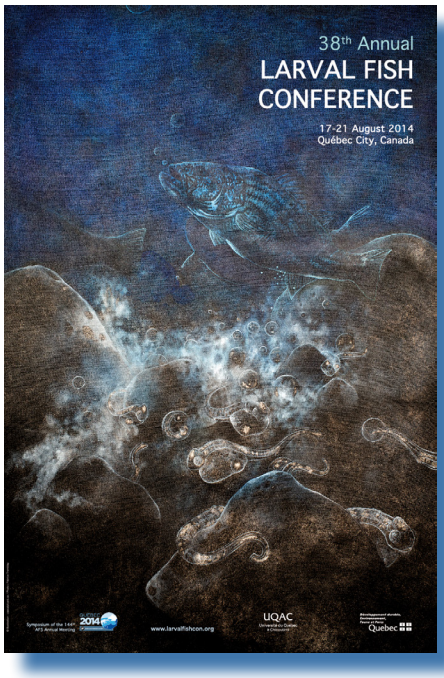
STAGES

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

Volume 35, Number 1 | Lee A. Fuiman, Editor | February 2014

38th Annual Larval Fish Conference
Second Call for Abstracts

Even though the LFC is organized as a symposium of the American Fisheries Society meeting, we are now collecting abstracts through the Larval Fish Conference portal until February 28. The local steering committee will then review submitted LFC abstracts and send a notification of acceptance to corresponding authors by March 7. While the steering committee will submit a proposed presentation schedule with titles of contributions to AFS, all authors will be asked to re-submit their accepted abstracts to the AFS submission portal by March 14. Details relative to registration will soon be available through the AFS meeting website. To assist you in planning your trip to Québec City, we suggest the following website: *www.quebecregion.com/en*.



In addition to the five theme sessions described below, papers on any other aspect of the early life history of fishes can be presented in a contributed papers session.

1) Hjort 100th anniversary session on the contribution of mortality during early life in driving recruitment variability (keynote speaker: Dr. Akinori Takasuka, Fisheries Research Agency, Japan).

...continued on p. 6

President's Message

Our best chances to communicate and discuss are our meetings, since meeting in person is so much more communicative than email correspondence, which we are flooded with every day. I'm therefore looking forward very much to meeting you all in Quebec City, Canada, where the 38th annual Larval Fish Conference will be held in conjunction with the 144th annual meeting of the American Fisheries Society from 17 to 21 August 2014. Besides having the opportunity to discuss our work in a bigger frame, we can also take the opportunity to make ourselves more visible. Therefore, the Early Life History Section is supporting a symposium on "Reproductive behavior and recruitment processes: Emerging understanding and future needs" organized by S. Lowerre-Barbieri , M. Karnauskas, M. Dickey-Collas, P. Pepin, C. B. Paris, and Y. Sadovy de Mitcheson to: (1) to bring together scientists working on different aspects of the stock recruitment paradigm; (2) to improve our knowledge of reproductive success through a better understanding of reproductive dynamics and recruitment success; and (3) develop a more comprehensive view of the factors that drive short-term and long-term productivity in marine fishes. This will bring together ELH

...continued on p. 7

Inside this issue

ELHS Back Then

10 years ago: First ELHS Special Publication: Armstrong and Child's classic "Stages in the development of Ictalurus nebulosus*."*

15 years ago: Tom Miller steps down as Newsletter Editor after 5 years and Perce Powles takes over.

20 years ago: ELHS publishes AFS Symposium 14: "Water quality & the Early Life Stags of Fishes."

25 years ago: Bob Hoyt steps down after 5 years as LFC Conference Proceedings Editor and Lee Fuiman takes over.

30 years ago: 8th LFC at UBC with 185 registrants (18 countries), 96 papers, 15 posters.

35 years ago: Darrel Snyder began to circulate the idea of forming a section with AFS dedicated to early life history of fishes.

