STAGES

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INSIDE THE ISSUE

The 48th Larval Fish Conference	2
Message from the outgoing presidet	2
The 47th Larval Fish Conference	3
NEWS FROM THE REGIONS	6
Pacific Rim Region	6
Southern Region	8
Northeast Region	9
European Region	12
Larval Fish Collection	14
Larva(e) of the Issue	15
Announcement	16
Ramble On	17
NEWSLETTER PRODUCTION TEAM	17

ELHS Back in the Days

10 years ago: Centenary of Hjort's 1914 publication

20 years ago: Section establishes J.H.S. Blaxter Student Poster Award. First winner was Jacqueline Jenkins of NOAA Beaufort Laboratory.

35 years ago: Student travel grants approvde by the Executive Committee

MESSAGE FROM THE PRESIDENT

Dear colleagues and friends,

I am excited to write this message as your incoming President. As I mentioned to participants at the 47th Annual Larval Fish Conference last May in Huron, Ohio, I am extremely proud to have the opportunity to give back to the Early Life History Section of AFS. I first interacted with this group during the 29th Annual LFC in Barcelona, where I traveled to give an oral and two poster presentations (!) as a first-year PhD student. I recall this meeting as one of the most intense experiences of my scientific career so far, which culminated by being offered the John H.S. Blaxter Award for the best poster presentation. Looking back at that meeting, I realize it was a crucial milestone that hooked me into early life history research for good!

Since then, I have attended numerous Annual LFCs, which are by far my favourite conference series. I have also served as Secretary (2015-2016) and Webmaster (2017-2022) for the section. I have always been impressed in the way that this Section and its Annual meeting bring together junior and senior scientists. This is to me a key asset that I would like to foster during my tenure as President.

I would like to thank outgoing officers Stuart Ludsin (President), Hannah Murphy (Secretary) and Jeffrey Buckel (Treasurer) who have done an outstanding job over the past years. Thanks to them, the current ExComm inherited a Section that is in excellent shape financially and membership-wise. I am thus looking forward to working with current ExComm members on exciting initiatives.In the short term, I am in the process of appointing a committee for the Elbert H. Ahlstrom Lifetime Achievement Award. The purpose of this award is to recognize sustained scientific excellence through research, teaching, administration or a combination of the three involving the early life history of fishes. Several inspiring and highly deserving colleagues will be retiring in the near future, so please consider the opportunity of preparing a nomination package. This committee will be chaired by President-elect Susana Garrido, so do not hesitate to contact her for information on the process.

Like all AFS chapters and sections, the ELHS needs to update its logo to include the new AFS visuals. Webmaster Olivier Morissette has accepted to chair a committee tasked with proposing options to the membership. We are currently recruiting members for this committee, so if you have an interest, please contact me or Olivier. Thank you for your consideration!

I look forward serving the Section during the next two years, so don't hesitate to reach out if you have ideas, suggestions or concerns about any ELHS-related issue. And I hope to see you at the 48th Annual Larval Fish Conference next year in Quebec City!

Sincerely,
Dominique Robert

ANNOUNCEMENT OF THE 48th LARVAL FISH CONFERENCE

48th Annual Larval Fish Conference:

The 48th Annual Larval Fish Conference will be held June 15-19, 2025 in Québec City! Boasting a history of more than 400 years, Québec City is the only walled city in North America. The venue is Hotel Le Concorde, located near "Old Québec", a vibrant district with stunning sceneries, excellent food, and many lodging options.

We now unveil the beautiful logo created by PhD student Charlotte Gauthier, and over the coming weeks, we will advertise several topical sessions within a broad and inclusive scientific program. Stay tuned!

Dominique Robert,
on behalf of the convening committee

MESSAGE FROM THE OUTGOING PRESIDEN

Dear ELHS friends and colleagues:

It seems like only yesterday that I started as President of the Early Life History Section and began planning the 47th Larval Fish Conference (LFC47), and now both my term as President and the conference are behind me. How time flies!

With my last message to STAGES, as the Section's outgoing President, I would like recap LFC47 and offer some thanks to those who helped me over the past couple of years.

Although my perspective is biased, I feel like LFC47 was a success. The science program was excellent as usual. We had just over 80 participants from all over the world, who delivered 43 talks and 23 posters. Plus, we had three keynote speakers – Ken Frank, Susana Garrido, and Ed Rutherford – who gave excellent, thought-provoking presentations. The off-site excursions, which included kayaking and tours of Castalia Fish Hatchery, Magee Marsh, and Stone Laboratory (Ohio State's Lake Erie field station on Gibraltar Island), were relaxing and unbelievably rain-free. The on-site social events, which included a poster session, a panel discussion on how to avoid scientific burnout (thank you Emma Siegfried for moderating!), and a dinner banquet with awards, a raffle with lots of great prizes, and a tribute to Ed Rutherford (who is set to retire this year), were highly engaging and entertaining. And best of all were the many conversations had in the hallways, session breaks, poster session, and bar area where lots of fun was had and scientific ideas were discussed. Thus, while I will be the first to admit that Huron, Ohio is no San Diego (LFC45) or Lisbon (LFC46), it held its own in the "fun and learning" department… it's the science, people, and interactions that make these conferences so good! So, thank you to everyone who attended!

I also want to extend a much deserved set of thanks to all who made LFC47 possible. Much thanks is especially owed to Jenny Pfaff, ShaLise Simmons, and Kristen Fussel for helping organize LFC47 and handling the bulk of the logistics. Much thanks is also owed to Raúl Laiz Carrion, Audrey Geffen, Frank Hernandez, and Tomas Höök for helping develop the science themes and organize the science program, as well as to Lee Fuiman and Tony Miskiewicz for organizing the judging of the John H.S. Blaxter (best poster) and Sally Leonard Richardson (best presentation) awards, respectfully. I would also like to thank the Early Life History Section Executive Committee (Rebecca Asch, Jeff Buckel, Marta Moyano, Hannah Murphy, Dominique Robert, and Kelsey Swieca), the Time and Place Committee (Chris Chambers and Hannes Baumann), the STAGES Newsletter editors (Alison Deary, Peter Konstantinidis, and Nalani Schnell), the Early Career Committee (Kelia Axler, Emma Siegfried, and Kelsey Swieca), the Regional Representatives (Catriona Clemmesen, Trika Gerard, Stacey Ireland, Katey Marancik, Dan Margulies, and Akinori Takasuka), and the ELHS Webmaster (Olivier Morissette) for their help making decisions about and/or advertising for LFC47, as well as for their help keeping me organized and on task during the past two years. Being President is easy when you have a great team surrounding you!

To conclude, I must admit that I am thankful that both my tenure as President and LFC organizing duties are behind me. However, I am leaving with the fullest confidence that Dom (and the rest of Executive Committee) will guide the Section masterfully, and that he and the rest of the LFC48 organizing committee will put on an excellent event in Quebec City next June. I look forward to seeing you there!
It has been an honor to serve you and the Section, and I wish you all a great rest of your summer!

Sincerely,
Stu Ludsin

47th LARVAL FISH CONFERENCE

Sally Leonard Richardson Best Student Paper Award 2024

Tony Miskiewicz

The Sally Richardson award is presented for the best oral presentation by a student at the annual Early Life History Society meeting. Details about the award and the biography for Sally Richardson are available on the ELHS website. At the 2024 meeting, 19 students presented oral papers which were judged by a panel of 10 people. The papers presented covered a diverse range of topics and were all of a very high standard. The judges awarded one winner and two honorable mentions as detailed below:

Winner
Charlotte Gauthier from the Université du Québec à Chicoutimi for her oral presentation: Otolith chemistry reveals habitat use by early life stage Atlantic halibut in the Gulf of St. Lawrence

Honorable Mentions
Spencer Gardner from the Department of Forestry and Natural Resources, Purdue University: Climate-induced variability in the recruitment potential of two Lake Michigan fishes

Jacob Jaskiel from the Boston University: Using a genome-wide, marker-based approach to Identify tuna species, assess population structuring, and infer demographic histories in the Central Equatorial Pacific

Fig. 1: Charlotte Gauthier received the Sally Richardson Award for the best Student Presentation (presented by Tony Miskiewicz).

