STAGES

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INSIDE THE ISSUE

ELHS Back in the Days

10 years ago: Larval fish taxonomist Dr. Mueno Okiyama, has passed

20 years ago: New webpage for the Larval Fish Conferences established

30 years ago: LFC held with JMIH at UT in Austin. First electronic only (diskette or email) abstract submission

MESSAGE FROM THE PRESIDENT

Dear ELHS friends and colleagues:

Happy Winter! I hope you all are doing well and not drowning in work like me. And if you are, with any luck, you like what you are doing! My advice to early career folks – learn how to say "no" so you can keep your personal and professional life manageable. This is a lesson that I never learned but wish I had. But enough about me…

I want to start by acknowledging and congratulating those who played a role in the recent Early Life History Section elections. First, I want to thank **Hannay Murphy**, our Section's Secretary, who led and coordinated the elections. They ran smoothly and successfully, which is a testament to Hannah being so organized and on top of things. Second, I want to thank all those who ran for a position. We had a great slate of candidates, which is encouraging to see, as it shows that our Section is valued by its members. I encourage everyone to considering running for open positions in the future, if you have the time and desire. All you need to know can be taught or learned along the way. Third, I want to congratulate those who were elected to governance positions, including **Susana Garrido** as President-elect, **Rebecca Asch** as Treasurer, **Kelsey Swieca** as Secretary-elect, and **Stacey Ireland** as the Northcentral Region Representative. We have a great leadership group ready to take over at the conclusion of the 47th Larval Fish Conference in May 2024, and a bright future ahead for the Section.

Speaking of the Larval Fish Conference (LFC), I encourage you to block off your calendars for LFC 47, which will occur in person during Sunday-Thursday, May 12-16, 2024, with a larval fish identification workshop that you can sign up for on Friday, May 17th. The conference will occur on the southern shore of Lake Erie at Sawmill Creek Resort (Huron, OH) with the larval fish identification workshop occurring a boat ride away at Ohio State University's Stone Laboratory on Gibraltar Island (Lake Erie). Additionally, the Early Career Committee is organizing a "Tips to Avoid Scientific Burnout" workshop, which will occur on Wednesday evening; it also will NOT overlap with the Business meeting so that early career folks can attend both events! And, as mentioned in previous STAGES newsletters, LFC 47 will be held in a resort setting with access to all sorts of nearby entertainment on the resort proper and nearby. Excursions we are arranging include a tour of Stone Lab with a Lake Erie Science Cruise, a tour of a local fish hatchery, charter boat fishing opportunities, and hiking/kayaking. I am also working with a team of scientists to organize a diverse science program that should engage freshwater and marine folks alike. We will also be able to support lots of student travel, owing to great sponsorship from Great Lakes agencies and universities, and are working hard to keep costs to all registrants as low as possible.

More information about LFC 47 can be found at https://larvalfishconference.com/, with more details expected to emerge throughout the winter.

I wish you all the best during the remainder of your fall and into early winter when I will provide my next update. As always, please reach out if you have any thoughts on how to improve the Section, questions about it or the upcoming LFC, or an interest in volunteering to help with the LFC 47 or Section in general.

Sincerely,

Stu Ludsin

ludsin.1@osu.edu

EARLY CAREER COMMITTEE

The Early Career Committee update & perspectives from the LFC46 survey results

The Early Career Committee (ECC) is an ad-hoc committee that aims to recruit and engage the next generation of larval fish scientists in the Early Life History Section (ELHS) of the American Fisheries Society (AFS). Every year the ECC typically plans and facilitates an Early Career Workshop in coordination with the AFS ELHS Executive Committee (ExComm) to increase engagement of early career scientists, share relevant professional skills, and provide networking and community-building opportunities not only at the annual Larval Fish Conference (LFC), but also at the Section level. Following the LFC46, we are happy to report that the ECC welcomed two new members (Emma Siegfried and Sagi Otorgust) — and we always welcome more! Please email afs.elhs@gmail.com if you are interested in joining the ECC.

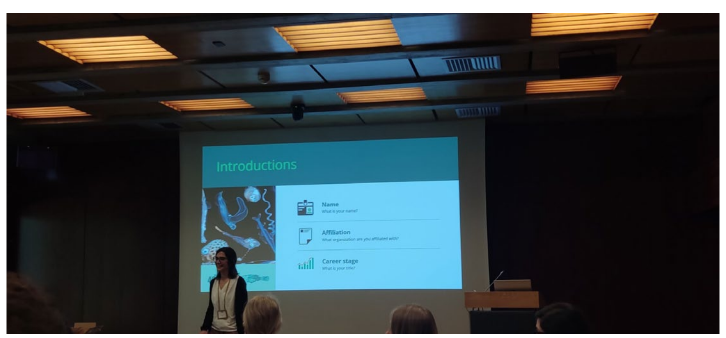

Fig. 1: Marta Moyano leads the LFC46 ECC Workshop.

Another responsibility of the ECC includes facilitating the post-conference survey. In 2023, 52 individuals participated in the survey and provided essential feedback on attendee demographics, interests, and experiences that will help the Section tailor future events to better meet our member's needs.

Demographics

Nearly 40% of the 2023 survey participants were first-time attendees of the LFC. More than half of the responders were senior researchers, 11% were post-doctoral scholars, and roughly 30% were students (n = 1 undergraduate; n = 14 graduate). Interestingly, the number of survey participants with 25+ years of experience in our field was exactly equal to the number with < 5 years (29% each). Most participants traveled to LFC46 from within Europe, followed by Canada. This year's survey indicated that the vast majority of respondents (80.4%) identify as white.

Membership & funding

Similar to previous years, the finances associated with AFS ELHS membership and conference attendance were at the forefront of survey results. Half of the survey participants were neither full nor affiliate members of the AFS ELHS and 16% were affiliate members only. The ECC recommends that the Section consider opportunities to streamline and reduce the financial burden of membership, especially for early career individuals. Some recommendations discussed within the ECC include sponsoring one year of Section membership for LFC student award recipients (talk and poster) and / or offering small membership grants similar to the Section's travel grants. On a similar vein, finances were the main obstacle to LFC46 attendance. Project budgets (50%) and external grants (25%) contributed to the funding of most conference attendees, but more than a quarter also relied on personal funds.

Mode of future conference delivery

This year's survey results suggest that conference participants greatly value in-person interaction, with >90% of responders indicating that a virtual attendance option would not have precluded their desire to attend LFC46 in-person. However, based on the survey results, if conference organizers pursue hybrid delivery in the future, they should consider offering entire days or sessions for virtual participation at a reduced cost.

Early Career Participation

The ECC planned and coordinated the LFC46 Early Career Workshop entitled 'Scientific Communication to a General Audience'. Graciously hosted by Dr. Marta Moyano (thank you!), this face-paced interactive session was well-attended and received (Fig. 1). Nearly 20% of survey responders participated, with one highlighting how meaningful participatory events like this year's workshop are to their networking and community development. In addition to workshop feedback, the survey provided essential insights into opportunities to increase engagement of early career scientists in the ELHS (Fig. 2). Multiple survey responses discussed the need to prevent scheduling of the Early Career Workshop and the Annual Business Meeting during the same conference timeslot. Precluding early career scientist participation in the Section's business matters reduces inclusivity, transparency, and institutional knowledge. The ECC is excited about the opportunity to discuss this finding with future conference organizers and work to adjust conference agendas accordingly.

With the 2023 LFC over, it is now time to begin planning for the 47th Larval Fish Conference, which will be held in Huron, Ohio (USA) on May 12-16th, 2024. In Ohio, we hope to continue our commitment to early career development by

Fig. 2: Participants of the ECC workshop at the LFC 46.

hosting another professional skills workshop. Responses to this year's survey suggest that the next Early Career Workshop will be focused on 'paper reviewing skills and strategies' or 'tips to avoid scientific burnout'. Please reach out to afs.elhs@gmail.com if you or someone you know would be interested in sharing expertise and helping the ECC host an event on one of these important topics! As always, thank you so much for your dedication to the ELHS and check out our Facebook page (@earlylifehistory) and Twitter account (@AFS_ELHS) for updates from our colleagues around the world.