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

May 2, 2014

News from the Regions

European Region

Hubert Keckeis

Survival and growth of herring eggs and larvae at different salinities

Herring, *Clupea harengus*, is widely distributed in the North Atlantic and exhibits great plasticity in time of reproduction and tolerance to a wide range of environmental conditions during its early life stages. In order to clarify phenotypic responses to salinity conditions, laboratory experiments were initiated to follow offspring subjected to controlled salinity levels at fertilization and throughout the subsequent 2 months. Full-sibling offspring of spring spawning herring from two sites in western Norway were incubated and reared at three nominal salinities: 6, 16 and 35 psu. After hatching larvae were fed live natural and cultured plankton in excess over a 7 week period to determine growth and survival at respective salinity levels. Viable offspring were produced in all salinities, but survival was lower and more variable at 6 than 35 psu, both during incubation and subsequent rearing. Further, initial larval growth was inhibited at 6 psu, but this was partly due to reduced survival and availability of natural zooplankton in the experimental tanks at this salinity. The final survival of larvae was also

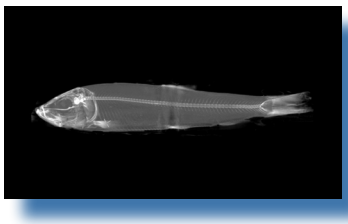


Figure 1: PET-CT image of 6 cm herring reared at 34-35 psu salinity (photo: Cecilie Brekke Rygh, UiB).

lower in the 6 psu treatment than in the 16 and 35 psu treatments. Average final size ranged between 21 and 27 mm and was largest among larvae reared at 35 psu, the salinity level closest resembling the conditions from where the offspring originated. These experiments constitute preliminary trials of multi-generational studies of genotypic responses to ambient salinity conditions in herring early life stages. In an ongoing experiment, herring from the Baltic were successfully crossed with local Atlantic herring, producing hybrid offspring in addition to regular stock-specific offspring. The plan is to keep the hybrid herring under common garden conditions for additional 2.5 years until onset of maturation for coming F_2 experiments.

Contacts: Arild Folkvord, Department of Biology, University of Bergen, Norway (*arild.folkvord@bio.uib.no*) and Leif Andersson, Department of Medical Biochemistry and Microbiology, Uppsala University, Sweden (*leif.andersson@imbim.uu.se*).

ACIDLARVAE – Acidification effects on temperate fish larvae

Project team: Ana Faria, Philip Munday, Laura Ribeiro, Rita Borges, Stephen Simpson, Emanuel J. Gonçalves

Despite recent significant advancement in understanding the likely impacts of ocean acidification in a few coral reef fish species, effects of elevated carbon dioxide on temperate reef fish larval behaviour and sensory capabilities are still poorly investigated.

A project, started in May 2013, and led by postdoc Ana Faria from Emanuel Gonçalves' lab at the Eco-Ethology Research Unit from ISPA (Lisbon, Portugal), has gathered an international team of fish larval biologists, namely Rita Borges (CCMAR, Algarve University, Portugal), Laura Ribeiro (IPMA, Portugal), Phil Munday (James Cook University, Australia) and Stephen Simpson (University of Exeter, UK) to investigate the effects of ocean acidification on sensory systems, early life history traits, performance, and brain function of temperate fish larvae, by exposing larvae to a range of treatments relevant to predicted future ocean pH levels. Ultimately, this two-year study, commissioned by the Portuguese Foundation for Science and Technology (PTDC/MAR-EST/4627/2012), will help advance

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Section Officers

HELP KEEP STAGES INTERESTING...

Send us a report of your research activities.

Pacific Rim Region

Akinori Takasuka

Integrated Monitoring of Small Pelagic Fishes in Morocco: Early life biology launched

Currently, the Early Life History Section has no members from Morocco, but perhaps some contributors in the future. Although Morocco is not a Pacific Rim country, I would like to introduce a project "Integrated Monitoring of Small Pelagic Fishes in Morocco (IMPM)," which is a cooperative program between the National Institute for Fisheries Research (Institut National de Recherche Halieutique, INRH) in Morocco and the Japan International Cooperation Agency (JICA).

I had an opportunity to visit INRH in Casablanca for the first time from November 25 to December 2, 2013, being invited by JICA. The INRH has an office of the IMPM project (Fig. 1). My tasks were: (1) to introduce hypotheses on biological mechanisms underlying climate impacts on population dynamics of small pelagic fishes; (2) to support estimation of spawning abundance index of small pelagic fishes based on egg and larval survey data; (3) to support analysis on optimal environmental windows for spawning of small pelagic fishes based on egg and larval survey data; and (4) to introduce reviews on growth and survival mechanisms during early life stages of fishes, as a technical cooperation "Fisheries Oceanography for small pelagic resource dynamics." Tasks (1) & (4) were organized in an open-style seminar format, and Tasks (2) & (3) were organized in a practical workshop style (Fig. 2). After these tasks, I also visited the INRH aquaculture center in M'diq for communications (Fig. 3). These activities constituted a part of the IMPM project.

Fig. 1. Dr. Naoki Tojo (JICA long-term expert) at the IMPM project office of the INRH.