John H. S. Blaxter Best Student Poster Award 2024

Lee Fuiman

The competition for the J.H.S. Blaxter Student Poster Award was held during the 47th annual Larval Fish Conference at the Sawmill Creek Resort in Huron, Ohio. Fourteen posters competed for the award. Each poster presentation was evaluated by three of the five appointed judges, based on research, management or cultural value of the work (35 points), structure and content of the poster (35 points), presentation by the student (20 points), and title and abstract (10 points). The judges identified two posters for special recognition:

Winner
Imanol Boussion from the Université du Québec à Chicoutimi for his poster: Size-selective mortality of Yellow Perch in Lake Saint-Pierre during their first winter

Honorable Mention
Kaleigh Arnold from Rice University for her poster: Allometric analysis of early skull development in *Amphiprion bicinctus* (Pomacentridae)

The Blaxter Award honors the contributions of John H. S. Blaxter, whose pioneering research on marine fish larvae, focusing on aspects of larval fish development, physiology and behavior, have influenced many researchers around the world and laid the foundation for experimental studies of developing fishes.

Fig. 2: Imanol Boussion received the John H. S. Blaxter Award for the best Student Poster (presented by Lee Fuiman).

Student travel grants at LFC47

Hannah Murphy former ELHS Secretary (2022-2024)

LFC47 proved to be another fantastic Larval Fish Conference! Since 2014, the American Fisheries Society Early Life History Section (AFS-ELHS) has awarded student travel grants through the Grace Klein-MacPhee Student Travel Award program. At LFC47, conference sponsorship in addition to the Grace Klein-MacPhee Student Travel Award allowed AFS-ELHS to award generous student travel grants to applicants. We awarded 17 student travel grants for LFC47, which was similar to LFC46 (n =14). The majority of students (n= 16) were from North America and received $390 USD while an international student received $760. Student Travel Grant awardees presented either an oral or a poster presentation on a wide range of research topics including habitat use, growth and survival, diet and prey selectivity, recruitment dynamics, aquaculture, and impacts of climate change. Awarding student travel grants is a high priority for AFS-ELHS as we want to encourage and facilitate the participation of researchers from all career stages at the Larval Fish Conferences. Congratulations to all the winners of this year's Student Travel Awards and we look forward to seeing you all next year in Quebec!

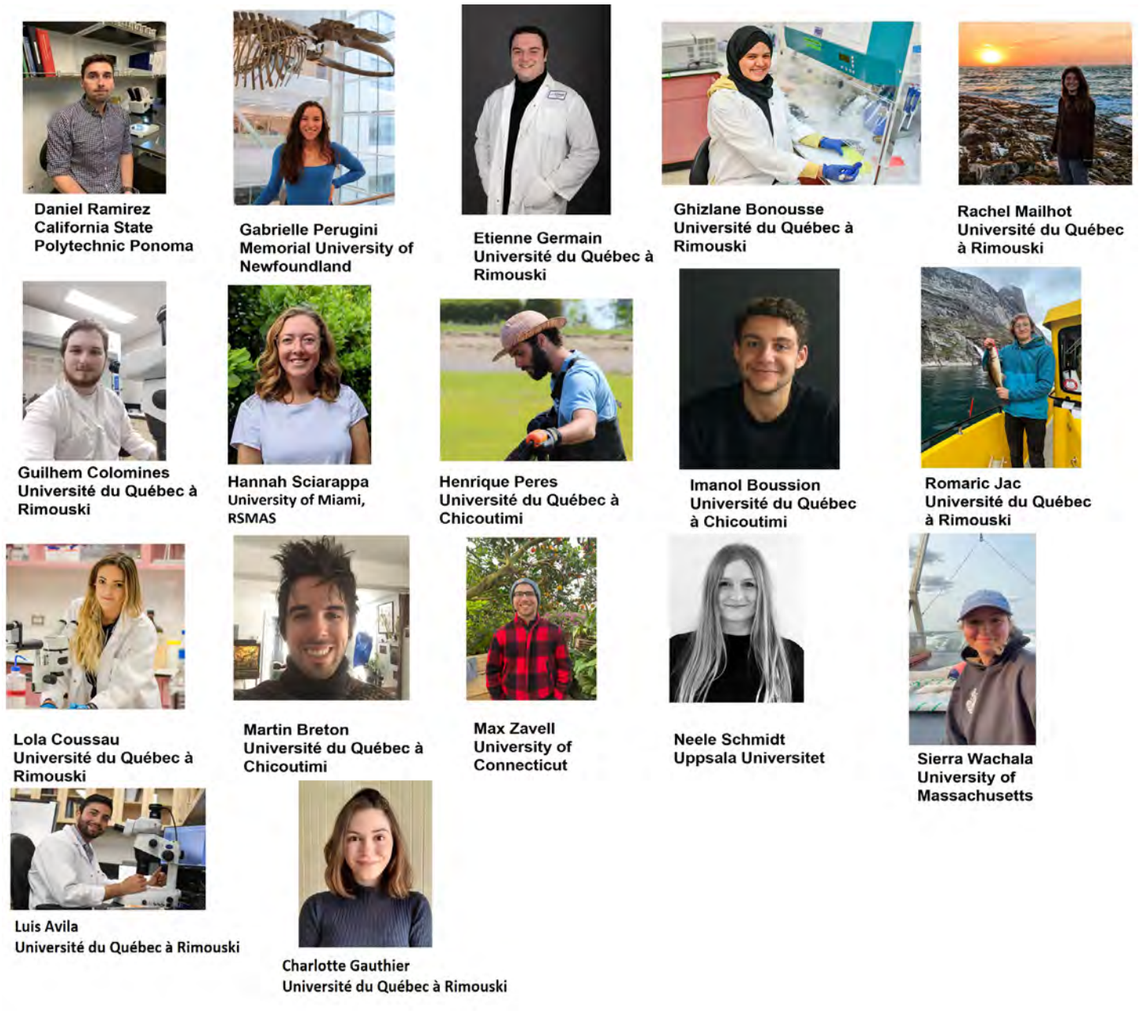

Fig. 3: The winners of the 2024 Grace Klein-MacPhee Travel Award.