NEWS FROM THE REGIONS

NORTHEAST REGION
KATEY MARANCIK

By Sarah Weisberg - Think larval fish work is esoteric? Built for the nerdy taxonomist, who loves to be alone with a microscope and some dichotomous keys? One moment inside our lab might cause you to reconsider.

This past summer, I assembled a team of high school and undergraduate women, based in the New York metropolitan area (Figure 3). Before arrival, they might not have cared about ichthyoplankton. But they came with a love of science, on a quest for research experience. The students found me through different pathways: I recruited one (Olivia Bonilla) with the Sea Grant Community Engaged Internship program, another (Raisa Khan) through AFS's Hutton program, two more (Molly Rubin and Hannah Karkout) via our university's Women in Science and Engineering honors program, and three (Brianna Brookes, Mariah King, and Natasha Gonzales) are connected to me through a years-long partnership built by their high school, East Side Community School, and the non-profit BioBus. Whatever the mechanism, they joined me, a PhD candidate in Janet Nye's lab at Stony Brook University, as paid Research Assistants.

I designed one of my dissertation projects so that it explicitly builds in roles for students who might not have previous experience with larval fish, or even with lab work (Weisberg, 2022). They start by learning how to handle plankton samples collected from offshore New York waters, using the microscope to isolate and image individual fish eggs and lar-

Fig. 3: Cohort of high school and undergraduate students working as paid Research Assistants in the Nye Lab, supporting me (right) with my dissertation research using DNA barcoding to study ichthyoplankton in the New York Bight. From left to right: Natasha Gonzalez, Mariah King, Brianna Brookes, Olivia Bonilla, Raisa Khan. Not pictured (working remotely): Molly Rubin and Hannah Karkout.

vae, which we submit for DNA barcoding analysis. Later, we analyze the sequence information and use it to identify individuals to the species level. Students participating remotely over the summer (Molly and Hannah) also worked to identify larvae visually – they successfully characterized the individual below as *Prionotus carolinus* (Figure 4), differentiating it from the also-common *Prionotus evolans*. I use the data for my dissertation, but also encourage students to spin off their own research projects: they have analyzed interannual variability (Figure 5), and we are working with a physical oceanographer to back out probable spawning locations of various species (as in Harada et al., 2015).

Fig. 4: Larva visually identified as *Prionotus carolinus* by undergraduates, after DNA barcoding analysis was unsuccessful.

The research is fascinating – to date, we have identified over 1,200 individuals of 33 species – but, perhaps more importantly, it is fun. Laughter filled the hallways all summer long, and the students created a community – a cohort. This not only made the long commute (over 4 hours daily, on the not-always-reliable Long Island Rail Road) pass more quickly, but it is key for building a more inclusive culture in our predominantly white field (Behl et al., 2021).

Now the fall is here and students have scattered to classrooms, each on a unique trajectory. But they have all told me that the lab experiences helped boost their confidence and a sense of belonging, not only in larval fish work but in the scientific community more broadly. And I wonder – might you also be able to leverage your research to welcome new members to this community?

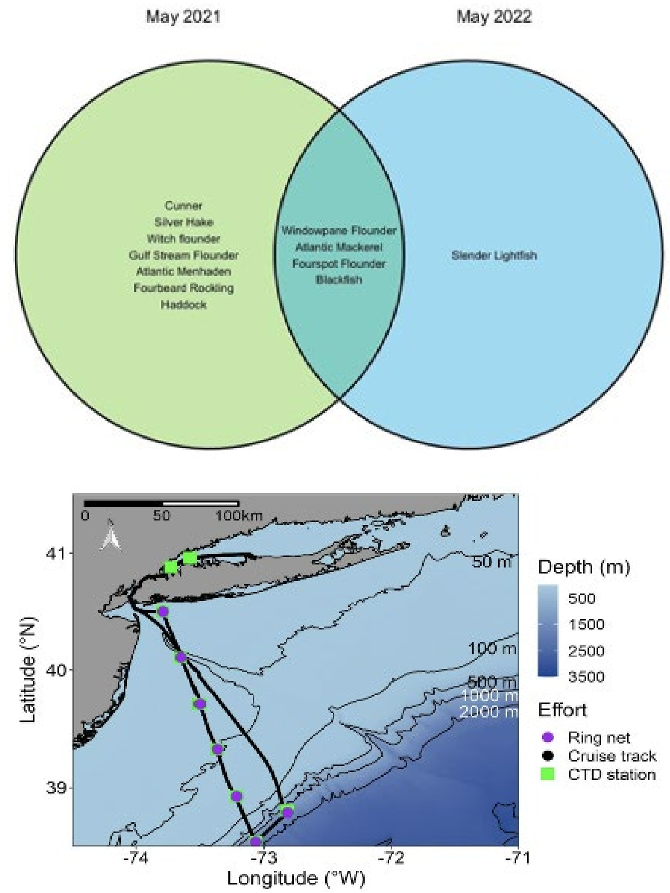

Fig. 5: A Interannual comparison of DNA barcoding results conducted by undergraduate students, showing the differences of species present during two successive May cruises (2021 and 2022). **B** Cruise track and locations of ring net sampling, for both years. May 2021 showed greater species abundance and diversity, compared to May 2022.

References

Behl, M., Cooper, S., Garza, C., Kolesar, S.E., Legg, S., Lewis, J.C., White, L., Jones, B., 2021. Changing the Culture of Coastal, Ocean, and Marine Sciences: Strategies for Individual and Collective Actions. Oceanography 34, 53–60.

Harada, A.E., Lindgren, E.A., Hermsmeier, M.C., Rogowski, P.A., Terrill, E., Burton, R.S., 2015. Monitoring Spawning Activity in a Southern California Marine Protected Area Using Molecular Identification of Fish Eggs. PLOS ONE 10, e0134647.

Weisberg, S. Pipeline, Pathway, Burrow: Reworking Science's Metaphorical Terrain. Historical Studies in the Natural Sciences 525(5): 629–639 (2022).

SOUTHERN REGION
TRIKA GERARD

Nitrogen Sources, Food-Web Dynamics and Habitat Quality for Larval Southern Bluefin Tuna in the Eastern Indian Ocean

Southern bluefin Tuna (SBT, *Thunnus maccoyii*) migrate long distances from their feeding grounds to spawn exclusively in a small oligotrophic area of the tropical eastern Indian Ocean (IO) that is rich in mesoscale structures, driven by complex currents and seasonally reversing monsoonal winds. To survive, SBT larvae must feed and grow rapidly under environmental conditions that challenge conventional understanding of food-web structure and functional relationships in poor open-ocean systems. This NSF-funded project is a US contribution to the 2nd International Indian Ocean Expedition (IIOE-2) that advances understanding of biogeochemical and ecological dynamics in the poorly studied eastern Indian Ocean The BLOOFINZ-IO (Bluefin Larvae in Oligotrophic Ocean Foodwebs, Investigations of Nutrients to Zooplankton – Indian Ocean edition) Program sampled the SBT spawning grounds during the 2022 spawning period aboard the RV *Roger Revelle* (Figure 6). Our main focus is to understand variability in Nitrogen sources, food-web fluxes and their relations to habitat quality for the early larvae of SBT in the Indian Ocean. We have multiple objectives including to a) assess SBT distribution, abundance and spawning in the region, b) examine sources and processes of nitrogen supply to primary producers and zooplankton supporting SBT, c) investigate variability in these processes across mesoscale features, d) analyze food-web structure, trophic fluxes and their influences on SBT larval trophodynamics and growth. In addition, a multidisciplinary approach utilized Lagrangian experiments to measure water-column ^{14}C productivity, N_2 fixation, $^{15}NO_3$- uptake and nitrification; community biomass and composition (flow cytometry, pigments, microscopy, *in situ* imaging, genetic analyses); and trophic fluxes through micro- and mesozooplankton grazing (Figure 7), remineralization and export.