Fig. 2. Workshop at the INRH in Casablanca.

Fig. 3. Meeting at the INRH aquaculture center in M'diq.

The IMPM project was launched to develop and improve fisheries resource monitoring and assessment for sustainable management of small pelagic resources of Morocco in summer 2010. The target species include *Sardina pilchardus*, *Scomber* spp., *Trachurus* spp., *Sardinella* spp., and *Engraulis encrasicolus* on the Atlantic coast of the North African waters. The INRH scientists have conducted long-term monitoring surveys for oceanographic conditions and egg and larval distributions and are now trying to improve stock assessments based on those data sets through geostatistical analyses, etc. The project has been well organized by a cooperation among INRH scientists (Project Coordinator: Mr. Azeddine Ramzi), Dr. Naoki Tojo (JICA long-term expert), and other JICA cooperators. Overall, I was impressed by their enthusiastic activities and strong collaborative relationships. For example, my review talk on the first day was intended to be around 60 minutes, but I received comments and questions for each slide. Eventually, our seminar starting at 10:00 extended to 16:30 after lunch.

In the IMPM project, the organizers and participants are now trying to incorporate early life biology into their sustainable fisheries. Such an effort has not been made in the Atlantic coast of the North African waters by Moroccan's own hand before. The first steps would be spawning habitat analysis to understand their biological responses to environmental factors and larval otolith analysis to understand growth–survival dynamics during early life stages. I would like to expect some contributions to the Early Life History Section from the IMPM project in the future.

Unusually large leptocephali seen in Indonesia may be the larvae of ribbon eels

A paper published recently in Marine Biodiversity Records reports on unusually large moray eel (Muraenidae) leptocephali that have been seen and photographed by divers in coastal habitats in several locations of Indonesia (Miller et al. 2013). Although most muraenid leptocephali are usually less than 90 mm, the large metamorphosing larvae that were observed at Sangeang Island, Lembeh Strait adjacent to Sulawesi Island, Ambon Island, and Bali appeared to be larger than 300 mm (6 sightings, 4–23 m depths). Their characteristics suggested that they are the leptocephali of ribbon eels, *Rhinomuraena quaesita*, whose larvae have remained unknown.

...continued on p. 5

Southern Region

Frank Hernandez

Investigating Deepwater Horizon Impacts on Ichthyoplankton in the Northern Gulf of Mexico

John Ransom, Jesse Filbrun, and Frank Hernandez, Department of Coastal Sciences, University of Southern Mississippi

A research team at the University of Southern Mississippi led by Dr. Frank Hernandez (Department of Coastal Sciences) is investigating potential impacts of the Deepwater Horizon oil spill (DWHOS) on ichthyoplankton in the northern Gulf of Mexico. Preliminary analyses of zooplankton assemblages from a long-term time series (see below) identified changes in community structure during the DWHOS (May–August, 2010) when compared to prior years (May–August, 2004–2009). The current research questions focus on the implications of these changes in zooplankton composition (i.e., larval fish prey) for ichthyoplankton survival and recruitment success:

If the zooplankton community changed during the spill, how did larval fishes respond? Did the DWHOS induce a "match-mismatch" dynamic in the planktonic food web? Did larval fishes switch prey resources? If so, what was the consequence for growth and condition? If not, were prey limiting? Were these predator-prey interactions equal across species? Were there larval fish "winners" and "losers" as a result of the change in zooplankton prey? What role does "normal" environmental variability play in these predator-prey dynamics?

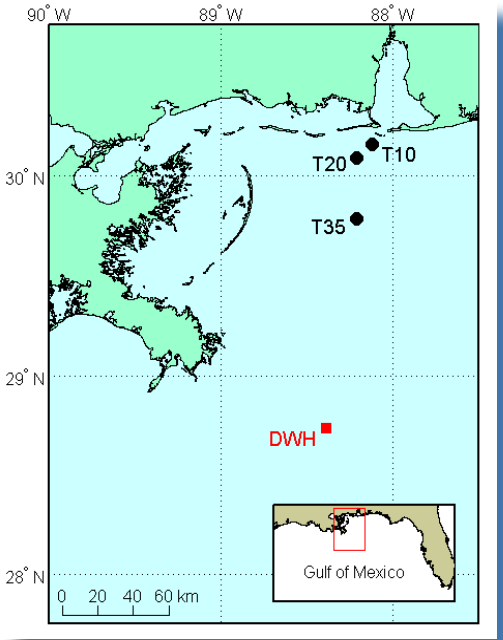

Figure 1. Locations of FOCAL sampling stations (T10, T20, T35) relative to the location of the Deepwater Horizon oil rig where it sank in 2010.

