STAGES

VOLUME 43 (1&2) **August 2022**

INSIDE THE ISSUE

ELHS Back in the Days

10 years ago: Centenary of the 1911-1912 United States cold wave remains one of the coldest winters recorded

15 years ago: Tragic passing of Stacy Moore Hagan (1971 - 2007)

20 years ago: LFC meets in Europe for the first time in Norway

25 years ago: President Jim Cowan codifies student travel grants

MESSAGE FROM THE PRESIDENT ELECT

Dear ELHS friends and colleagues:

As the incoming President of the Early Life History Section of AFS, I want to share some thoughts about the past year and the upcoming ones. I would like to start by thanking the ELHS Executive Committee and Larval Fish Conference organizers for shepherding the Section through another rough year, owing to the COVID-19 pandemic. These past two years were unprecedented, which made leadership and planning challenging. Despite the challenge, I was pleased with the success of the our 44th Larval Fish Conference during May 2021, and am appreciative Hannes Baumann and his organizing team for their incredible effort. Their pre-workshop communication was outstanding, and the Larval Fish Conference was a success, despite being virtual, with just over 150 registrants from about thirty countries. While I would always prefer to meet face-to-face, and am excited for 45th LFC at Scripps this year, I am proud by what Hannes and his team were able to pull off. I would also like to thank the ELHS Executive Committee for keeping our section in good financial standing, our sections' secretary, Alison Deary, for keeping the ELHS membership and Executive Committee aware, and Peter Konstantinidis and Simon Geist for their effort to get a new addition of the STAGES newsletter out. I feel very good about the situation in which I am entering as President.

In terms of my upcoming term as President, which technically began at the 45th LFC business meeting, I will only say that I am super excited. My past several years (decade?) have been incredibly busy, which prevented me from getting fully engaged with this section. I recently shed several time-consuming responsibilities and have been on sabbatical since August so I will have ample time to devote to the ELHS during my tenure as President. While we still need to solidify our Section's goals for my term as President, I am excited by opportunities to continue to increase demographic diversity within our Section, as well as disciplinary diversity (e.g., continue to bolster participation of freshwater scientists). As previously mentioned in ELHS Executive Committee and business meetings, targeted advertising, travel grants, and fellowships offer potential means to achieve these ends. Bolstering the education mission within our Section, which we discussed at previous meetings, is something that I would also fully support. For example, Ed Roseman (the Northcentral Region representative) and I proposed an Early Life History continuing education track (certificate) as part of the in-person 2020 American Fisheries Society meeting, which was supposed to occur in my home city, Columbus, OH (USA). This track consisted of attending a workshop on the larval fish collection and identification, attending talks on larval fish early life history, and participating in a discussion with a panel of early life history experts. Unfortunately, the COVID-19 pandemic led to this track never coming to fruition because the in-person meeting was canceled; however, I would support efforts to bring it back to life during my time as President. Such a track, or others like it, would allow for students and current professionals to receive more formal training in the early life history of fishes and provide the opportunity to add an additional line to their resume/CV. If any of you have ideas on what such a track (certificate) might look like, or any other ideas on how to improve the education mission of the ELHS, feel free to send your ideas or suggestions to me (ludsin.1@osu.edu), Ed Roseman (eroseman@usgs.gov), or Alison Deary (alison.deary@noaa.gov) so that we can compile them for future discussions.

I want to close by saying thank you for taking the time to read this far and for your support of the ELHS of AFS. I am being sincere when I say that I am very open to suggestions on how to help continue making the ELHS so great. Thus, do not hesitate to reach out to me or other members of the Executive Committee (see membership here: https://earlylifehistory.fisheries.org/governance/) if you have ideas or thoughts. These ideas can pertain to membership, the LFC, education, policy, the website, governance, etc. As Brené Brown, an American research professor, lecturer, author, and podcast host stated in a 2012 TED talk, "Vulnerability is the birthplace of innovation, creativity, and change." Dare to be vulnerable and share your ideas with us!

I look forward to the two years that I get to serve you all and the Section, and hope to meet as many of you as I can during upcoming meetings.