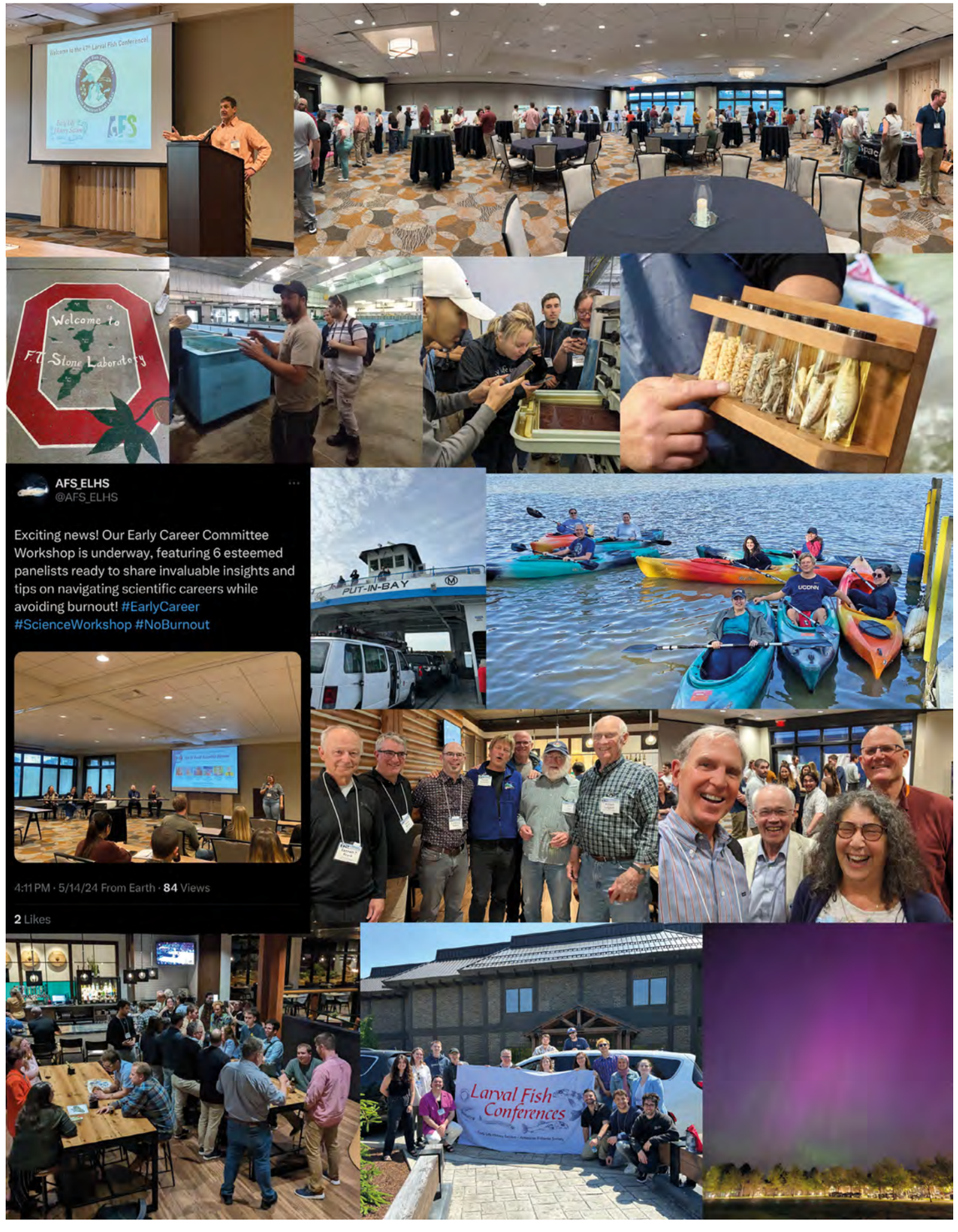

Fig. 4: Impressions from the LFC 47 in Huron, Ohio.

NEWS FROM THE REGIONS

PACIFIC RIM REGION
AKINORI TAKASUKA

Distribution and isotopic composition of Japanese eel leptocephali in relation to hydrographic structure

Shingo Kimura and Michael J. Miller
Atmosphere and Ocean Research Institute, The University of Tokyo

A recently published paper in Fisheries Oceanography by Kimura et al. (2024) examined stable isotopic compositions of Japanese eel, *Anguilla japonica*, leptocephali in their North Equatorial Current (NEC) spawning area and larval transport region during 7 research cruises (2002–2013) as shown in Figure 5. The main focus of the paper was to examine their isotopic signatures in relation to larval size and distributions compared to the salinity front location that affects their spawning latitude along the western side of the West Mariana Ridge (Kimura and Tsukamoto, 2006; Aoyama et al., 2014).

Leptocephali have an unusual feeding ecology that appears to be focused on consuming marine snow type particles, and stable isotopic analyses of their body tissues has been one approach to try to learn about what they may feed on by comparing to particulate organic material (POM) isotopic signatures among different taxa of leptocephali and locations (e.g., Miyazaki et al., 2011; Feunteun et al., 2015; Ghinter et al., 2021). In this study, preleptocephali (newly hatched pre-feeding larvae) had isotope ratios reflecting maternal ratios, but feeding-stage leptocephali (8–56 mm) tended to have higher δ15N values at lower latitudes typically in areas south of the salinity front. The smallest larvae tended to be near the salinity front each year. Large differences of δ13C values of larvae between the NEC and farther to the northwest in the Subtropical Countercurrent were likely due to spatial baseline differences between the two currents.

Along with showing the salinity structure across the latitudes of westward flow of the NEC in 7 different years, the present study also highlighted a pattern that has been seen in other isotope studies on leptocephali, which remains a mystery. As first shown by Miyazki et al. (2011), and noted in more detail by Feunteun et al. (2015), there are two groups of taxa that consistently have different isotopic signatures regardless of geographic region. Species of *Ariosoma* of the congrid subfamily Bathymyrinae and species of the family Nemichthyidae, both of which have larvae that can grow to at least about 200 mm and up to about 300 mm, have lower δ15N values and higher δ13C values than all other families of leptocephali (Figure 6) that have been tested (maximum sizes of mostly <100 mm). It is unclear if this is due to feeding at different depths or feeding on different types of food materials etc. Further research using refinements on existing techniques of visual gut content observations, isotopic analyses, and NGS analysis of DNA sequences from gut contents (no

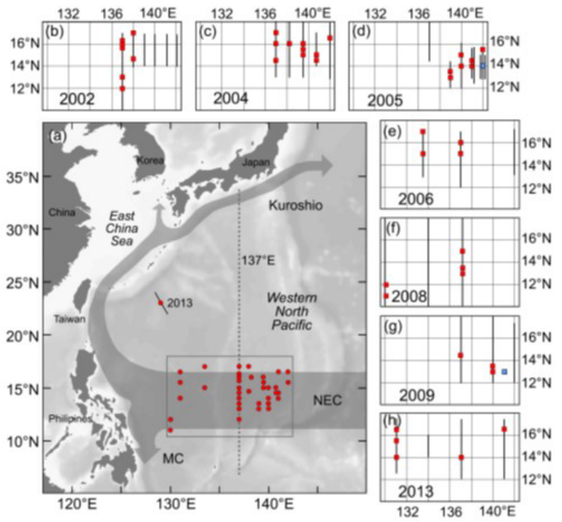

Fig. 5: Survey area and collection sites of the Japanese eel leptocephali in the Kimura et al. (2024) study: North Equatorial Current (NEC); southward flowing Mindanao Current (MC); and northern branch of the NEC that becomes the Kuroshio Current (a), where the Japanese eel leptocephali from each year were collected (b–h). A rectangle in (a) depicts the area included in (b–h). Red circles (main map) and red squares (individual years) in all panels indicate locations where leptocephali were collected. Preleptocephali were collected around regions indicated by blue squares (individual years). Thin lines indicate observational cruise lines.

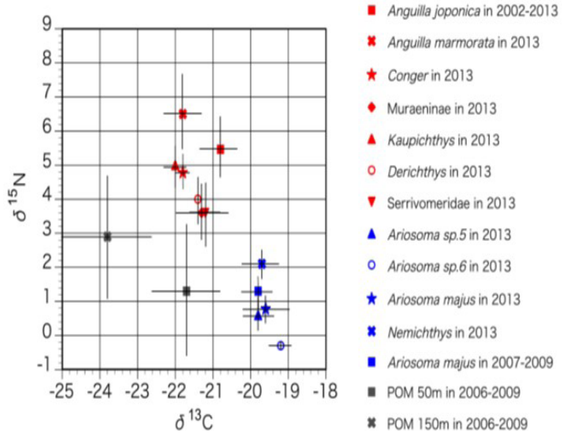

Fig 6. Kimura et al. (2024) plots of average POM nitrogen (δ15N) and carbon (δ13C) stable isotope ratios from 50 and 150 m in 2006–2009, of *Ariosoma* leptocephali collected 2007–2009, *Anguilla marmorata*, Muraenidae, *Conger*, *Ariosoma*, *Kaupichthys*, *Derichthys*, Serrivomeridae, and *Nemichthys* collected in 2013, and all *A. japonica* collected 2002–2013. Leptocephalus isotope ratios were separated into two isotopic groups (red: Group 1, blue: Group 2) of taxa according to Feunteun et al. (2015). Bars show standard deviations.

intestine tissue to avoid sequence contamination; Chow et al., 2019) are needed to fully understand the feeding ecology of leptocephali.

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Temperature or growth effect? Mechanism behind uncoupling between otolith and somatic size in Japanese anchovy larvae

Shota Tanaka[1],, Shizuna Togoshi[1], Naotaka Yasue[2], and Akinori Takasuka[1]*
[1]Graduate School of Agricultural and Life Sciences, The University of Tokyo, Tokyo, Japan
[2]Wakayama Prefectural Fisheries Experimental Station, Wakayama, Japan
**shotana0326@gmail.com*

Japan waters host a unique commercial fishery in which larval stages of small pelagic fish (called *shirasu*) are commercially captured by trawlers for food resources (e.g., raw fish for sushi and dried fish for snacks or ingredients) (Fig. 7). The Kii Channel (Wakayama Prefecture, Japan) is one of the most famous *shirasu* fishing grounds. We have collected Japanese anchovy *Engraulis japonicus* larvae throughout the year and found that the otolith and somatic size relationship was relatively weak when samples from different seasons were pooled. Such a weak relationship has also been reported in the previous studies (Yasue and Takasuka, 2009; Yasue et al., 2011).