At the core of this research effort are data from one of the few pre-DWHOS plankton surveys in the region with high temporal (monthly) and spatial resolutions (three cross-shelf stations, each with vertically-discrete sampling; Fig. 1). The Fisheries Oceanography of Coastal Alabama (FOCAL) program was initiated by Dauphin Island Sea Lab scientists in 2004 to assess potential impacts of a proposed liquefied natural gas facility. With additional funding support from the State of Alabama's Department of Conservation and Natural Resources, Marine Resources Division, the study continued through 2012. The current project is supported by the Gulf of Mexico Research Initiative (*research.gulfresearchinitiative.org/research-awards/projects/?pid=221*), and includes funding for additional surveys (May–August, 2013–2015). The combined time series provides a wealth of data for comparing baseline (2004–2009), impact (2010), and recovery (2011–2015) periods.

To determine the effects of the DWHOS event on larval fishes, we are currently comparing diets, growth, and condition of larval fishes collected during baseline, impact, and recovery periods. Fish diets are being characterized by examining gut contents and available prey in the water column. We will also explore using stable isotope measurements of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in fish tissue to: (1) determine whether oil carbon was transferred up through the lower food web to the fish (using $\delta^{13}C$), and (2) examine temporal changes in the diets/trophic position of larvae at length (using $\delta^{13}C$ and $\delta^{15}N$). Fish growth will be quantified using daily growth rings in sagittal otoliths (Fig. 2) and length-at-age relationships. Fish condition will be determined using measurements of critical body dimensions (e.g., eye diameter, depth at pectoral fin, head length) and deviations in body dry weight at length.

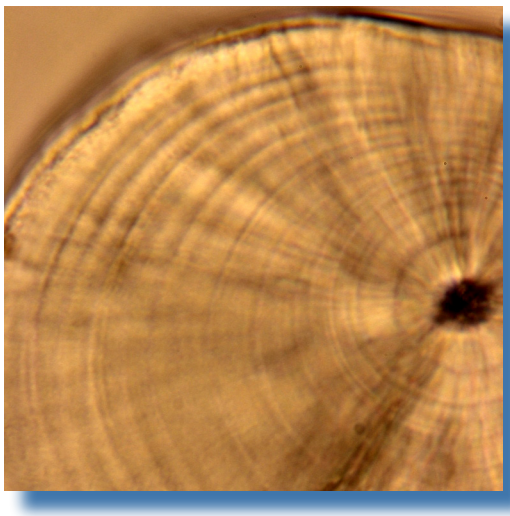

Figure 2. Image of a sagittal otolith (radius = 60 µm) extracted from an 11-day-old Spanish mackerel larva.

Three target species have been chosen for analyses, each with ecological and/or fisheries importance: Spanish mackerel (*Scomberomorus maculatus*), red snapper (*Lutjanus campechanus*), and Atlantic bumper (*Chloroscombrus chrysurus*; Fig. 3). Our efforts to date have focused mainly on Spanish mackerel, led by John Ransom (MS graduate student).

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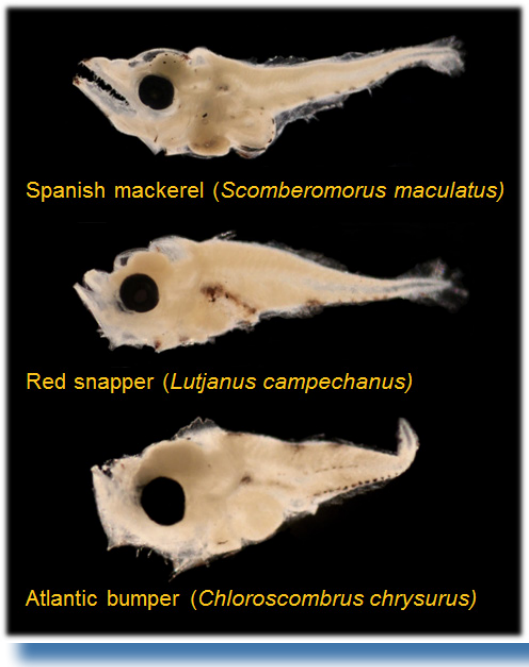

Figure 3. Images of larval fish for target species in the current study. (Notochord lengths from top to bottom: 4.5, 3.1, 2.2 mm).