Sincerely,

Stu Ludsin

NEWS FROM THE REGIONS

EUROPEAN REGION
CATRIONA CLEMMESEN

Exploring maternal and cohort effects on Atlantic herring offspring quality: Is Bigger, Early, Better?

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[3]Thünen Institute of Baltic Sea Fisheries, Germany

Although female Atlantic herring (*Clupea harengus*) only spawn once per season, successive waves of adult spawners entering shallow nursery areas over several months (e.g. from March to May/June) create different cohorts of larvae. According to a common paradigm, larger and older adult herring spawn earlier while smaller and younger first-time spawners spawn later in the season. In recent decades, spawning stock biomass has dramatically declined due to poor year class survival. One potential cause is increasing winter temperature which leads to earlier spawning of benthic eggs and the hatching of yolk-sac larvae and a potential mismatch between young larvae and their prey (calanoid copepods). It is important, therefore, to gain insight on the processes driving potential differences in the survival of these successive spring cohorts. Is a climate-induced shift in the reproductive timing of herring responsible for the poor survival and low recruitment in this stock? Are there intrinsic differences in the quality of eggs and larvae produced by females that spawn early versus those that spawn late?

Fig. 1: Patrick Polte preparing the Bongo net for catching herring larvae (left), Amy Huang stripping herring eggs onto a plate (middle), and incubation tank in the laboratory (right).

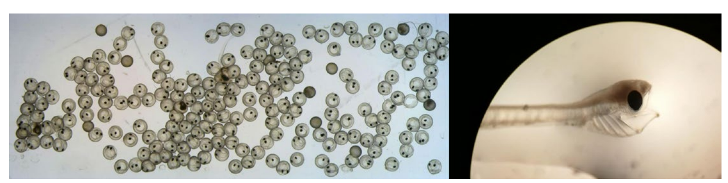

Fig. 2: Herring embryos on one egg plate (left) and gape opening of first-feeding larvae.

To investigate cohort-related differences and trends in offspring traits, we combined laboratory experiments and field observations. Mature herring were sampled in a major nursery area of western Baltic herring at early, middle and late phases of the spring spawning season in 2019 and 2020. Stripped-spawned eggs were incubated in the laboratory at warm and cold temperatures and sizes of females, eggs and yolk-sac larvae were measured and compared. Additionally, the gape size of first-feeding larvae captured in situ early and late in the spawning season was measured.

While there are overlaps in range of sizes of females spawning early, in the middle and late in the season, compared to late spawners, early spawners were larger (total length), spawned at colder temperatures and produced larger eggs which developed into larger larvae at hatch in the laboratory. These larvae hatched early in the season, however, grew less during the yolk sac phase at the warm versus the cold incubation temperature in the laboratory. Moreover, for first-feeding larvae captured in situ, gape size was significantly smaller in the early and larger-sized larvae compared to the late and smaller-sized larvae in the season.

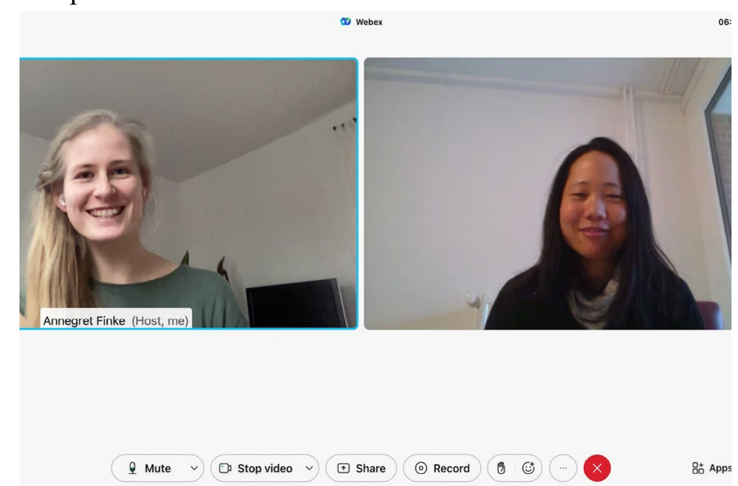

Fig. 3: Annegret Finke (left) and Amy Huang (right) discussing their results in a virtual meeting.