An uncoupling between otolith and somatic size has been attributed to negative and positive effects of somatic growth and temperature on otolith size, respectively (e.g., Fey, 2001, 2006; Fey and Greszkiewicz, 2021). To investigate how uncoupling between otolith and somatic size is generated in Japanese anchovy larvae, we examined the effects of somatic growth and temperature on the seasonal variability in the otolith and somatic size relationship (Tanaka et al., 2024).

We collected 11 cohort samples comprising 3,551 anchovy individuals in the Kii Channel, Japan during April 2021 to April 2022. Relative otolith size at a given somatic size (ROS) was negatively related to somatic growth within each seasonal cohort sample, but the relationship became weak when all the data were pooled. On the contrary, temperature had positive effects on ROS. Given that somatic growth was not positively related to temperature (Fig. 8), the temperature effect would mainly explain the seasonal variability in the otolith and somatic size relationship in anchovy larvae. The multiple regression analysis showed that temperature influenced ROS almost six times more

Fig. 7: Commercial *shirasu* trawl in the Kii Channel, Japan and Japanese anchovy *Engraulis japonicus* larvae.

than somatic growth.
Overall, our study showed that an uncoupling between otolith and somatic size in anchovy larvae was generated by the counter effects of somatic growth and temperature, with the effect of temperature being particularly strong

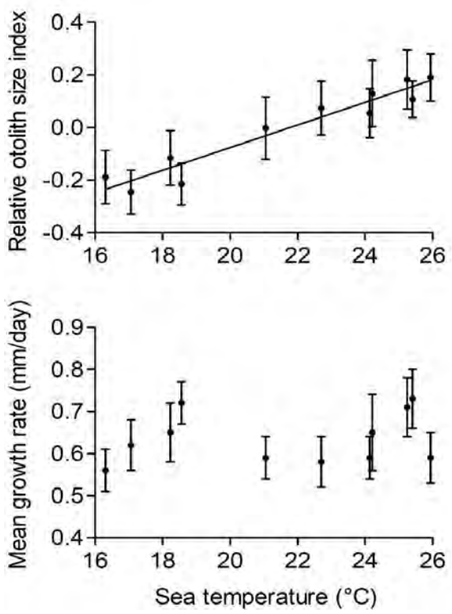

Fig 8. Relationship of mean values of relative otolith size index (ROS) and mean growth rate to sea temperature for each seasonal cohort sample for Japanese anchovy *Engraulis japonicus* larvae. Mean ± standard deviation is shown for each sample (Tanaka et al. 2024).

(Tanaka et al., 2024). The observed counter effects should be taken into account when estimating past larval growth for fish larvae obtained from different environmental conditions. The paper is now published in Fisheries Research (Tanaka et al., 2024).

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SOUTHERN REGION
TRIKA GERARD

Identification of *Thunnus* spp. Larvae using high resolution Melting Analysis

Long-term plankton surveys in the Gulf of Mexico (GOM) through NOAA's Southeast Area Monitoring and Assessment Program (SEAMAP) yield extensive data on the early life stages of fishes useful in population assessments, ecosystem monitoring, and management of marine resources. However, the value of ichthyoplankton surveys as fisheries-independent data for stock assessments and ecosystem models is limited by the inability to identify larvae to the species level for many important targeted species. Only 30% of 2,000+ marine fish species in the GOM have their early life stages described, with 70% undescribed or inadequately described due to incomplete descriptions or poor diagnostic characteristics. Lack of consistent, species or genus-level taxonomic identification creates a gap in knowledge of the population and community structure and larval ecology for many fishes in the GOM, which can hinder both fisheries stock assessment and ecosystem-based fisheries management.

Development of molecular techniques over the past three decades has provided a versatile tool to aid in the identification of the early life stages of fishes. A project started by researchers at NOAA's Southeast Fisheries Science Center (SEFSC) in collaboration with Dr. Jaime Alvarado-Bremer at Texas A&M Galveston utilizes a relatively novel and highly sensitive genotyping technique, high resolution melting analysis (HRMA), in order to provide a finer scale resolution of the taxonomic identifications of larvae found in the SEAMAP ichthyoplankton archive. HRMA relies on characterizing single nucleotide polymorphisms (SNPs) that are visualized as changes in fluorescence due to differences in melting temperature (Tm) of the amplicons. This method, in combination with the fast minimally invasive DNA isolation "Shake and Stew" protocol developed by Dr. Alvarado-Bremer will result in a substantial advance on GOM species distributions and abundance estimates, while at the same time provide nearly undamaged specimens for the reassessment of characters leading to improvement of larval species identification keys based on morphology

Most of the ichthyoplankton collected during SEAMAP Surveys are initially sorted to family, with some identifications of commercially important species reaching genus or species level. The focus of this work is on the data-limited pelagic species belonging to the families Carangidae, Scombridae (specifically the tunas) and Istiophoridae. Identifications of species in these families are difficult to discern and therefore leave a gap in the population knowledge of species like greater amberjack, lesser amberjack, little tunny, yellowfin tuna, blackfin tuna, sailfish and blue marlin. For a preliminary run of the HRMA method with archived SEAMAP larvae, a total of 180 larvae identified down to the genus *Thunnus* were sent to Texas A&M for processing. From these larvae, species-level identification was attained for all 180 larvae (Figure 9), allowing for a greater taxonomic resolution of larvae that would generally be left at genus level within the SEAMAP database. Identifications for the remaining *Thunnus* larvae from 2017-2019 and Istiophoridae larvae from 2015-2021 are completed and being compiled now. *Seriola* spp. larvae are in queue for processing and will be finalized by the end of 2024. Using the HRMA assay technique will provide cost effective, timely, reliable, and accurate data that has not been previously available to fisheries managers where the positive identification of the early life stages of targeted species has been troublesome.

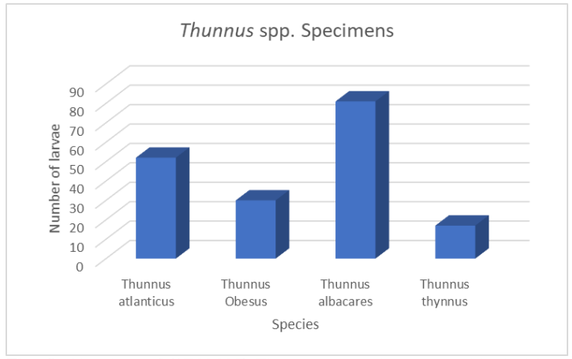

Fig. 9: Number of SEAMAP *Thunnus* spp. larvae positively identified down to species level using high resolution melting analysis (HRMA).

NORTHEAST REGION
KATEY MARANCIK

Highly variable otolith chemistry in Baltic herring larvae captured in the Finnish Archipelago

Katja Mäkinen[1], Marjut Rajasilta[1], Johannes Sahlsten[1] & Karin Limburg[2]
[1]Archipelago Research Institute, University of Turku, Turku, Finland
[2] State University of New York College of Environmental Science and Forestry, Syracuse, New York, USA.

The brackish Baltic Sea offers a challenging environment for marine fish because of its low and unstable salinity, coupled with the trend of rising temperatures. Under these conditions, the maternal influence on offspring quality is expected to increase, since the alternating periods of high and low salinity and temperature put the fish under physiological stress induced by abiotic or biotic factors, or both. Against this background, a spawning herring population has been monitored annually since 1984 in the northern Baltic Archipelago Sea in order to understand factors affecting herring reproduction. Given its Baltic-wide distribution, high but variable stock biomass, and central role in the ecosystem and fisheries of the Baltic Sea, the Baltic herring (*Clupea harengus membras*) is an intriguing species for studying the effects of environmental changes on aquatic life.