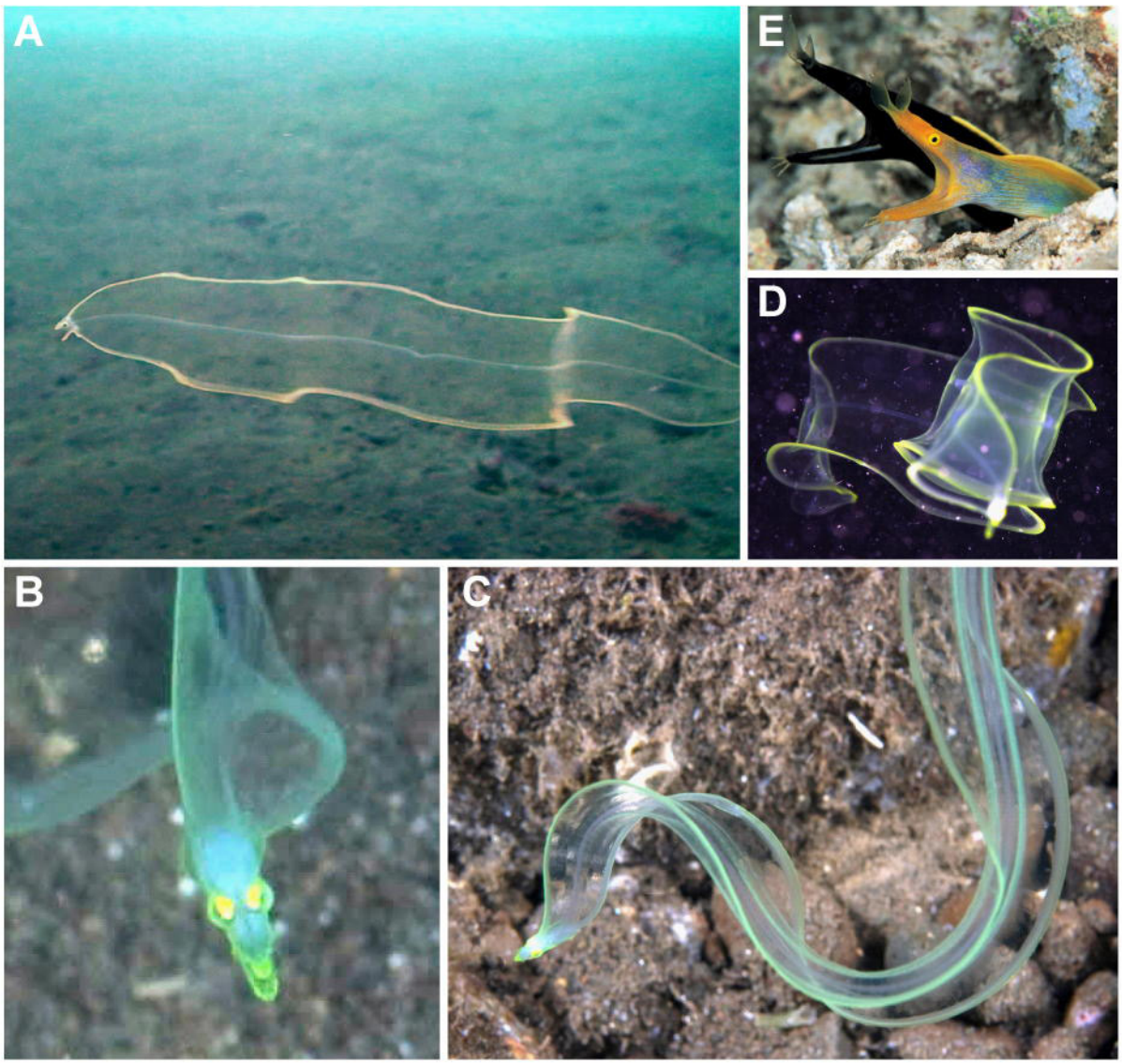

Fig. 1. Photographs of the large muraenid leptocephali seen at (A) Bali, by Rob Rutgers (Netherlands), (B, C) Sangeang Island, by Jerry Powel (USA), (D) Lembeh Strait, by Tunç Yavuzdoğan (Turkey), and (E) ribbon eels in Indonesia, by Tony Wu (Japan).

Pacific Rim...cont'd from p. 3

Ribbon eels are distinctive for their ribbon-like bodies, widely opening jaws, and large protruding nostrils. The head and body shapes and protruding nostrils of these leptocephali were similar to ribbon eels (Fig. 1), but future DNA matching or observations of transformation into the eel stage will be needed to confirm their identity.