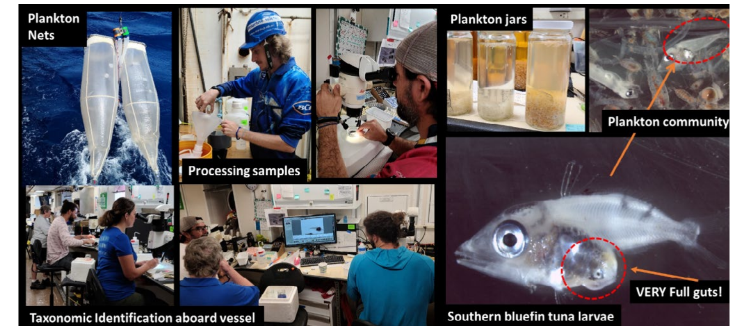

Fig. 6: Research cruise operations on cruise RR2201 of R/V Roger Revelle January-March 2022

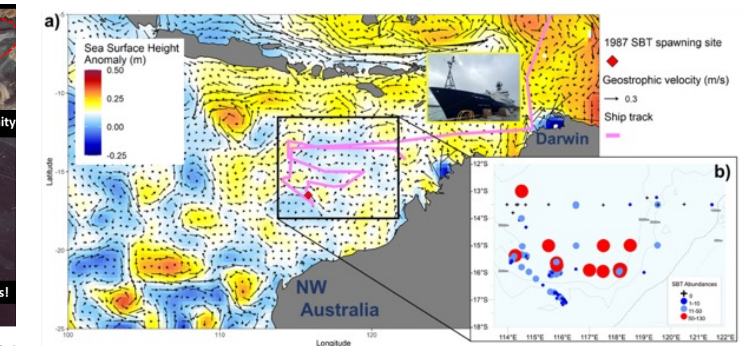

Fig. 7: A The cruise track, sea surface height (m) anomaly plus geostrophic velocity is indicated during the 2022 survey (2 Mar 2022); **B** preliminary presence/absence and SBT abundances are indicated as bubble plots for raw counts in the study area.

For more information, please contact Estrella.malca@noaa.gov or ddie@rsmas.miami.edu

NORTCENTRAL REGION
ED ROSEMAN

Pre-restoration Ichthyoplankton Assessment in the Boardman/Ottaway River, Michigan, USA

Robin DeBruyne and Ed Roseman, U.S. Geological Survey Great Lakes Science Center

The U.S. Geological Survey Great Lakes Science Center Fish Early Life History Lab, led by Drs. Robin DeBruyne and Ed Roseman, started a new larval fish field research program on the Boardman/Ottaway River in spring 2023 to provide information in support of the Great Lakes Fishery Commission's FishPass project. FishPass (http://www.glfc.org/fishpass.php) is the capstone of a two-decade restoration project on the Boardman (Ottaway) River, that will reconnect the river with Lake Michigan in Traverse City, Michigan, USA.

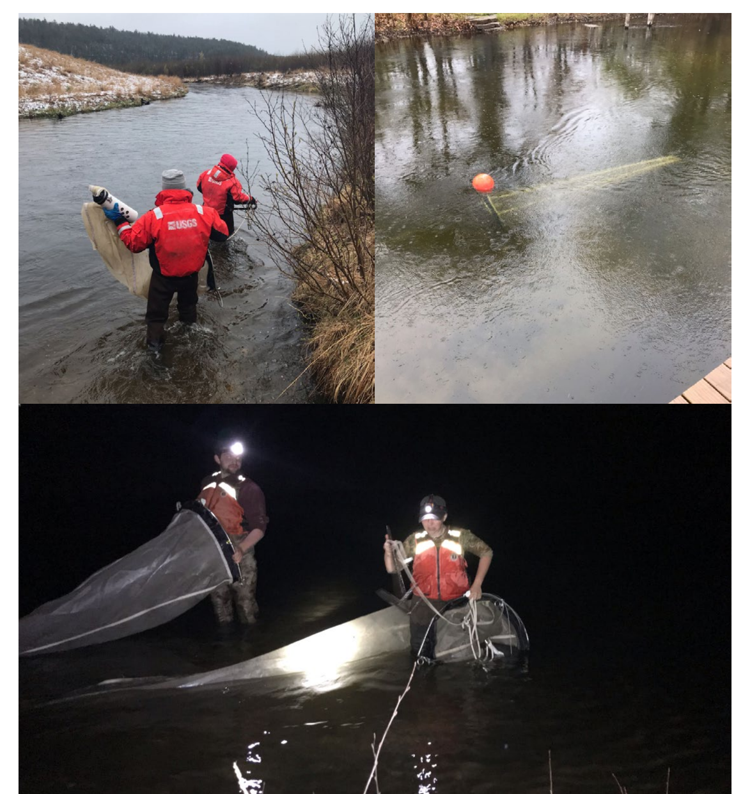

Fig. 8: Setting passive D-frame samplers during day and night surveys. Photo credits: Ed Roseman

Fig. 9: Larva present in May 2023 night sampling event.

The restoration project will replace the deteriorating Union Street Dam with a new, complete barrier to all fish that will have the ability to sort and selectively pass desirable fishes while blocking harmful invaders like sea lamprey. The USGS GLSC lab's efforts are providing preliminary data on the phenology, community composition, and ecology of larval fish drift above and below the dam replacement site. Over 800 samples were collected during day and night sampling in 2023 (Figure 8). Sample processing is in progress and, so far, has revealed catches of Catostomidae, Percidae, Salmonidae, Gobiidae, and Centrarchidae. Population genetics of native Catostomidae are of particular interest to the restoration team, and samples of larvae will be processed by Dr. Jared Homola's genetics lab at the Wisconsin Cooperative Fishery Research Unit at University of Wisconsin Stevens Point (Fig. 9).

PACIFIC RIM REGION
AKINORI TAKASUKA

A recent review paper published in Reviews in Fish Biology and Fisheries provides great future perspectives on ichthyoplankton research based on the research cruises in the Indonesian Seas. Here is a summary of the paper, which I hope that will induce you to read the full review article. Then, I introduce the "Biological Ocean Observer" application tool from Australia.

A Century of Ichthyoplankton Research in Indonesian waters: lessons from the past, challenges for the future

Augy Syahailatua[1,2], Muhammad Taufik[3], Karsono Wagiyo[3], Hagi Y. Sugeha[1], Charles P. H. Simanjuntak[4], Sam Wouthuyzen[1,2], Michael J. Miller[5], and Jun Aoyama[6]

Dominique Robert[1] and Akinori Takasuka[2]

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[6]Otsuchi Coastal Research Center, The Atmosphere and Ocean Research Institute, The University of Tokyo, Otsuchi, Iwate, Japan

A recently published review paper in Reviews in Fish Biology and Fisheries entitled "A Century of Ichthyoplankton Research in Indonesian waters: Lessons from the past, Challenges for the future" by Syahailatua et al. (2023) overviews the history of ichthyoplankton research in Indonesia and presents perspectives on future research. It explains how there were very few published papers or reports on that subject until the year 2000 when collaborations with Japan helped to start increased interest and research activity. Three research cruises were conducted between Indonesia and Japan on the R/V Baruna Jaya of Indonesia to search for the spawning areas of anguillid eels in the Indonesian Seas (Fig. 10). Those surveys along with some surveys of the R/V Hakuho Maru of Japan discovered the short-distance migration behavior of some species of anguillids by collecting their small leptocephali and resulted in collections of many marine eel leptocephali. Those surveys also helped to stimulate new research efforts on ichthyoplankton that included many recent surveys that analyzed the collections of fish larvae (Fig. 11). The review documents these cruises and their general results with some data tables and figures about the composition of tuna larvae, and families of fish larvae and leptocephali. It also presents photographs of some of the collected materials (Fig. 12), and outlines the goals for increasing ichthyoplankton research in Indonesia in the future.