Our first results already reveal multiple differences in the offspring produced at different times of the season such as differences in body size (in the laboratory) and gape size (in the field). Larvae from early season spawners may benefit from their larger body size since larger larvae tend to have higher mobility and are better able to catch prey or escape certain predators. However, a smaller gape size may limit the amount of prey items available to them. This becomes even more dramatic especially when prey abundance is low. In future studies, we will further investigate the impacts of warming temperature and trait differences on the survival of feeding larvae produced by early-, mid-, and late-season spawners in a laboratory setting. Also, we will examine the timing of prey fields and environmental factors in relation to the occurrence of larval cohorts in situ.

Ichthyoplankton assemblages in the Gulf of Naples (South Italy)

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The Gulf of Naples (south central Tyrrhenian Sea, Italy) is one of the most intensely fished area in the Mediterranean Sea and it is a very productive fisheries region in the Tyrrhenian Sea. This region has been the birth place of ichthyoplankton taxonomy in the Mediterranean and in the world. Thanks to the presence of one of the oldest for marine and ecological studies institution in Italy and in the world, the 'Stazione Zoologica Anton Dohrn' research center, the taxonomy of marine vertebrate and invertebrate organisms was first described and catalogued. However, since the pioneering work of D'Ancona and colleagues on the samples collected and curated by Salvatore Lo Bianco on the taxonomy of fish early life stages of the Gulf of Naples (Lo Bianco et al., 1956), there have not been subsequent published ichthyoplankton studies (Fig. 4). In 1962, the well-known American ichthyologist, Elbert H. Ahlstrom, wrote: "*The Italians have left the best monograph available on the study of the eggs, larvae, and juvenile stages of fish .... However, this interest in fish larvae is now historical, as I was able to notice in my visit in 1959*".

To fill this knowledge gap, a research team from the Stazione Zoologica Anton Dohrn, and the Oregon State University in Corvallis, has started a study of long-term perspective. In particular, the team is assessing both the possible spawning areas for demersal and pelagic commercial fish species, close to the shelf-slope edge and submarine canyons, and the coastal fish recruitment close the island of Ischia (Fig. 5). The team is based at the Ischia Marine Centre, an historical territorial marine lab of the Stazione Zoologica founded by the naturalist Anton Dohrn in 1872 (Fig 6).

Bio-physical and climate conditions at the time and location of fish spawning and during larval stages can affect distribution and abundance during later life stages (Ciannelli et al., 2015). From an ecosystem perspective, ichthyoplankton assemblages provide an early indicator of shifts in community dynamics (Doyle et al., 2009) and water masses (McClatchie et al., 2018) and are known to be linked with climate variability (Auth et al., 2011). Thus, the characterization of ichthyoplankton assemblages and the physics of the ocean at the time and location of spawning are prioritized in many fisheries oceanography programs (McClatchie et al., 2014). In this context, the initial results of our team have been

Fig. 4: Example of old drawings (Sparidae, Diplodus vulgaris) in the Lo Bianco monographs (Lo Bianco et al., 1956).

published in a paper entitled 'Ichthyoplankton assemblages and physical characteristics of two submarine canyons in the south central Tyrrhenian Sea' (Ciannelli et al., 2022). Here the team has characterized the fish assemblages around two large canyons: Dohrn and Cuma. They provided the first description of summer 2021 ichthyoplankton assemblages in the vicinity of the two canyons and co-occurring physical conditions in the vicinity of bathymetric features of two submarine canyons (by using the Lagrangian particle tracking analyses at the time of the sampling). They sampled a total of 295 fish larvae, including 14 orders, 19 families and 8 fish eggs families (Fig. 7). The most abundant species was

