and in the recent literature, have demonstrated the importance of compensatory controls during the early life history, the spatial and temporal scales of coherence in recruitment patterns among and between species, and factors affecting resilience to exploitation.

The issues surrounding recruitment processes remain at the heart of critical concerns in resource management. An understanding of the nature of population regulation and recruitment dynamics is indispensable in setting sustainable harvest rates. The concerted effort directed at the question of why marine populations vary in space and time was well represented at the symposium. With respect to management needs, understanding and predicting persistent changes in physical forcing or environmental shifts operating at mid-frequencies (e.g. 5-10 yr or longer) are perhaps most critical because they will potentially require adjustments in management strategies. The level of mechanistic understanding required to meet this need is within grasp.

M. J. Fogarty

## UPCOMING MEETINGS

## Fish Otolith Research and Application

**Bergen, Norway**

**20-25 June 1988**

The objectives of the 2nd International Symposium are to bring together scientists and exchange knowledge on fish otolith research and to provide a forum where group discussion will result in the clarification of issues and the development of new directions in this rapidly evolving field.

Papers will be presented in five areas, each with their own keynote speakers. The areas and featured keynote speakers are:

### Otolith Physiology and Morphology

**Thomas Linkowski (Poland), Sophie Dove (Australia), Arthur Popper (USA)**



### Estimation of Fish Growth

**Daniel Kimura (USA), Beatriz Morales-Nin (Spain), Jacques Panfili (France), Iain Suthers (Australia)**



### Otoliths in Studies of Populations

**Chris Chambers (USA), Eric Volk (USA), Kevin Baily (USA)**



### Otolith composition

**John Kalish (Australia), Steve Campana (Canada), Dave Secor (USA), Simon Thorrold (USA).**

The proceedings for the conference will be published in Fishery Research in 1999. Submission of abstracts is now closed, but there is still an opportunity to register for the conference. For conference details please visit <http://158.37.91.10/sear/oto98/oto98.html>. If you have specific questions please email [symp98@imr.nol](mailto:symp98@imr.nol).

September 1997

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**1988 Southern Division AFS  
Midyear Meeting  
Lexington, KY  
February 26 - March 1, 1998**

The midyear meeting will be held in the Radisson Plaza Hotel in Lexington. If paid before before 15 January, registration is \$60. Late registration will be \$80. Students who are not provided with financial assistance through their University may request registration waiver. These requests **must be in writing** and made prior to January 15, 1998. **There will be no on-site registration waiver made.** Requests should include name, mailing address, e-mail address, daytime phone, educational institution, faculty sponsor and a brief statement of why registration waiver is required. Send requests to Scott Morrison at the address listed below. Students accepting registration waivers will be expected to provide some assistance with the meeting facilitation (running projectors, helping with registration, etc.). Sign-up duties will be at the on-site registration table.

**Registration Form**

Name: \_\_\_\_\_  
Affiliation \_\_\_\_\_  
Mailing Address: \_\_\_\_\_  
Phone: \_\_\_\_\_  
Email: \_\_\_\_\_

[ ] Enclosed check or money order for \$60, or \$80 payable to: *Kentucky Chapter AFS*

*mail to:  
Scott Morrison / MidYear Meeting  
2311 Ohio Avenue  
Parkersburg, West Virginia 26101*

Associated with the midyear meeting will be two workshops held on February 27th. The workshops will be on "Bioenergetics Modelling for Microcomputers", and "Modelling fish populations to predict the effects of size limits." If you are interested in the former workshop, please contact Dr. Kyle Hartman at (304) 292-2941. If you would like to attend the second workshop please contact at (334) 844-4785. Attendance at either workshop is an additional \$25 on top of conference registration.

**Larval Fish Conference  
Ann Arbor Michigan  
July 9- 13, 1998**

Look for registration information in the next edition of Stages

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## DATES TO REMEMBER

Feb 26 - March 1, 1998	Southern Division Meeting, AFS	Lexington, KY
June 20-25, 1998	2nd International Symposium on Fish Otolith Research and Application	Bergen, Norway
July 9-13, 1998	22nd Annual Larval Fish Conference	Ann Arbor, MI
July 16-22, 1998	78th Annual Meeting of the American Society of Ichthyologists and Herpetologists	Guelph, Ont
August 23-27, 1998	American Fisheries Society Meeting	Hartford, CT

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