Reference

Syahailatua, A., Taufik, M., Wagiyo, K., Sugeha, H. Y., Simanjuntak, C. P. H., Wouthuyzen, S., Miller, M. J., and Aoyama, J. (2023) A Century of Ichthyoplankton Research in Indonesian waters: lessons from the past, challenges for the future. Reviews in Fish Biology and Fisheries. https://doi.org/10.1007/s11160-023-09802-6

The Biological Ocean Observer

The site of "Biological Ocean Observer" aims to integrate, analyse, and visualise data collected by the Integrated Marine Observing System (IMOS) around Australia. The project provides full open source for the application tool (freely available on GitHub). The major categories of the data in the app include microbial, phytoplankton, zooplankton, larval fish, and environmental data. Please access the site: https://shiny.csiro.au/BioOceanObserver/

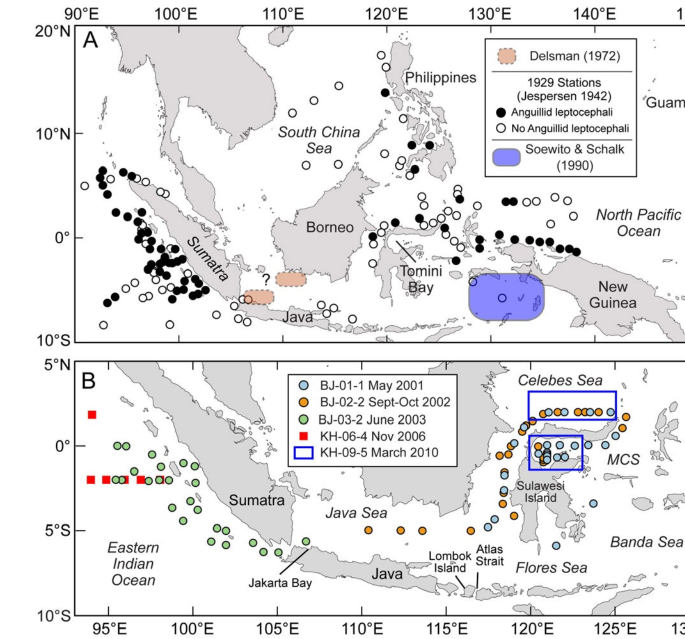

Fig 10. Map of the net sampling stations (small circles) of the Danish Round the World Expedition that collected fish larvae in the Indonesian Seas in 1929 (A), and a map of the IKMT sampling stations for collecting leptocephali that were made in Indonesian waters (B) from 2001 to 2010 by Indonesian (R/V Baruna Jaya VII, BJ) and Japanese (R/V Hakuho Maru, KH) research vessels.

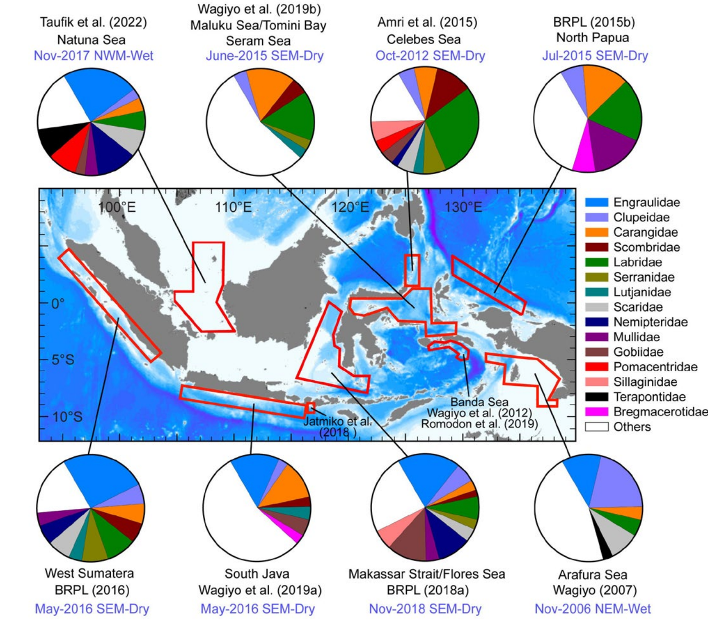

Fig 11. Map of the regions where ichthyoplankton studies have been conducted (red lines) at various times of year, listing some of the studies that have been published and showing the balanced compositions of the collected fish larvae in various studies (pie charts) that show families that comprised at least 2% of the catches, and other less abundant families pooled together (others). The monsoon seasons (NE, NW, SE monsoon) at the time of the surveys are shown.

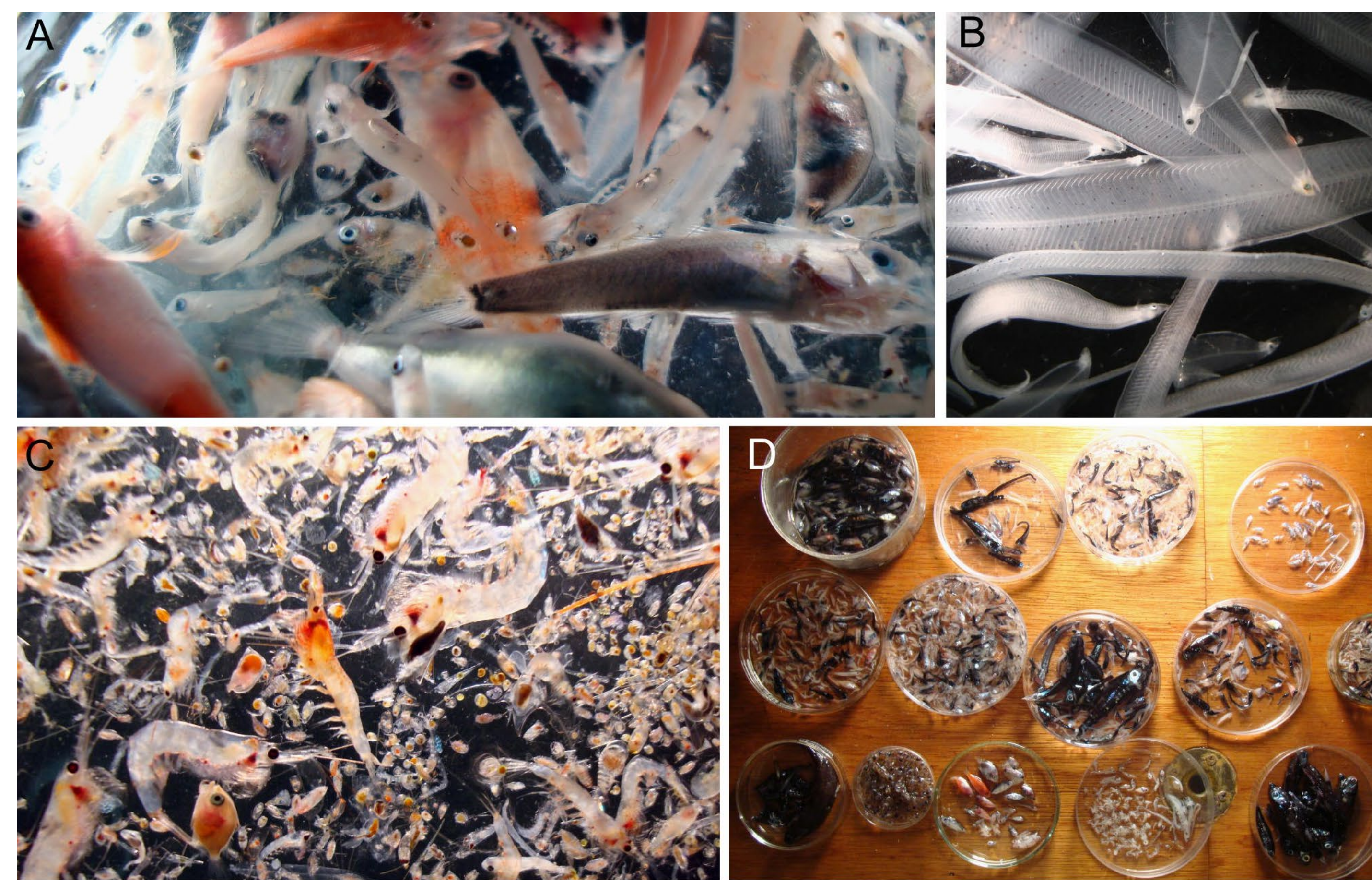

Fig. 12: Photographs of freshly caught fish larvae and post-larvae **A**, mixed leptocephali **B**, a portion of a whole IKMT sample including fish larvae, crustaceans, and pelagic mollusks **C**, and **D** various fish larvae and mesopelagic fishes sorted from one IKMT tow that were all caught in Tomini Bay of northern Sulawesi Island in March 2010 during a Hakuho Maru cruise.