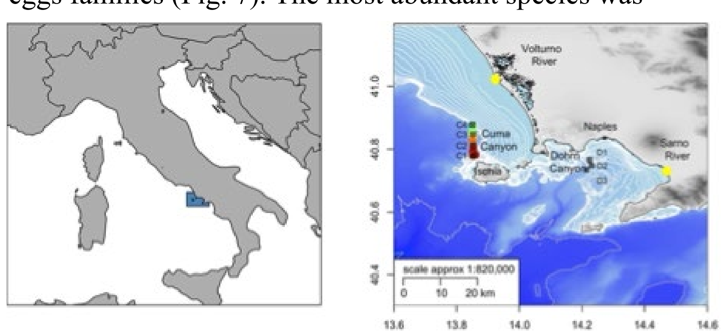

FIG. 5: Sampling area in the Southern-Central Tyrrhenian Sea (top left side), with details of sampling stations surface temperature (°C, top right) and salinity (PSU, bottom left) collected with an underway thermosalinograph during sampling in the Cuma stations. The yellow dots on the upper right panel indicate the mouths of the Volturno and Sarno rivers.

Fig. 6: The Ischia Marine Centre (IMC), named Villa Dohrn since built in 1906 as the private summer Villa of the Dohrn's family, was enlarged and transformed in 1969 as a Centre on the seashore devoted to study the ecology of benthic organisms and communities.

Engraulis encrasicolus, which was found at densities comparable to other known spawning grounds of the western Mediterranean. Mesopelagic species, such as Gonostomatidae and Myctophidae, were also abundant, especially at the Cuma Canyon. Results showed that the majority of the sampled taxa were either pelagic (Engraulidae, Scombridae, and Carangidae) or mesopelagic (Myctophidae and Gonostomatidae). Apart from a few specimens belonging to the families Bothidae and Gadidae, there were not many demersal or benthic taxa present in the samples. The species composition found is mostly attributable to sampling time, focused in the summer season. The Ischia team is continuing their investigations and has already established a change of species assemblages from pelagic and mesopelagic to demersal species including gadid, during the fall and winter months. Further investigations are ongoing to have a seasonal and interannual characterization of the ichthyoplankton assemblages around the studied area. Once again, the results of this exploratory study highlighted the need to extend this type of sampling in space and time (long-term monitoring programs).

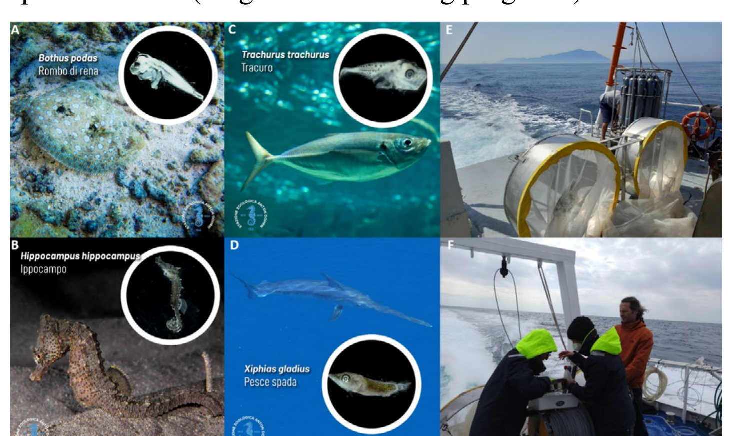

Fig. 7: Some examples of the fish species (A, Bothus podas; B, Hippocampus hippocampus; C, Trachurus trachurus; D, Xiphias gladus) collected through a Bongo Plankton Net (E, December 2021) around the Gulf of Naples (Cuma and Dohrn canyons).

After a long gap in the sampling effort (60-plus year hiatus of research of early life stages of fishes in the Gulf of Naples), we are now aware of the historical importance of long-term sampling and monitoring projects. In addition, climate change is rapidly changing the abiotic conditions in which fish early life history stages (eggs, larvae and juveniles) will growth in the next decades. We need to understand and to model the physical, biological and social aspects of the coastal marine system and to provide insights that inform management of important commercial fish species. Knowledge of spawning areas is also necessary for fisheries management, to design successful networks of marine protected areas or to implement efficient conservation programs in general (Di Franco et al., 2012).