Since the onset of this monitoring, spring-spawning (May-July) herring have been collected annually from trap nets deployed near known spawning sites. Random samples of approximately 150–200 fish are taken from the catch, analyzed, and included in a time series that now spans 40 years. In concert with the time series, a tissue bank has also been maintained, including the otoliths of the analyzed individuals, as well as a set of tissue samples from specific individuals. During the monitoring period, the length of herring decreased significantly both in the juvenile phase and in older fish. The most obvious change occurred at the stage when salinity of the seawater decreased and the temperature increased in the spawning and nursery area (Figure 10). Large between-individual

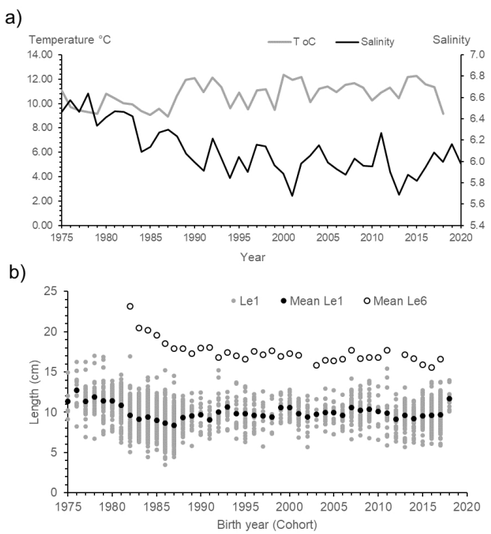

Fig. 10: (a) Mean annual salinity and mean temperature of the first growing season (T oC) in the spawning area, and (b) mean body

Fig. 10 continued: length (cm) of the Baltic herring at age 1 (Le1) and at age 6 (Le6) by birth year (=cohort) in the spawning population monitored in the Archipelago Sea since 1984. Le1 was measured from the otoliths of fish at ages 2-14 years using the back-calculation procedure; Le6 shows the mean length of six-year-old herring in the population samples collected annually. Le1: Total n = 3350 (of the data, 95 % comes from fish at ages 2-7 years); Le6: Total n = 1794. Grey circles = individual fish; black circles = mean Le1 and open circles = mean Le6.

variation in length suggested that some of the fish reproducing in the area originated from other spawning areas where salinity is higher. To investigate the natal origin of the herring, we collected juvenile herring between the 4th and 5th of September 2023 in the Airisto Inlet area in SW Finland using a small seine net (Figure 11). Despite intensive seining, only 20 larvae were collected. The larval herring (mean = 2.7 cm; range 1.9 cm¬–3.2 cm TL) were frozen with seawater in small Falcon tubes. In the laboratory, individuals were thawed, and otoliths were removed under a microscope using a small scalpel and needles, then later mounted directly on a glass slide for chemical

Fig. 11: Map showing the larval herring sampling locations in the Archipelago Sea, northern Baltic Sea.

analysis.

The otoliths were analyzed by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) at the State University of New York College of Environmental Science and Forestry (ESF). We analyzed (in order of mass) Li, B, Mg, P, K, Ca, Mn, Cu, Zn, Sr, I, Ba, Pb, and U, calibrated to concentration (ppm), and expressed the results as Element:Ca x 1000. Because they were so small, we used a 50-µm laser spot size and analyzed transects that ran along the longest axis. In some cases, we ran two transects, one on top of the other, to determine if we had reached the core. Generally, we analyzed the surfaces and ca. 10 microns below, and the core could be seen post-lasering. The ages are yet to be determined.

We found considerable variation in elemental ratios. Most surprising to us was the range in strontium:calcium values (grand mean of otolith average values: 2.66, range 1.5 to 4.1). This was not an autocorrelative function of calcium concentration (p = 0.67). Otolith Sr:Ca ratios are generally correlated with water Sr:Ca (Kraus and Secor 2004), so this suggests different source waters. Barium:Ca values were positively correlated (p = 0.04) with Sr:Ca, again suggesting differences in source waters. Principal components analysis (Figure 12) and cross correlations found other close associations of elemental ratios, primarily Mg, K, and Zn; and Li, B and U, in addition to Sr and Ba. Mg and K are physiologically regulated (Kalish 1989), zinc and boron are associated with otolith protein (Limburg and Elfman 2010; Limburg et al. 2023), whereas lithium can be influenced by temperature and trophic level (Thibon et al. 2021). The clustering of Li, B, Mg, K, Zn, and U on the positive Component 1 axis suggests these all are physiologically regulated, whereas Ba and Sr on the second principal component may indicate environmental control.

Recent diving surveys in our study area have revealed that herring eggs do not adhere well to local algae, and this appears to contribute to egg mortality and reduced recruitment (P. Vahteri personal communication). Thus, the possibility of larvae appearing from other regions of the Baltic Sea, perhaps the Baltic Proper, occurring from hydrographic transport may support local recruitment. Other geochemical tracers that potentially could help elucidate origins include strontium and oxygen isotope ratios, or biological markers such as parasites.

Given the changing environmental conditions, as well as fishing pressures, identification of spawning and nursery areas for Baltic herring is becoming increasingly important. Although our numbers of larvae are low, future research might adopt the approach of Moll et al. (2019), i.e., using multi-elemental fingerprints to separate origins, even if they are unknown. This can be accomplished on adult otoliths by analyzing the chemistry of the core region.

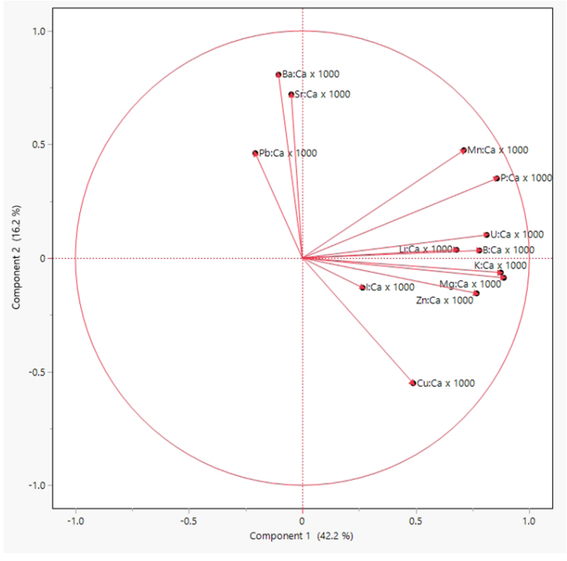

Fig. 12: Principal components analysis of 20 larval otoliths of Baltic herring.

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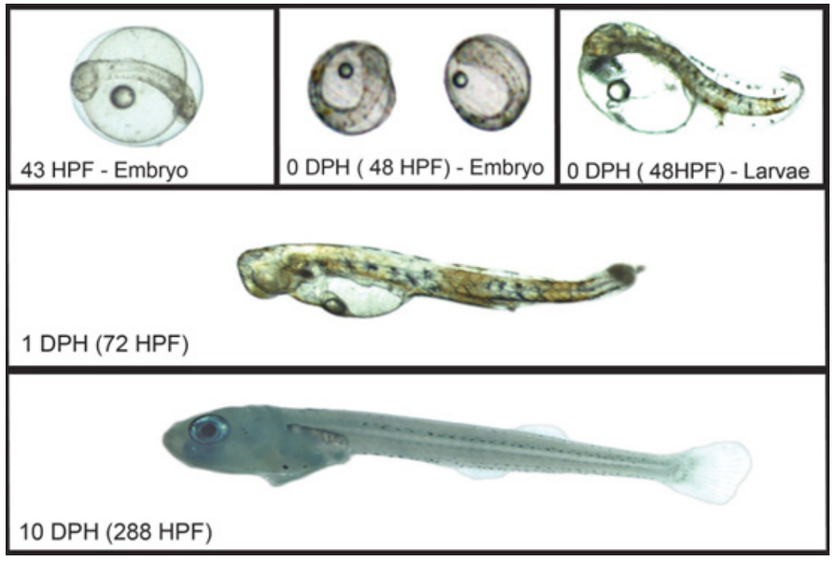
Resiliency of black sea bass, *Centropristis striata*, early life stages to future high CO_2 conditions

Max D. Zavell[1,2] & Hannes Baumann[1]
[1]Department of Marine Sciences, University of Connecticut, Groton, CT, USA
[2] School for Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, MA, USA.