EUROPEAN REGION
CATRIONA CLEMMESEN

Wintertime growth limitation of herring larvae: combining physiological modelling with novel zooplankton observations

Anna Akimova[1], Myron A. Peck[2], Gregor Börner[3], Cindy van Damme[4] and Marta Moyano[5,6]

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While annual monitoring surveys of marine fish larvae are widely used to provide an early view on the potential recruitment success of stocks, these surveys typically do not sample potential larval prey or predators. Given the current technological advances in plankton imaging, we propose that such surveys could be cost-effectively expanded to include the collection of zooplankton data which, in turn, are crucial to assess processes impacting survival such as larval foraging success. We conducted a pilot study using North Sea Autumn Spawning herring (*Clupea harengus*) as a case study species. This herring stock has experienced low recruitment during the past two decades which has been associated with poor larval survival presumedly due to poor feeding success (Payne, Hatfield et al. 2009; Fässler, Payne et al. 2011). However, specific areas and the timing when herring larvae are most prone to mortality via starvation remained uncertain.

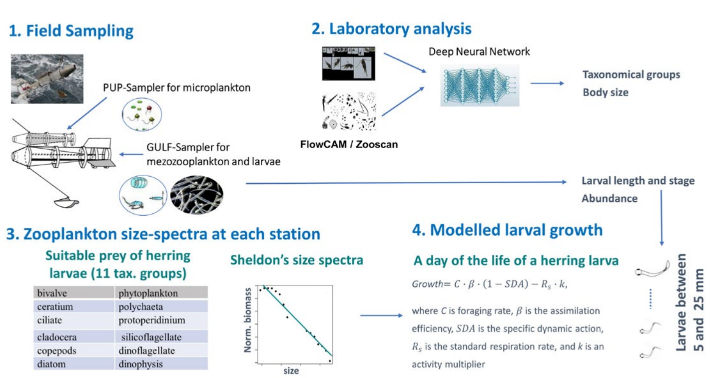

Fig. 13: Flowchart of the methodology encompassing field sampling, laboratory analyses, zooplankton size-spectra and larval modelling.

To comprehensively sample the wide range of zooplankton organisms potentially preyed upon by herring larvae, we employed a dual sampling approach (Fig. 13): a Gulf VII high-speed sampler with 280-µm mesh grid was used to gather herring larvae and large mesozooplankton, while an attached PUP sampler with a 55-µm mesh size captured smaller mesozooplankton and microplankton. In the laboratory, herring larvae were staged and their length was measured. Zooplankton samples underwent image-processing using a FlowCam and ZooScan, complemented by a neural network tool to facilitate the taxonomic identification of the main zooplankton groups (Conradt, Börner et al. 2022). Utilizing the measured individual sizes and counts of the planktonic organisms, we constructed Sheldon's normalized biomass size-spectra (Sheldon, Prakash et al. 1972) at each station. This methodology enabled us to estimate the biomass of microplankton within undersampled size classes.

The collected prey data were integrated into a physiological individual-based model (IBM) to evaluate whether the observed zooplankton was adequate to support growth and survival of herring larvae (Akimova, Peck et al. 2023). Our physiological model determines the energy budget of a herring larva by simulating its food intake through the optimal foraging approach and accounting for larval temperature- and size-dependent metabolic rates. We estimated growth of herring larvae within size classes ranging from 5 to 26 mm, as were observed in the field. Our model outcomes indicated that young-potentially first-feeding herring larvae < 10 mm experienced food-deprivation and starvation at most of the stations in autumn, whereas older and larger larvae exhibited robust growth (Fig. 14). This aligns with Hjort's critical period hypothesis, which postulates a particularly high rate of starvation mortality among first-feeding fish larvae in marine ecosystems (Hjort, 1914). It is worth noting that the actual mortality rate is greatly influenced by the size-distribution of first-feeding herring larvae, a characteristic that is poorly known for this herring stock. In contrast, the winter-spawned larvae, particularly those located in the English Channel, were predicted to face extended periods of food scarcity and to be affected by food-limitation and starvation across all observed size-classes.

Consistent with prior research, we demonstrated that herring larvae must incorporate a significant proportion (up to 40%) of microzooplankton into their diet for positive growth, particularly in areas where zooplankton is scarce. Additionally, our investigation revealed that the size structure estimated for the zooplankton community closely aligns with the op-

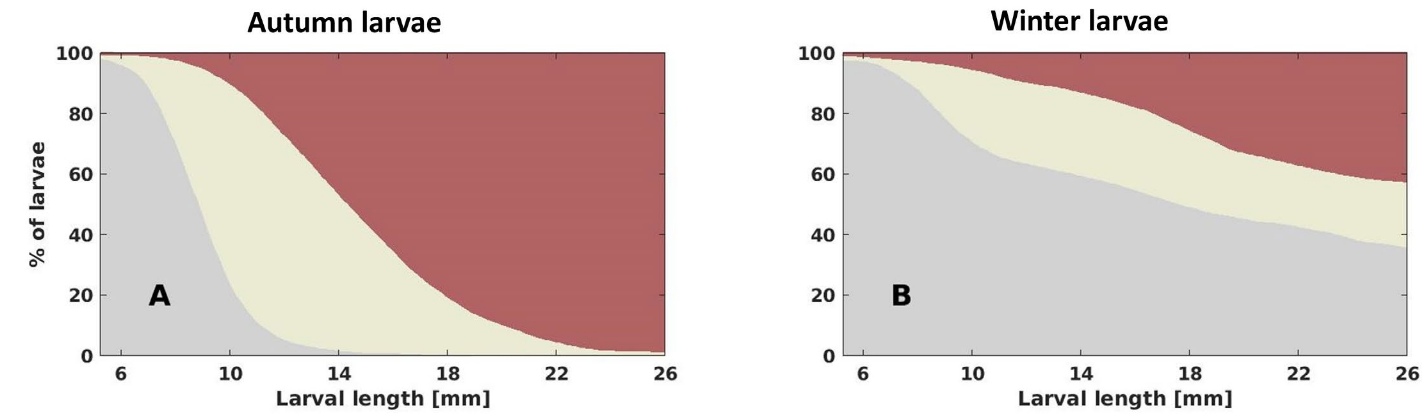

Fig. 14: The fraction of all sampled stations (in %) where herring larvae of different length were predicted to experience starvation (gray), food-limitation (beige) or to grow at their maximal temperature-, light- and size-dependent growth capacity (brown) in autumn **A** and winter **B**.

timal feeding requirements of herring larvae. Potential alterations in the size distribution of zooplankton or in the feeding requirements of larval herring in the future due to climate change could have a detrimental effect on the growth and survival of autumn herring larvae. We estimated that herring larvae will need approximately 35% (28%) more zooplankton in winter (in autumn) to cover their higher metabolic costs due to the +2°C warmer temperatures projected by the end of the 21st century.

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Practical training course on the use of the new software modules of the online tool SmartDots for identification of fish eggs and larvae

Cindy van Damme

SmartDots is an online tool to aid calibration of fish ageing, maturity and egg and larvae identification and staging calibration exercises. http://www.ices.dk/data/tools/Pages/smartdots.aspx This year the SmartDots software was further developed and now has an egg and a larva module included.

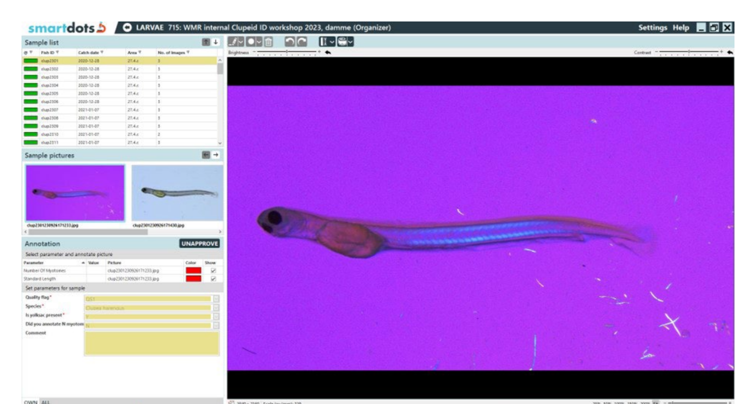

Fig. 15: View of the SmartDots software.

An online 1-day hands-on course, was held on 9th of November to learn how to use the SmartDots web application for setting up events for exchanges, workshops and internal testing and to download data from an egg and larval identification and staging event. Paricipants learned how to use the newly developed SmartDots software modules for eggs and larvae identification and staging.

The course is very practical. At the end of the course, participants were able to set up an event, to download data and to use the different modules of interest for you.