The leptocephali appeared to be entering shallow habitats at an early stage of their metamorphosis into young eels and looking for places to hide when they were filmed or photographed. A video clip of four of these larvae from different locations that is associated with the Miller et al. (2013) paper can be seen online: (*australianmuseum.net.au/BlogPost/Fish-Bits/Large-Muraenid-Leptocephali*). The video recordings and photographs of these leptocephali that were made by divers from the Netherlands, Turkey, the United States, England, and Japan are some of the best views of live leptocephali in nature that are available so far. This study is a good example of using the observations made by recreational divers and underwater photographers to advance scientific knowledge about larval fishes. Interestingly, ribbon eels have recently spawned and produced early stage leptocephali in captivity in an aquarium in an Austrian zoo, allowing the early larvae of ribbon eels to be seen for the first time: (*www.zoovienna.at/news/weltweit-erste-muranen-nachzucht-im-tiergarten-sch*).

References

Miller, M. J., Rutgers, R., Haythorne, B., Yavuzdogan, T., Obata, S., Wu, T., Rutgers, H., Powell, J., and Tsukamoto, K. (2013) Observations of large muraenid leptocephali in coastal Indonesia: locations of sightings and behavior of the larvae. *Marine Biodiversity Records* 6:e82, 1–8.

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Stages

European Region...cont'd from p. 2

our understanding on how these aspects may influence behavioural patterns relevant for dispersal and habitat detection.

Specifically, the following questions will be addressed: (1) Will ocean acidification affect the ability of temperate fish larvae to use olfactory cues for predator detection? (2) Will larvae reared in acidification conditions be able to detect reef sounds? (3) Is ocean acidification affecting brain function, therefore compromising important behaviours, such as lateralization? (4) What are the effects of CO_2-induced ocean acidification on the embryonic and larval life histories of temperate reef fish species and on the size, shape, and symmetry of larval otoliths? (5) Will exposure to acidification affect individual swimming performance?

The experiments will be conducted on wild-caught and laboratory-reared larvae. The former will be collected at the Arrábida Marine Park (where the team has been working for several years) using light traps. Lab-reared larvae will include benthic and pelagic spawners, two clingfishes (Gobiesocidae), *Lepadogaster purpurea* and L*epadogaster lepadogaster*. The pelagic model species will include, so far, the sparid *Diplodus sargus* (Sparidae).

Three different scenarios of ocean acidification were chosen: pH 8.15 (control), pH 7.8, and pH 7.6, which simulate ocean pH levels expected to occur ca. 2100 due to present and future CO_2 emissions.

The expected results from this innovative project will provide a better understanding of the consequences of predicted ocean acidification on early life traits and behaviours directly involved in larval survival with consequences for future replenishment and sustainability of marine populations. The project outputs will provide evidence for a first comparison between potential consequences of acidification in temperate and tropical reef fish larvae by contrasting the results obtained with the currently available literature. §

38th annual Larval Fish Conference...cont'd from p. 1

2) Larval dispersal and population connectivity (keynote speaker: Dr. Paul Snelgrove, Memorial University of Newfoundland, Canada).

3) Contribution of early life history studies to the management of fish populations (keynote speaker: Dr. John Farrell, SUNY College of Environmental Science and Forestry, USA).

4) Larval development: How physiological tools can be used for studying global challenges? (keynote speaker: Dr. Guy Claireaux, Université de Bretagne Occidentale, France).

5) Ecology, modeling, and emerging issues for fish early life history in the Laurentian Great Lakes (keynote speaker: Dr. Stuart Ludsin, Ohio State University, USA).

6) Contributed papers.

Important dates:

February 28, 2014 - Abstract submission deadline (LFC website: *www.larvalfishcon.org/Conf_home.asp?ConferenceCode=38th*)

Southern Region...cont'd from p. 4

Feeding incidence of subsampled Spanish mackerel larvae (n = 97) was low (18%), with diets comprised of unidentified larval fish and various crustacean zooplankters. The smallest piscivorous larva was only 3 mm long, and the guts of one 9-mm larva contained two larval fish. Initial analysis of otoliths extracted from Spanish mackerel collected during 2011 (n = 27) show that radial otolith growth is a good proxy for somatic growth in length, with an average body growth rate of 0.7 mm d^{-1}. Perhaps the most interesting result to date is condition of Spanish mackerel larvae based on critical body dimensions. Across all years (2009–2011), larvae hatched in May are in poorer condition (with smaller heads and shallower bodies) than those hatched in June, July, and August. The seasonal pattern of larval condition in 2010 was similar to those in other years. For the remainder of this research project, we will continue to investigate DWHOS impacts on larval Spanish mackerel (an early piscivore), and also extend our analyses to red snapper and Atlantic bumper, two species with more typical, zooplanktivorous early feeding modes.