Abstract:

Ocean acidification is a symptom of marine climate change resulting from the uptake of anthropogenic carbon dioxide (CO_2) into the world's ocean, thereby potentially affecting survival, growth, and numerous other traits in fish early life stages. But some fish species are clearly more CO_2-resilient than others, perhaps because they reside in more CO_2-variable, inshore habitats as opposed to more CO_2-stable offshore waters. Here we studied the early life CO_2 sensitivity of an ecologically and economically important fish species (Black Sea Bass, *Centropristis striata*) that seasonally migrates between offshore overwintering and inshore feeding and nursery grounds. We produced embryos from wild spawners and reared them until 10 days post-hatch (dph) at three contrasting pCO_2 levels (~400, ~2200, ~3000 µatm), finding no statistical effects of pCO_2 on hatching success (~28%) or survival to 10 dph (~23%). At the extreme pCO_2 level, surviving larvae were 1.2× larger and grew 55% faster compared to control pCO_2 conditions. These results extend pioneering work by Meseck et al. (2022; https://doi.org/10.1002/mcf2.10200) to confirm a surprising CO_2 tolerance of *C. striata* early life stages. This suggests existing adaptation to high CO_2 conditions either because of seasonal exposures at productive inshore environments or at offshore depths during overwintering.

Link to Paper:
https://link.springer.com/article/10.1007/s10641-024-01561-y



Figs. 13: Rapid development of *Centropristis striata* early life stages at 22°C.

Studying the predation of gelatinous plankton on larval fishes

Ina Stoltenberg und Felix Mittermayer
GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany

Fish stock recruitment is largely determined by larval mortality, which is generally caused by two major factors, starvation or predation (Cushing, 1990). The predation of gelatinous plankton, jellyfish in particular, on fish larvae has been documented for several taxa and is occurring on a global scale (reviewed in Purcell & Arai, 2001). Predation was often particularly strong on yolk-sac stages and starving fish larvae, which are particularly vulnerable due to their smaller sizes and lower mobility compared to older and/or well-fed larvae (Purcell et al., 1987). Predation effects of jellyfish on fish larvae can be substantial. For example, in Kiel Fjord predation of *Aurelia aurita* on herring larvae was suggested to be more important for recruitment than the herring spawning stock biomass (Möller, 1984). *Mnemiopsis leidyi* A. Agassiz, 1865, a lobate ctenophore, originates from the east coast of North America and was introduced to Ponto-Caspian and European waters. Since its introduction to the Black Sea, *M. leidyi* has been suspected as one of the primary factors contributing to the collapse of fish stocks in this region, albeit in interaction with other anthropogenic pressures (Oguz et al., 2008). Various studies have suggested that *M. leidyi* has the potential to significantly prey on fish eggs and larvae (Rilling & Houde, 1999), potentially exerting a negative influence on recruitment dynamics. *M. leidyi* was first reported in the western Baltic Sea and Kiel Fjord in 2006 (Javidpour et al., 2006). In the eastern Baltic Sea, the abundance of *M. leidyi* overlaps with larval fish populations of various species such as cod (*Gadus morhua*) Schaber et al., 2011). However, the interaction between *M. leidyi* and fish larvae has been sparsely studied (reviewed in Stoltenberg et al. 2021) an the interaction between *M. leidyi* and herring larvae (*Clupea harengus*) in the Baltic Sea remains unclear. In Kiel fjord, which serves as one of the spawning grounds for herring, temporal overlaps between *M. leidyi* and herring larvae have been observed (Javidpour unpublished data).

To enhance understanding of the potential predation impacts of *M. leidyi* during these periods, we conducted laboratory feeding experiments with *M. leidyi* and herring larvae under Baltic Sea conditions (Fig. 14). Our study aimed to determine: 1) the ability of *M. leidyi* to capture and consume herring yolk-sac larvae, and 2) the influence of larval age, 3) predator size and 4) the presence of alternative prey on the clearance rates on herring larvae.

Our results showed, that all sizes of *M. leidyi* that were tested (1.3 – 2 cm oral to aboral length) were capable of catching and digesting herring yolk-sac larvae (Fig. 15) and they did so in 88% of the treatments. Younger larvae (0-12 h post hatch) were significantly more vulnerable to predation of *M. leidyi* than older larvae (24-84 h post hatch) and larger specimen of *M. leidyi* caught more herring larvae than smaller specimen. When given an alternative prey source, in form of a native copepod species

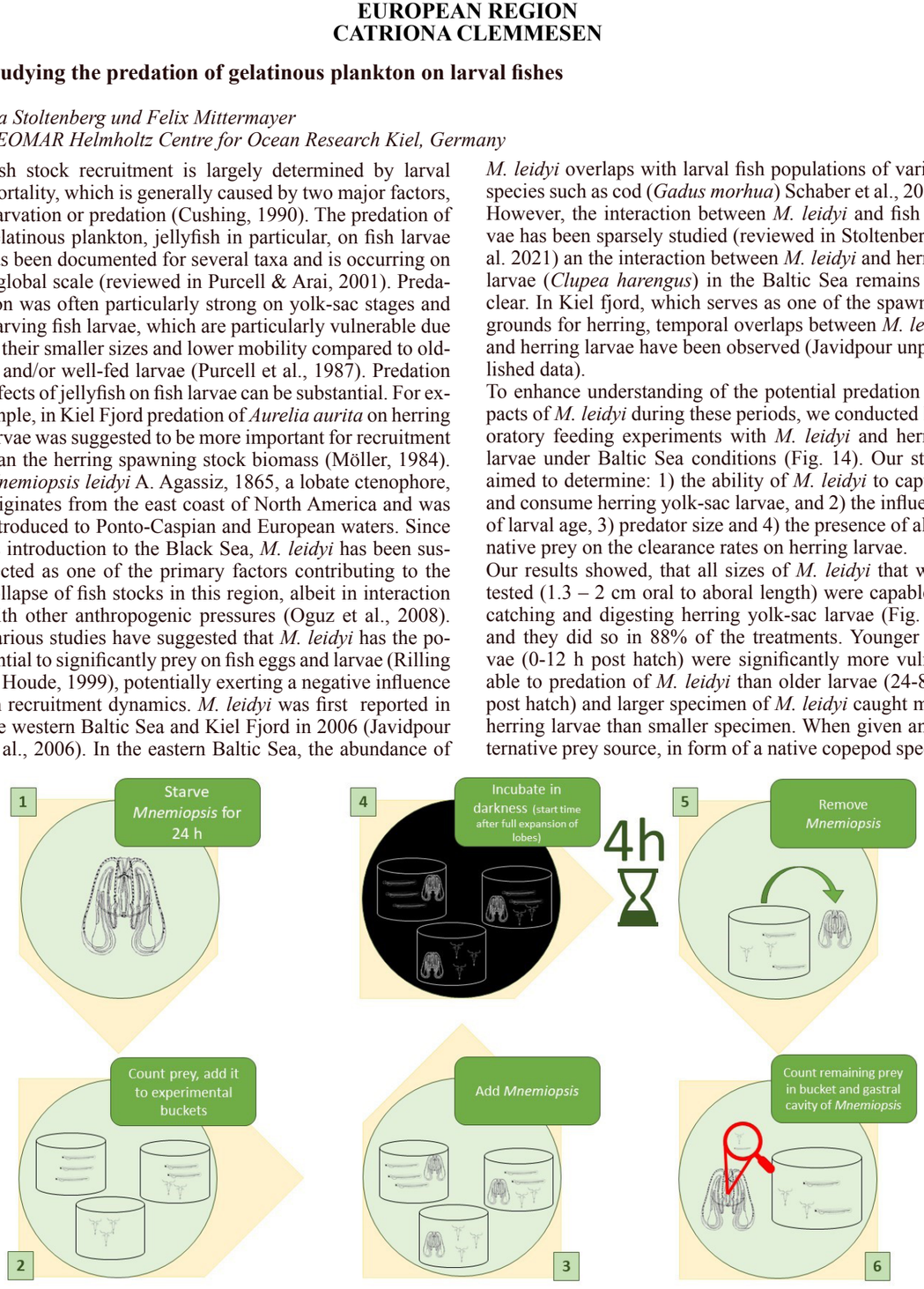
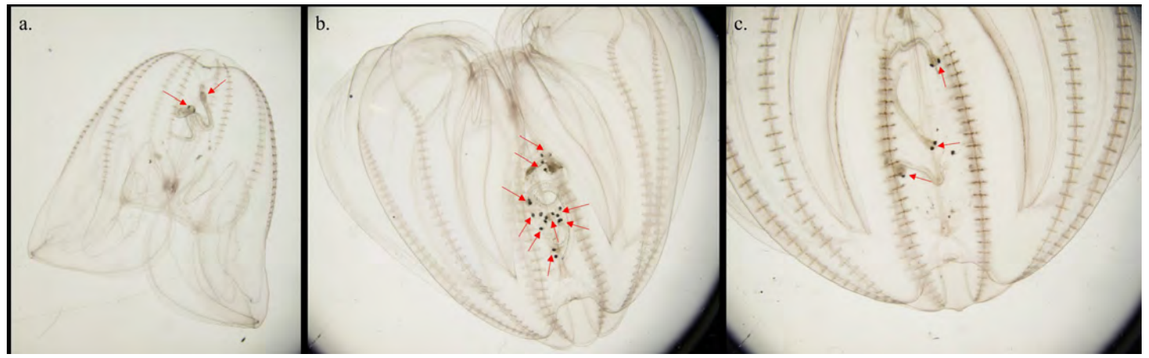