The course was free and open for all. Find out more about ICES: https://www.ices.dk/events/Training/Pages/default.aspx

Herring larvae and Ocean Alkalinity Enhancement: studies in mesocosms and lab*

Silvan Goldenberg, Michael Sswat, Marta Moyano, Gregor Börner, Maria Couret Huertas, Daniel Brüggemann, Arild Folkvord, Ulf Riebesell, KOSMOS team

*presented at the Small Pelagic Fish conference in Portugal

Ocean alkalinity enhancement (OAE) has emerged as a promising negative emission technology to fight the climate crisis (Gatusso et al. 2021). It accelerates a natural process –weathering of minerals –that increases the capacity of seawater to store CO_2 from the atmosphere and by elevating pH, counters ocean acidification. These changes by OAE might have direct physiological effects on marine organisms as well as indirect effects through changes on other trophic levels, but there is still very limited knowledge about these effects (Bach et al. 2019; Gatusso et al. 2021).

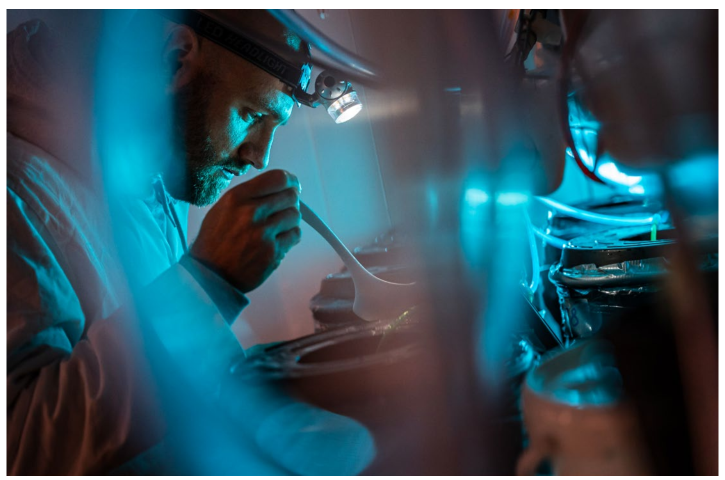

Fig. 16: G. Börner fishing for herring larvae in the lab of UiB. Photo credit: Uli Kunz https://uli-kunz.com

Norwegian spring-spawning herring (*Clupea harengus*) is a perfect case study to study impacts of OAE as its one of the most important commercial fisheries in the North Atlantic (Fig. 16). Herring also play a key intermediate role in the food web. To include both pathways in which OAE may impact herring larvae, we conducted a laboratory experiment to explore direct effects and a mesocosm experiment to explore direct and indirect effects (Fig. 17). A large scale mesocosm study was carried out in spring/summer 2022 on a fully functional pelagic community under different intensities of OAE. In total, ten mesocosms (60 m^3) were deployed for 56 days in the Raunefjord (Norway) from May until early July. Five mesocosms were assigned along a gradient of OAE to each of two alkalization methods, calcium-based and silicate-based OAE. On the day of alkalinity addition, each mesocosm received 100 larval herring (25 days old). Changes in hydrography and plankton community composition and biomass were regularly collected throughout the experiment. The surviving herring larvae were sampled at the end of the experiment and sampled for morphometrics and other characteristics.

Fig. 17: Herring larva from the lab. Photo credit: Uli Kunz https://uli-kunz.com

to study only the direct physiological effect along a gradient of OAE on herring larvae of different ages and thus be able to disentangle both effects in the mesocosms. Here, we created an artificial OAE shock for 10 days (Fig. 18). A total of six tanks were used in the experiment, three that were exposed to the OAE and three that were not. Several physiological and behavioral traits were studied in both treatments, including growth, metabolic rate, and swimming behavior.

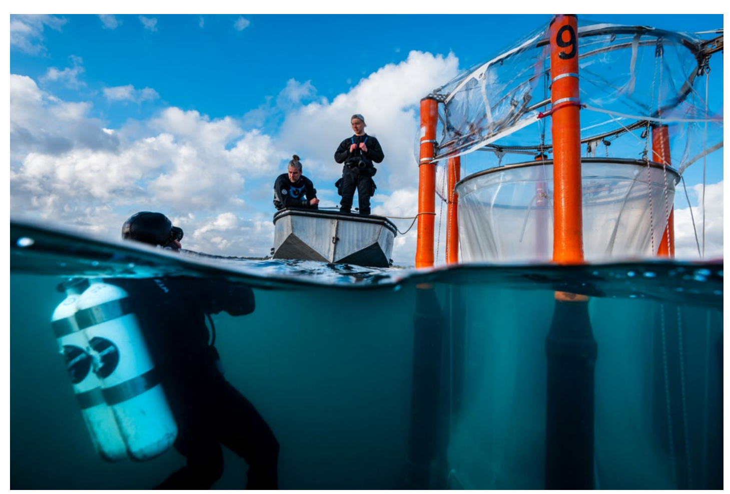

Fig. 18: Mesocosm with divers in Raunefjorden. Photo credit: Uli Kunz https://uli-kunz.com

The results from our experiments will help in guiding decision making on the implementation of carbon-dioxide removal methods, which is urgently needed, and thus we are preparing to submit this work in the next month.

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Quality Standards in Marine Biology: the NMBAQC Scheme

Marianne Wootton, Marine Biological Association mawo@mba.ac.uk

We all appreciate good data, but how can we guarantee that the numbers we are using represent accurate and reliable data? On the flipside, for those involved in organism identifications, it's not uncommon for doubt to creep into one's mind, particularly for the lone practitioner, and to sometimes question if you have made a correct identification.

In 1994, the NE Atlantic Marine Biological Analytical Quality Control (Fig. 19) (NMBAQC) Scheme was set up to address such concerns. It provides a source of external Quality Assurance (QA) for laboratories engaged in the production of marine biological data. In essence, anyone using the data from a participating laboratory can have confidence that certain elements of their practices and results are robust. Equally, those providing the biological data get a shot in the arm of confidence that they are indeed producing quality data.

Fig. 19: NMBAQC Scheme logo.

The NMBAQC Scheme helps to standardise results and methods by providing best practice guides, taxonomic workshops, ring-tests and training exercises. Driven by a need for governments to use the best data available for use in policy, the scheme reports to HBDSEG (the Healthy & Biologically Diverse Sea Evidence Group) under the U.K.'s Marine Monitoring & Assessment Strategy (UKMMAS).

The scheme is made up of seven distinct components, each run by separate scheme administrators and technical managers, and includes: particle size analysis, marine invertebrates; fish; epibiota; macroalgae; phytoplankton and zooplankton.

In July 2023, the Marine Biological Association (MBA) (Fig. 20) held a two-day results and training workshop for the recent NMBAQC zooplankton test with Nalani Schnell as guest speaker (Fig. 21).

Fig. 20: Marine Biological Association logo

Since its inception in 2013, the zooplankton scheme component has been run by Marianne Wootton, Senior Plankton Analyst at the Continuous Plankton Recorder (CPR) Survey, MBA in Plymouth, UK.

The test takes place every two years and participants are required to identify a range of specimens, from crustaceans to cnidarians and phoronids to fish larvae, that they might find in plankton samples from the North Atlantic (Fig. 22). Participants are also asked to complete an enumeration exercise

Fig. 21: Zooplankton ringtest workshop participants outside the Marine Biological Association, Plymouth.

together with a written quiz and are allowed to undertake the test in the comfort of their own laboratory.

Once a deadline has passed and results have been submitted, participants are invited to a results workshop in Plymouth, where all answers (anonymous) are discussed. A scoring system is presented and participants get to decide as a community what the correct answer is, thereby promoting best practice within and between laboratories. After all their hard work on the test, participants are then rewarded with a training session.

This year, the workshop had a fishy theme and guest speakers were Nalani Schnell from the Muséum National d'histoire Naturelle, France, and Linford Mann from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS), UK.

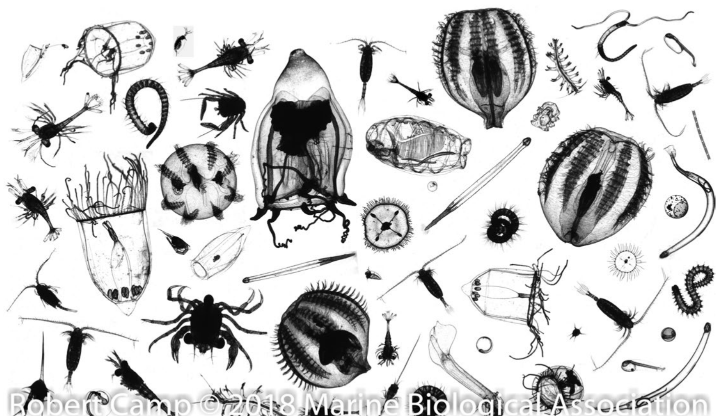

Fig. 22: Mixed zooplankton sample from Plymouth.