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Studying effects of river restoration measures on larval fish assemblages

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Within the framework of a joint-training program Zhen Wang from Institute of Hydrobiology, Chinese Academy of Sciences, is studying the effects of different river stabilisation and modification measures on the early stages of riverine fish assemblages in the Yangtze River and in the River Danube in Austria. River alterations very often change the habitat configuration of inshore areas, and thus alters the availability and environmental conditions of the nursery zones of the larvae of many characteristic fluvial species. As a consequence, effects of these habitat degradations on the recruitment process and year class strength of fish populations are to be expected. By analysing major characteristics of larval assemblages along environmental and river modification gradients, new insights about the identity and nature of relevant controlling factors are observed. These findings in turn provide important information to design effective and sustainable restoration measures. In his scientific approach, Zhen Wang analysis information on structural and taxonomic assemblage composition, biodiversity and abundance as well as trophic- and somatic condition of individual fish larvae in different sections of the Yangtze River. During his stay as a visiting PhD student, the taxonomic composition of larval assemblages in a free-flowing section of the River Danube, where a large restoration program has been carried out, is investigated.

Fig. 9: Fish larvae of endemic species in the Yangtze River.


Fig. 8: The authors, Hubert Keckeis and Zhen Wang

NORTH CENTRAL REGION
ED ROSEMAN

Prospecting Potential Grass Carp Spawning in Great Lakes Tributaries; no news is good news (for the moment)

Grass Carp (*Ctenopharyngodon idella*) were introduced into the United States to control aquatic vegetation and they have previously been captured in all of the Great Lakes except Lake Superior. Many states, including Ohio, established a stocking program requiring all stocked fish to be sterile (triploid). However, four juvenile grass carp were captured by a commercial fisherman during 2012 in the Sandusky River, a tributary to Lake Erie. The juvenile Grass Carp were fertile (diploid), further, they likely originated from the Sandusky River based on otolith microchemistry. The University of Toledo and U.S. Geological Survey scientists initialized egg sampling in the Sandusky River, Ohio in 2014 and successfully collected Grass Carp eggs in 2015, 2017, 2018, 2019, and 2021. No eggs were collected in 2016 or 2020. Egg sampling in the Maumee River, Ohio started in 2017 and eggs were successfully collected in 2018 and 2019. Consequently, spawning in the Sandusky River and Maumee River has been confirmed, but spawning may occur in other USA Great Lakes tributaries. In 2021, our goal was to prospect rivers where adults have been captured, but no eggs have yet been documented. We sampled for eggs and larvae using 500 µm mesh bongo nets on the tributaries of Lake Erie (Cuyahoga, Ohio (35 tows), and Huron, Ohio (5 tows) rivers), Lake Huron, Michigan (Tittabawassee River, 14 tows), and Lake Michigan, Michigan (St. Joseph River, 5 tows). When possible, sampling was timed to high flow events that cue grass carp spawning. No Grass Carp eggs were found in any of the newly prospected locations. Failure to find new spawning tributaries is good news, but must be interpreted cautiously. A lack of eggs would happen if no spawning occurred, i.e. a true zero value, but we could also have failed to find eggs because we didn't sample in a location or time that eggs were present, or eggs were present at very low density and we missed them by chance. Continued monitoring for evidence of spawning in other Great Lakes tributaries is crucial to effectively target removal of adult Grass Carp from locations where they may pose the highest risk.


Fig. 10: Grass Carp eggs are large (~3-4mm) and can be visible in the collection cup in the field. Photo by Nicole King.


Fig. 11: Patrick Kocovsky and Madeline Tomczak (U. Toledo) collect Grass Carp eggs on the Sandusky River. Photo by Nicole King.

Early Life History Research from the U.S. Geological Survey Great Lakes Science Center

In fall 2021, we collaborated with the U.S. Fish and Wildlife Service and The Nature Conservancy to initiate new research to document the extent of lake whitefish (*Coregonus clupeaformis*) spawning at sites along the south shore of Lake Erie. Lake whitefish populations in Lake Erie are very low, and Lake Erie is the southern extent of their range in the Great Lakes. The areas sampled were based on historic information and models summarized by Hannah Schaefer's recently published master's research at University of Michigan (https:// DOI: 10.1127/adv_limnol/2021/0072). For our egg collections, we used diaphragm pumps and egg mats to collect the eggs of lake whitefish and lake trout (*Salvelinus namaycush*) at sites in the central and western basins, but none from the eastern basin. This work will continue in fall of 2022.