Fig. 14: Experimental design used for all experiments and treatments. Only larval age, *M. leidyi* size and prey type changed respective to the treatment. All treatments were done in five replicates.



Figs. 15: *Mnemiopsis leidyi* with ingested herring larvae. Red arrows point out herring larvae individuals. a.) A small *M. leidyi* specimen (oral-aboral (o-a) length 0.9 cm, total length (TL) 1.4 cm) that ingested two herring larvae. b.) A *M. leidyi* (o-a length 1.9 cm TL 2.2 cm) specimen that ingested at least nine herring larvae. c.) One of the larger *M. leidyi* specimen in this study (o-a length 2.8 cm, TL 3.7 cm) with three ingested herring larvae.

(*Acartia tonsa*), *M. leidyi* continued feeding on both prey species with no difference in clearance rates compared to clearance rates with only one prey source (Fig. 16).

We conclude that *M. leidyi* predation in the wild can be a factor negatively affecting the already low herring recruitment particularly in the light of climate change and changes on phenology of prey and predator (Mittermayer & Clemmesen, unpublished data). However, further field studies and monitoring are needed to estimate the temporal and spatial overlaps of herring larvae and *M. leidyi* to quantify in situ predation rates.

For more detailed information please see the original publication:

Ina Stoltenberg, Felix Mittermayer, Catriona Clemmesen, Jan Dierking, Jamileh Javidpour (2024): Predation on Baltic sea yolk-sac herring larvae (*Clupea harengus*) by the invasive ctenophore *Mnemiopsis leidyi*, Fisheries Research, Volume 273, 106973, https://doi.org/10.1016/j.fishres.2024.106973.

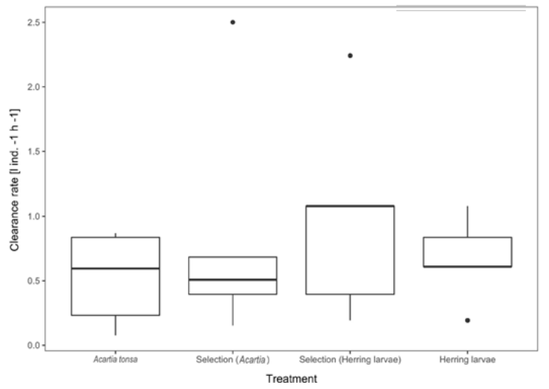


Fig. 16: Clearance rates of *Mnemiopsis leidyi* (size 2–3 cm oral-aboral length) in the prey selection experiment (n =5). Treatment *Acartia tonsa* and herring larvae included only one prey type (10 ind. l -1 , *A. tonsa* individual and 1.3 ind. l -1 herring larvae), while the prey selection treatment (selection (*A. tonsa*)/ selection (Herring larvae)) included both prey types (same concentrations as in the single treatments). The bar represents the median; the box represents the 25th–75th percentile; whiskers extent max./min. 1.5× IQR above/below the box; the dots indicate the outliers.below the box; the dots indicate the outliers.

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LARVAL FISH COLLECTION OF THE ISSUE

The fish larvae collection at the Natural History Museum of Denmark (NHMD)

[1] *Peter Rask Møller, Curator of Fishes, NHMD (Pdrmoller@snm.ku.dk)*
[2] *Mackenzie Helane Kinney, Collection Manager, NHMD (mki@snm.ku.dk)*

The Natural History Museum of Denmark (NHMD) was established in 2004 through the merging of the University of Copenhagen's Zoological Museum (ZMUC), Geological Museum, Botanical Museum, and Botanical Garden. Despite the recent merging of the museums, the collections themselves go back to the 17th century. The ichthyology collection is one of the largest collections in Europe, holding 120,000 registered lots containing approximately 500,000 specimens. This includes more than 1,500 primary types, and the unique Forsskåls Fish Herbarium from 1761-1767. One of the strengths of this collection is the large larval fish collection.

The core of the larval fish collection was assembled and overseen by Prof. Johannes Schmidt (1877-1933), renowned for discovering the spawning area of the Atlantic eel, *Anguilla anguilla* (Schmidt 1922). His collection efforts began with North Atlantic species around Iceland and the Faroe Islands with the S/S Thor, and continued with the numerous R/V Dana expeditions, the most famous and extensive of which took place in 1921-22 and 1928-30. During these expeditions, fine-meshed gear was used to collect pelagic fishes from depths up to 1000 m, resulting in an exceptionally rich collection. Initially stored at the Danish Fisheries (now DTU Aqua), these enormous collections of mesopelagic fishes and fish larvae were later saved from being discarded by former curators Jørgen Nielsen and Erik Bertelsen. Since 1967, the collection, which also includes larvae from tropical and subtropical coastal areas, has been stored in the building of the former Zoological Museum.

The larvae collection at NHMD is immense (Fig. 17), with the currently registered 177 jars nowhere near reflective of its true size, as an overwhelming majority of the fish larvae collection remains unregistered. In actuality, the collection spans over 40 shelf meters of preserved materials, mostly stored in glycerol and/ or formaldehyde fixed. Despite the largely unregistered status, much of the collection has been sorted to family level. These efforts were undertaken either during the original cruises or subsequently, showcasing the monumental efforts of esteemed fish larvae ichthyologists such as Jeff Leis, Dave Johnson, Sergei A. Evseenko, Geoff Moser, David G. Smith, Mike Fahay, Peter Castle, Emma Karmovskaya, John Paxton (e.g., Fig. 18) and Nalani Schnell. During his tenure, curator Emeritus Jørgen Nielsen facilitated collaboration among these specialists, and even co-authored a popular guidebook to fish larvae of the North Sea.

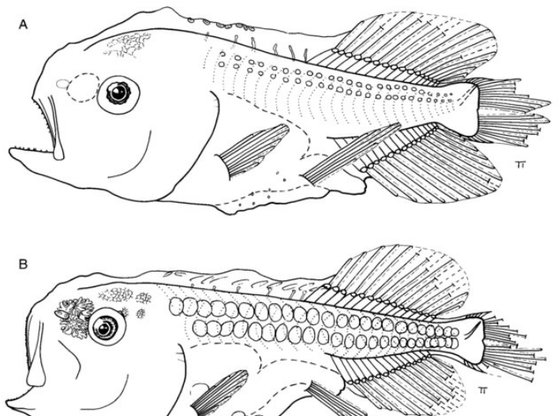


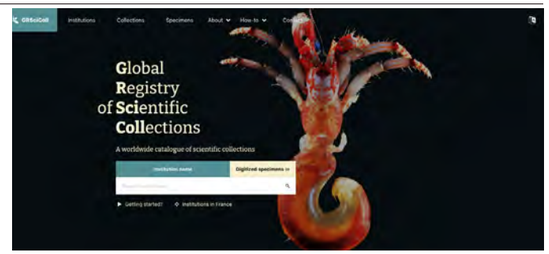
Fig. 18: From Paxton et al. (2001). Figure 3. *Rondeletia bicolor*. a, ZMUC P2340805, 7.2 mm SL larva, note outline of Tominaga's organ anterior to eye (dashed line); b, ZMUC P2334327, 13.5 mm SL juvenile, Tominaga's organ is extensive anterior to the eye.