Linford started things off with an interesting talk on the International Triennial England Mackerel Egg Survey with fish egg identification practical. This seamlessly led onto Nalani kindly delivering an invaluable lecture on "an introduction to fish larvae identification" followed by a practical session.

The NMBAQC scheme is open to all: from competent monitoring authority laboratories to consultants and both UK and non-UK participants.

Further information is available from the NMBAQC website: http://www.nmbaqcs.org/

LARVA OF THE ISSUE

Fig. 23: Larval stage of *Bathysaurus mollis* (NMNZ P. 062308), collected southwest of New Caledonia.

Earlier this year Elodie Vourey and I described a rare *Macristium*-stage larva of the species *Bathysaurus mollis* (Fig. 23) of the family Bathysauridae, or deep-sea lizard fishes. The Bathysauridae is an aulopiform family with two species in the only genus *Bathysaurus* (*B. mollis* and *B. ferox*). Larval stages of the two species are exceptionally rare and only six were reported for *B. ferox* and five of *B. mollis*, which makes ours the eleventh larvae known since its discovery 120 years ago.

In 1903 Regan described a 110 mm standard length specimen, which he believed was a new species. At the time he was unaware that the specimen was a larval stage. It was in fact the first larval *Bathysaurus ferox*. Regan described it as *Macristium chavesi* (now a junior synonym of *B. ferox*), after Major Chaves from the Ponta Delgada Museum, Azores. Based on the number of fin rays and the position of the fins Regan postulated that the species must closely be allied with the Bathysauridae.

Reference

Konstantinidis, P., Vourey, E., 2023. A rare *Macristium*-stage *Bathysaurus mollis* (Aulopiformes, Bathysauridae) from the South Pacific. Deep-Sea Research Part I-Oceanographic Research Papers 200.

LARVAL FISH COLLECTION OF THE ISSUE

Virginia Institute of Marine Science, Nunnally Ichthyology Collection

By Sarah K. Huber, Eric J. Hilton, and Sarah Muffelman

Through its more than 60-year history, the Nunnally Ichthyology Collection at the Virginia Institute of Marine Science (VIMS) has grown from an uncatalogued teaching collection to become the largest collection of preserved fishes in Virginia. Although worldwide in scope, the collection's holdings are particularly strong in fishes from the Chesapeake Bay and its tributaries, freshwater reaches of Chesapeake and Delaware bays, Virginia's coastal waters, deep waters of the western North Atlantic, and freshwaters of Virginia, with a focus on the fauna of the central Appalachians. The collection has grown through the research and collection programs of its curators, other VIMS faculty and staff, and graduate students, as well as through acquisition of orphaned collections. The collection also serves the Commonwealth of Virginia as a repository for voucher specimens collected by state agencies and as a record of the biodiversity of fishes of Virginia.

Fig. 24: Gulper eel leptocephalus (*Eurypharynx pelecanoides*) from the Nunnally Hall ichthyology collection.

The VIMS collection maintains c. 41,000 cataloged lots of fluid preserved fishes (c. 385,000 individuals), tissue samples from c. 4,000 individuals, >600 dried skeletons and >2000 cleared and stained specimens. The collection also contains a large, partially cataloged collection of larval fishes (with c. 4,900 multispecies and 7,300 single-specimen uncatalogued lots and thousands of unsorted plankton samples), consisting of collections made in the Caribbean, the Mid- and South Atlantic Bights, and the Chesapeake Bay, as well as ichthyoplankton from long-term plankton studies from the Atlantic, Pacific, and Southern Oceans (Fig. 24). For all long-term time-series and plankton collections, significant environmental (e.g., temperature, salinity, nutrients, oxygen) and biological (e.g., Chlorophyll a, phytoplankton community structure) data were collected in parallel with tows, and these data are linked to specimen records.

Chesapeake Bay, Coastal Virginia, and Mid-Atlantic Coastal Samples

Over the course of more than 40 years, researchers at VIMS have conducted several ichthyoplankton surveys throughout the Chesapeake Bay (e.g., the Lower Bay Zooplankton Monitoring Program; Grant & Olney 1979), within its immediate proximity (e.g., the Chesapeake Bay Plume; Olney 1978, 1996), and other regions of coastal Virginia and the mid-Atlantic (e.g., collections funded by the Bureau of Land Management; Vecchione & Grant 1983). Most of these studies were under the direction of Drs. George Grant and John Olney and their students. Additionally, numerous taxon-specific surveys (e.g., for striped bass, shads and herrings, cobia, and red drum) and river-specific surveys (e.g., James River) have generated numerous general ichthyoplankton samples. These samples have been collected by various methods and by survey-specific protocols, for which reports and/or raw data are available. The Chesapeake Bay Larval Fish Ingress Time-series (INGRESS), which ran from 2007-2015 identified patterns in the timing and abundance of influx of shelf-spawned ichthyoplankton into Chesapeake Bay and the York River Estuary (Ribeiro et al., in 2015).

Palmer Antarctica Long-Term Ecological Research study (PAL LTER)

The region along the Western Antarctic Peninsula (WAP) is currently experiencing one of the fastest rates of warming on Earth, resulting in declines in sea ice extent and duration, and affecting the marine food web. PAL LTER commenced in 1990 to investigate the effects of climate change on the WAP pelagic ecosystem (Ducklow et al. 2012; Steinberg et al. 2012). A regional-scale cruise samples the WAP in January each austral summer (and is ongoing). The goals of the zooplankton component of PAL LTER are to determine the long-term effects of climate change on zooplankton community structure (e.g., Corso et al., 2022), the role that zooplankton play in biogeochemical cycling, and how changes in zooplankton over time are affecting higher trophic levels. All larval fishes collected from this program from its start to the present day are housed in the VIMS Larval Fish collection (Fig. 25), and have contributed to the understanding of the diversity of this unique ichthyoplankton fauna (e.g., Konstantinidis et al. 2016; Corso et al. 2023).

Fig. 25: Spiny icefish larva (*Chaenodraco wilsoni;* VIMS 20286) from the Nunnally Hall ichthyology collection.

Bermuda Atlantic Time-series Study (BATS). BATS commenced monthly sampling in Oct. 1988 as part of the U.S. Joint Global Ocean Flux Study (JGOFS) program. The goals of this time-series research are to obtain an understanding of the basic processes that control ocean biogeochemistry on seasonal to decadal time-scales, determine the role of the oceans in the global carbon budget, and ultimately improve our ability to predict the effects of climate change on open-ocean ecosystems (Steinberg et al. 2001, Lomas et al. in press). For each lot of larval fishes, there is corresponding environmental data including hydrography, nutrients, particle flux, pigments and primary production, bacterioplankton abundance and production, and zooplankton biomass and community structure. The time series for larval fishes on BATS began in April 1994 and continues to the present day.

Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom Symbioses (ANACONDAS)

The Amazon River plume supports high production and is a carbon sink in an otherwise oligotrophic region of the western tropical North Atlantic Ocean. Zooplankton were collected in the day and night in Spring 2010, Fall 2011, and Summer 2012 throughout the plume region (between 4-12° N and 45-57°W). Samples were collected inside and outside of plume waters, as well as at frontal regions at the plume boundary. Larval fishes from this study are sorted into multispecies lots, with some lots containing over 1,000 individuals. As with other long-term collections, all samples have corresponding environmental and biological data, including zooplankton community.

EDdy Dynamics, mIxing, Export, and Species composition (EDDIES)

The goal of the zooplankton component of this study was to elucidate how different types of mesoscale eddies in the Sargasso Sea affect the structure of zooplankton communities (Goldthwait & Steinberg 2008, Eden et al. 2009). Mesoscale eddies are prevalent in this region, and are ca. 150-200 km in diameter (see McGillicuddy et al. 2007). Zooplankton were collected at night at the center of 7 of the 10 eddies sampled during the 2 field seasons. In addition, two types of eddies were targeted for intensive sampling, a cyclonic eddy in 2004 and an anti-cyclonic mode-water eddy in 2005. For the selected target features, tows were conducted during the day and night inside, periphery, and outside the eddies.