In addition to the species-specific studies, ichthyoplankton assemblage dynamics are currently being analyzed, led by Dr. Jesse Filbrun (postdoctoral researcher). Analyses to date suggest no differences before, during, and after the DWHOS event (in contrast to the zooplankton analysis). Moreover, total larval fish abundance, family richness, and abundances of selected species did not differ among periods. Changes in the zooplankton community without concurrent shifts in larval fish assemblages, however, implicates the potential for sublethal effects on larval fishes. A parallel investigation used molecular identification of fish eggs collected with neuston nets in 2010 to provide the first ever description of an egg assemblage for the region. Importantly, this effort (led by Drs. Frank Hernandez and Keith Bayha) identified approximately 30 species whose eggs were at high risk of exposure to surface oil and dispersant, a list which included a diverse suite of taxa (dominant species included blackwing searobin, Spanish mackerel, little tunny, scaled sardine, sand seatrout, and whitebone porgy, among others).

It has been nearly four years since the DWHOS released millions of barrels of oil into the northern Gulf of Mexico, and the impacts on fisheries and their environment are still largely unknown. Ultimately, our results will fill critical information gaps needed by marine ecologists and fisheries managers to understand and predict the short- and long-term effects of the oil spills on important commercial and recreational fisheries in coastal ecosystems. §

March 7, 2014 - Notification of abstract acceptance

March 14, 2014 - Submission deadline of accepted abstracts through AFS portal

August 17-21, 2014 - Meeting dates

— Dominique Robert (*dominique.robert@mi.mun.ca*)
Pascal Sirois (*pascal_sirois@uqac.ca*)
(on behalf of the organizing committee)

Bill Leggett to Receive Ahlstrom Award

The Early Life History Section of the American Fisheries Society will present its prestigious Elbert H. Ahlstrom Lifetime Achievement Award to Dr. William C. Leggett at the 38th annual Larval Fish Conference, to be held in Québec City in conjunction with the 144th annual meeting of the American Fisheries Society from 17 to 21 August 2014. The presentation will be part of the LFC program.

The exceptional contributions of Dr. Leggett to our understanding of the early life history of fishes have inspired the careers of a number of fisheries scientists worldwide and have led to major progress in fish ecology and studies of recruitment dynamics. In a plenary tribute session chaired by Dr. R. Christopher Chambers, former PhD students and postdoctoral fellows of Dr. Leggett's laboratory will present an overview of their research programs featuring early life stages of fish. Invited speakers include:

Dr. Kenneth W. Able (Institute of Marine and Coastal Sciences, Rutgers University, USA)

Dr. Julian J. Dodson (Biology Department, Université Laval, Canada)

Dr. Louis Fortier (Biology Department, Université Laval, Canada)

Dr. Kenneth T. Frank (Bedford Institute of Oceanography, Department of Fisheries and Oceans, Canada)

Dr. Thomas J. Miller (Chesapeake Biological Laboratory, University of Maryland, USA). §

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

and reproductive scientists to begin to understand the complex interactions between these processes and how they affect spatial ecology and productivity.

With great pleasure I want to inform you that Dr. William C. Leggett has been selected to be given the "Elbert H. Ahlstrom Lifetime Achievement Award in recognition of his exceptional contribution in fish early life history research. His overall contribution to the fields of larval fish ecology and recruitment research is exceptional, both by the quality and impact of his research. He has provided intensive training of the next generations of scientists and served the American Fisheries Society in a variety of functions. The research performed and the results achieved by himself and his team have inspired numerous early life history scientists and have had a profound influence on this field of research. Therefore, I'm delighted to announce that the Early Life History Section of AFS will present its prestigious Elbert H. Ahlstrom Life Achievement Award to Dr. William C. Leggett, as part of the LFC program in Quebec City. The local hosts Dominique Robert and Pascal Sirois are organizing a plenary tribute session chaired by Dr. Chris Chambers, in which Dr. Leggett's former PhD students and postdoctoral fellows (Dr. Kenneth W. Able, Dr. Julian J. Dodson, Dr. Louis Fortier, Dr. Kenneth T. Frank and Dr. Thomas J. Miller) will present an overview of their research programs featuring early life stages of fish.