Fig. 17: The fish larvae collection at the Natural History Museum of Denmark (NHMD)

While the larger fish in the NHMD ichthyology collection are individually numbered using the P ZMUC number system, larval fish are usually assigned a single number per jar, regardless of the number of specimens within. This underscores the vast scale of the collection. In 2024, the registered collection was transitioned to the Specify software, where specimens now receive NHMD numbers and are frequently uploaded to GBIF. The fish collection is readily accessible to researchers and visitors, particularly for studying the larval fish collection and identifying its invaluable specimens. Plans are underway to relocate the collection to new facilities in central Copenhagen at the newly constructed NHMD in the coming years.

ANNOUNCEMENT: **GRSciColl**

The Global Registry of Scientific Collections, or GRSciColl, is a comprehensive, community-curated repository of information about scientific collections that extends work initially started by the Consortium of the Barcode of Life (CBOL).
By providing information about physical scientific collections—their content, location, contacts, associated institutions, and collection codes and identifiers—GRSciColl offers a resource for a wide range of uses by experts, researchers and members of broader society.



access to the website:
https://scientific-collections.gbif.org/

LARVA(E) OF THE ISSUE

During our latest mackerel egg survey in June 2024 in the Celtic Sea, we found (oval) eggs and larvae of *Echiodon drummondii* or Drummond's pearlfish in multiple samples. Though we know this species occurs in this area, we had never encountered it before during our regular surveys since the 1980's.
By Ewout Blom & Cindy Van Damme

Fig. 19: Larva of *Echiodon drummondii* or Drummond's pearlfish.

ANNOUNCEMENT

First sections of Early Life History and Biology of Marine Fishes: Research inspired by the work of H Geoffrey Moser published on line

Jeff Leis, Institute of Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania, Australia

The first 10 of 19 parts of the long-awaited volume inspired by the research career of Geoff Moser, who passed away in September 2021, should be available by the time this issue of Stages is released. The volume, guest edited by Jeff Leis, Bill Watson, Bruce Mundy and Peter Konstantinidis, is now appearing as NOAA editorial staff complete their work on the individual contributions. The full volume will contain an Introduction, a biography and annotated bibliography of Geoff Moser, and 17 research papers. Contributors are from the USA, Australia, Brazil, Chile, France, Japan, and Mexico. The first 10 papers by 39 contributors will be found on the NOAA NMFS Professional Papers website - https://fisherybulletin.nmfs.noaa.gov/content/early-life-history-and-biology-marine-fishes-research-inspired-work-h-geoffrey-moser

Titles and authors are listed below. NOAA Editorial Staff hope to have the remaining research papers published this summer. This will be followed by publication of a hard copy as NOAA NMFS Professional Paper 24.

Introduction by Jeffrey M. Leis, William Watson, Bruce C. Mundy, and Peter Konstantinidis

H Geoffrey Moser's contributions to fisheries biology and ichthyology by Bruce C. Mundy, Jeffrey M. Leis, William Watson, and Peter Konstantinidis

Discovery and description of elaborate larval cusk-eels and the relationships among Acanthonus, *Tauredophidium*, and *Xyelacyba* (Teleostei: Ophidiidae) by Matthew G. Girard, Ai Nonaka, Carole C. Baldwin, and G. David Johnson

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

Osteological development of the surf silverside (*Notocheirus hubbsi*) (Teleostei: Atheriniformes: Notocheiridae) by Brian S. Dyer, Francisca Zavala-Muñoz, Valentina Bernal-Durán, and Mauricio F. Landaeta

Larval development of multispotted goby (*Sicydium multipunctatum* Regan, 1906), Awaous sp. Valenciennes, 1837, and small goby (*Evorthodus minutus* Meek and Hildebrand, 1928) in the Mexican Pacific by Ricardo Javier Saldierna-Martínez, Gerardo Aceves-Medina, Enrique A. González-Navarro, Sylvia Patricia A. Jiménez-Rosenberg, Armando Hernández-López, Martín Enrique Hernández-Rivas, Alejandro Trinidad Hinojosa-Medina, and José De La Cruz-Agüero

Larvae of the black durgon (*Melichthys niger*) (Teleostei: Balistidae) from the northern Gulf of Mexico by Denice Drass and Glenn A. Zapfe

Larvae of checked swallowtail (*Odontanthias borbonius*) (Teleostei: Serranidae: Anthiadinae), with comparisons of spiny ornamentation in related anthiadine species by Yoshinobu Konishi

Morphological and molecular identification of rare longhorn butterflyfish larvae (Chaetodontidae) by Nalani K. Schnell, Ai Nonaka, Elodie Vourey, and G. David Johnson

Early life stages of the Japanese dory (*Zenion japonicum*) (Zeniontidae: Zeiformes) from the central North Pacific Ocean by Peter Konstantinidis, Alvaro Cortes, Alton Livingstone, Rahiza De Thomas, Daniel Gilles, Alexander Brown, Noah Dolinajec, Sarah Wright, Kate Erly, Nathan Hayes, Colin Mulloy, Jermiko Sims, and Christopher Farnworth

Early Life History and Biology of Marine Fishes: Research inspired by the work of H Geoffrey Moser

Author(s): Jeffrey M. Leis, William Watson, Bruce C. Mundy, and Peter Konstantinidis (guest editors)
Year published: 2024
Report: NOAA Prof. Paper NMFS 24
Articles for this volume are published online after being typeset. The full volume will be published in print after all articles are published online. To see those that have been published and abstracts for papers in process, click on Report link above.

RAMBLE ON

Alison Deary

Where to start? Luckily this is a Ramble On so I can wing this piece! I have not attended a LFC since 2019 so it was wonderful seeing my Larval Fish friends again in Huron, Ohio for LFC47! Personally, the conference was fun because I presented on the final results from my last NOAA project and then presented on what I am doing now with the US Fish and Wildlife Service as well as show off my new threads: my uniform. I want to echo everyone who has shared their impressions from the conference. Thank you, Stu and Jenny, for an amazing event! The agenda was strong and all of the students gave wonderful presentations, showcasing that we have a strong cohort recruiting to our field!

Alison Deary & Nalani Schnell

A huge thank you to Peter Konstantinidis for his years of dedication as lead editor of the STAGES newsletter. We joined Peter on the editorial board for the last issue of STAGES in December 2022, convincing us to join the team with the words "it actually is fun". With those words he had Nalani on board. He brought Ali into the fold when she was still Secretary during the pandemic to provide an external review and she continued on after that. He taught us a ton about the ins and outs of the newsletter and how to assemble it. Under Peter's tenure as editor, he also brought us some new sections, the "Larva of the Issue" and the "Larval Fish Collection of the Issue", which added an emphasis on specimen- and archive-based larval fish research. Congratulations, Peter, on your new adventure!

We wish you all a great summer!

Ali & Nalani

NEWSLETTER PRODUCTION TEAM

Social Media
Contact Olivier Morissette
Département des sciences fondamentales
Université du Québec à Chicoutimi
555, boul. de l'Université
Chicoutimi (Québec) G7H 2B1

Northeast Region
Katey Marancik
NMFS, Northeast Fisheries Science Center
Narraganset, Rhode Island
katey.marancik@noaa.gov

North Central Region
Stacey Ireland
USGS Great Lakes Science Center
Ann Arbor, Michigan
sireland@usgs.gov

Southern Region
Trika Gerard
NMFS, Southeast Fisheries Science Center
Miami, Florida
trika.gerard@noaa.gov

Western Region
Daniel Margulies
Inter-American Tropical Tuna Commission
La Jolla, California
dmargulies@iattc.org

Pacific Rim Region
Akinori Takasuka
University of Tokyo
Tokyo, Japan
atakasuka@mail.ecc.u-tokyo.ac.jp

European Region
Catriona Clemmesen
GEOMAR, University of Kiel
Kiel, Germany
cclemmesen@geomar.de

Newsletter Editors
Nalani Schnell-Aurahs
Muséum national d'Histoire naturelle
Station Marine de Concarneau, France
nalani.schnell@mnhn.fr

Alison Deary
Abernathy Fish Technology Center U.S. Fish & Wildlife Service
1440 Abernathy Creek Road
Longview, WA 98632-9764