VERtical Transport In the Global Ocean (VERTIGO)

In this study larval fishes (Fig. 26) were collected in mesopelagic zooplankton communities between the subtropical Hawaii Ocean and the subarctic North Pacific Ocean as part of a research program investigating the factors that control the efficiency of particle export to the deep sea (VERTIGO; Buesseler et al. 2007). Zooplankton were collected from net tows taken between 0-1000 m at each site to investigate the biomass size structure and the abundance of the major taxonomic groups (e.g., Steinberg et al. 2008). The magnitude and extent of diel vertical migration for various size fractions and taxa was also examined.

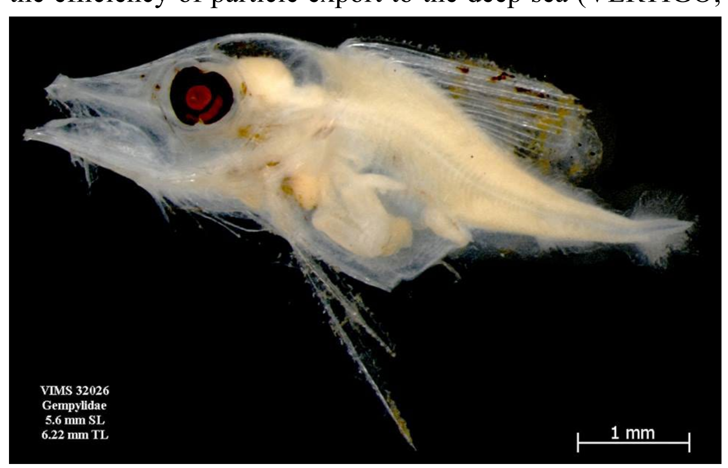

Fig. 26: Snake mackerel larvae of the family Gempylidae (VIMS 32026) from the Nunnally Hall ichthyology collection.

Other Notable Early Life History and Ichthyoplankton Collections. Several smaller collections are housed in the larval fish collections at VIMS. These samples resulted from directed research projects by faculty at VIMS or gifts, and include samples from the Galápagos Islands (n=30 lots), the Amazon River (n=10 lots), Belize (n=1,163 lots), the Bahamas (n=14 lots), the Sargasso Sea (n=12 lots), coastal Brazil (n=246 lots), Cape Verde (n=48 lots), and Gulf of Maine and other northern east coast locations (n= c. 1450 lots).

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ANNOUNCEMENT

H Geoffrey Moser, a leading, highly influential, larval-fish biologist, passed away on 30 September 2021. A collection of 17 peer-reviewed research papers inspired by Geoff's research career and authored by 69 researchers from seven countries has been assembled under the guest editorship of Jeff Leis, Bill Watson, Bruce Mundy and Peter Konstantinidis. This collection is in press in the NOAA NMFS *Professional Papers* series. Below, we provide the titles and authorship of the research papers and also of a research biography of Geoff Moser that includes a list of his publication. We thank the authors and reviewers of these contributions for their efforts.

Unfortunately, the anticipated publication date of the "Moser volume" is to be determined due to events in the US congress. Although most US government funding has been extended, a partial or even full government shutdown of unknown length could still occur. Unfortunately, this would include the activities of the NOAA NMFS editorial staff.

Jeff Leis, Bill Watson, Bruce Mundy and Peter Konstantinidis.

Early Life History and Biology of Marine Fishes: Research inspired by the work of H Geoffrey Moser Edited by Jeffrey M Leis, William Watson, Bruce C. Mundy and Peter Konstantinidis

Leis, J.M., P. Konstantinidis, B.C. Mundy and W. Watson. **Introduction**.

Mundy, B. C., J. M. Leis, W. Watson and P. Konstantinidis. **H Geoffrey Moser's contributions to fisheries biology and ichthyology.**

Girard, M. G., A. Nonaka, C. C. Baldwin and G. D. Johnson. **Discovery and description of elaborate larval cusk-eels and the relationships among *Acanthonus, Tauredophidium,* and *Xyelacyba* (Teleostei: Ophidiidae)**.

Leis, J. M. and R. Galzin. **Morphological and swimming ontogeny in larvae of a small predator on coral reefs: the orchid dottyback, *Pseudochromis fridmani* (Teleostei, Pseudochromidae).**

Dyer, S. B., F. Zavala-Muñoz, V. Bernal-Durán and M. F. Landaeta. **Osteological development of the surf silverside *Notocheirus hubbsi* (Teleostei: Atheriniformes: Notocheiridae).**

Saldierna-Martínez, R. J., G. Aceves-Medina E. A. González-Navarro, S. P. A. Jiménez-Rosenberg, A. Hernández-López, M. E. Hernández-Rivas, A. T. Hinojosa-Medina and J. De La Cruz-Agüero. **Larval development of *Sicydium multipunctatum* Regan 1906, *Awaous* sp. Valenciennes 1837, and *Evorthodus minutus* Meek and Hildebrand, 1928 in the Mexican Pacific.**

Drass, D. and G. A. Zapfe. **Larvae of the black durgon, *Melichthys niger* (Teleostei: Balistidae) from the northern Gulf of Mexico**

Konishi, Y. **Larvae of an anthiadine fish the checked swallowtail (*Odontanthias borbonius*) (Teleostei: Serranidae: Anthiadinae), with comparisons of spiny ornamentation in related anthiadine species.**

Schnell, N. K., A. Nonaka, E. Vourey and G. D. Johnson. **Morphological and molecular identification of rare longhorn butterflyfish larvae (Chaetodontidae)**

Konstantinidis, P., A. Cortes, A. Livingstone, R. De Thomas, D. Gillis, A. Brown, N. Dolinajec, S. Wright, K. Erly, N. Hayes, C. Mulloy, J. Sims and C. Farnworth. **Early life stages of the Japanese dory, *Zenion japonicum* (Zeniontidae: Zeiformes) from the central North Pacific Ocean**

Charter, S. R., W. Watson and J. R. Hyde. **Early larvae of the whitespeckled rockfish, *Sebastes moseri* Eitner, Kimbrell and Vetter 1999 and the dwarf-red rockfish, *S. rufinanus* Lea and Fitch 1972 (Pisces: Sebastidae) identified by molecular methods**.

Deary, A. L., M. S. Busby, J. Barrett, K. E. Axler and A. Overdick. **Advancements in ichthyoplankton taxonomy in the large marine ecosystems of Alaska: 1979–2021.**

Smith, W. L., M. G. Girard, H. J. Walker, Jr. and M. P. Davis. **The phylogeny of bristlemouths, lightfishes, and portholefishes with a revised family-level classification of the dragonfishes (Teleostei: Stomiiformes).**

Bowlin N., M., A. R. Thompson, J. P. Zwolinski, W. Watson and P. A. Hastings. **Ontogenetic vertical distribution and abundance of early life history stages of mesopelagic fishes off central California.**

Miskiewicz, A. I. J. Riley, A. J. Caley, P. A. Matis and I. M. Suthers. **Seasonal and oceanographic variation in larval flatfish assemblages off the south-east Australian coast.**

Marin Martinez, C. M., R. J. Latour, M. C. Fabrizio, E. D. Houde and E. J. Hilton. **Larval fish assemblage dynamics in the York River Estuary, Virginia, U.S.A**

Castro, M. S. de, C. de Oliviera Dias and A. C. T. Bonecker. **Spatial and temporal variability of the larval fish assemblage in the tropical Southwest Atlantic Ocean (12°S–22°S).**

Sassa C., M. Takahashi and Y. Tsukamoto**. Species composition, distribution, and growth of *Diaphus* "slender-type" larvae (Pisces: Myctophidae) in the Kuroshio waters of the East China Sea.**

Victor. B. C. **Rapid long-distance multispecies transport of shorefish larvae to the oceanic tropical eastern Pacific, revealed by DNA barcodes and otolith aging of larvae captured over the Galapagos Rift**

RAMBLE ON

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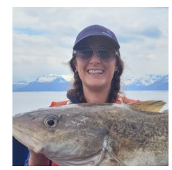

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