I have another very joyous announcement to make. There has been a very generous donation of "leftovers" from Sue Sponaugle, host of the Larval Fish Conference in Miami in 2013, to our section to be used for student travel support. Thank you very much, Sue, for this great support for our student participants. This means that we will be able to support some student travel for the AFS/LFC meeting in Quebec City in August this year and in more years to come. More detailed information on how to apply will be placed on the LFC web page soon.

I think that we have a very fascinating and interesting meeting coming up this year. Besides celebrating the 100th anniversary of Hjort's contribution on mortality, we will learn more about larval dispersal and population connectivity and be introduced to ecology, modeling, and emerging issues for fish early life history in the Laurentian Great Lakes. Sessions on how physiological tools can be used for studying global challenges and contribution of early life history studies to the management of fishes are excellent examples of how we can deepen our understanding and increase the discussion with other AFS sections members.

REMINDER

Deadline for sending contributions for the next issue of ***Stages****:*

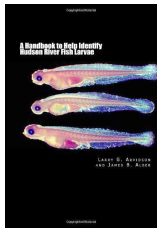
May 3, 2013

So, submit your abstracts to the Larval Fish conference using the LFC web page now. Please notice that the formalities are different this year. Dominique Robert and Pascal Sirois will initially collect abstracts through the Larval Fish Conference portal until February 28. The local steering committee will then review proposed contributions and send a notification of acceptance to corresponding authors by March 7. While the steering committee will submit a proposed presentation schedule with titles of contributions to AFS, all authors will need to re-submit their accepted abstracts to the AFS submission portal by March 14.

With this I wish you all success with your research and enjoyment with the interesting work you all are doing. §

— Catriona Clemmesen-Bockelmann, President

Publications



Available now: *A handbook to help identify Hudson River fish larvae.*

By L. G. Arvidson and J. B. Alber.

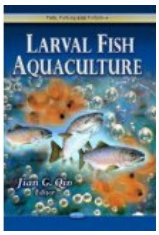
Published by the authors, Rosendale, New York. 2013.

With recent studies demonstrating an alarming decline in many species of fish living and breeding in the Hudson River, a new book by limnologists Larry G. Arvidson and James B. Alber offers professionals and laymen a view of the less seen aspect of the lives of fishes: A Handbook to Help Identify Hudson River Fish Larvae.

The Hudson is an unimpeded corridor from the Atlantic to ancestral spawning grounds and a nursery for many diadromous species as well as nonmigratory ones. Draining parts of the Adirondacks, Catskills and the Berkshires, the springtime runoff yields a rich broth of nutrients, minerals & plankton that sloshes back and forth on twice-daily tides nurturing the young fish. Its 13,500-square-mile watershed makes it one of the two principal spawning grounds of the east coast of North America.

Using a Nikon PFM system on a stereozoom microscope the authors photographed larvae as small as 2.5 millimeters in length on highspeed color film. Striped bass, bay anchovy, and sturgeon are among the more than 25 species pictured in full color detail. Simplified line drawings and a dichotomous key supplement the 52 photographs of field-collected specimens. A glossary and an extensive, detailed reference list may assist investigators in their task of evaluating the large variety of fish stocks living in the 315-mile-long river.

The authors believe their "Handbook..." to be the first of its kind for the Hudson River. Priced at $23.00, the book is now available at *CreateSpace* or *Amazon*. §



Available now: Larval Fish Aquaculture.

Edited by Jian G. Quin.

Published by Nova Science Publishers, Inc.. ISBN:978-1-62417-899-3. 2013.

Aquaculture continues to grow more rapidly than all other animal food-producing sectors. The gap between seafood supply and market demand suggests a great potential for aquaculture development to meet the needs of seafood consumers. Larval fish rearing is a bottleneck to supply sufficient quantity and high quality of fingerlings for grow-out production. This book aims to provide comprehensive references on larval fish aquaculture. Specifically, it attempts to update the recent development in larval fish feed and feeding, environmental manipulation and hatchery management and to suggest future research needs for improvement of production efficiency in larval fish culture. Currently no book of this kind is available to cover major issues in larval fish aquaculture from an environmental, biological and managerial perspective. This book starts from environmental factors including temperature, salinity and light, and then extends to the major biological and managerial issues in larval fish rearing including live feed production, feeding and digestion, gas bladder development, metamorphosis, cannibalism control and weaning strategies. This book will become a useful reference text for researchers and hatchery managers advancing knowledge in larval fish rearing and a supplementary textbook for advanced courses in larval fish biology and aquaculture.

Eight chapters, three chapters authored by four U.S. contributors. §

Other Publications

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...continued on p. 9

continued from p. 8

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