In spring and summer 2022, U.S. Geological Survey Great Lakes Science Center staff will participate in the Cooperative Science and Monitoring Initiative on Lake Huron. This is a binational multi-agency collaboration that rotates annually from one Great Lake to another. In 2022 we will intensively assess habitats and aquatic populations across all basins of the lake and the St. Marys River, the waterway connecting Lake Superior to the lower Great Lakes. An emphasis in 2022 is the examination of factors limiting lake whitefish recruitment, with hypotheses being tested on match-mismatch of larval lake whitefish with zooplankton food resources, assessment of habitats in nearshore areas of the lake, and measurements of larval production and transport in the St. Marys River.

Fig. 12: Crew preparing the egg pump for deployment (left) and lake whitefish eggs collected from the bottom of Lake Erie near Huron, OH (right). Credit: USGS GLSC.

Assessing Early Life Stage Ecology of the Great Lakes Largest Lake Sturgeon Population

Lauren Eaton, a contracted fisheries biologist for the U.S. Geological Survey Great Lakes Science Center at The University of Toledo is leading the analyses of over 10 years of lake sturgeon (*Acipenser fulvescens*) egg deposition and larval drift data from the St. Clair and Detroit Rivers System (SCDRS). The SCDRS is the 145 km long corridor that connects Lake Huron to Lake Erie and is the epicenter of recovery for lake sturgeon populations. These rivers have shipping channels that are dredged to maintain an excess of 10 m depth and relatively high flow velocities, often over 1 m/sec. Since lake sturgeon recruitment can be limited by the quality and availability of spawning habitat, seven artificial spawning reefs have been constructed since 2004 near historic spawning locations to restore lost habitat and increase recruitment. Egg mats, benthic D-frame nets, and depth-stratified conical nets were used to gauge lake sturgeon use of the artificial reefs and larval movement throughout the system. We are currently preparing a USGS Scientific Investigations Report for public release later this year that explores the past ten years of data. We found that lake sturgeon quickly made use of the artificial reefs, spawning on them almost always during the first spawning season, and then continuing to spawn on most reefs year after year. Data from the benthic D-frame nets revealed that larval lake sturgeon were captured throughout the system, with highest catch per hour at the St. Clair River reefs. This was expected given the large spawning population at the head of the St. Clair River near Port Huron, Michigan, and Sarnia, Ontario. Depth-stratified conical nets were placed at surface, middle, and bottom depths in the rivers in 8 to 10 meters depth. Although we found the highest catch per hour in the bottom nets, both yolk-sac and post yolk-sac stage larvae were captured at all sampling depths. In 2021 we sampled for eggs near the spawning reefs and for larvae at new sites not associated specifically with the spawning reefs in the St. Clair River. We captured eggs at all functioning spawning reefs and caught a record high number of larval lake sturgeon. This was a very exciting discovery for our group, and we plan to continue to assess lake sturgeon spawning and larval ecology as part of standard monitoring programs.

Fig. 13: Checking egg mats for evidence of spawning in the Detroit River. Credit: USGS GLSC.

Fig. 14: Setting a D-frame net to collect drifting lake sturgeon larvae in the St. Clair River. Credit: USGS GLSC.

Measuring Larval Fish Export from the St. Marys River Rapids

With guidance from Dr. Brandon Gerig at Northern Michigan University, Master of Science candidate Faith VanDrunen is working on a collaborative research project with the U.S. Army Corps of Engineers, U.S. Geological Survey Great Lakes Science Center, U.S. Fish and Wildlife Service, and Lake Superior State University to assess the magnitude of larval fish exported from the St. Marys River Sault Rapids. Her work will determine the influence of varying Lake Superior outflows through the compensating gates of the Soo Locks complex on larval fish production from 2018 to 2021. Historically, lake whitefish, cisco (*Coregonus artedi*), lake sturgeon, and introduced Pacific and Atlantic salmonids spawned within the Sault Rapids. However, construction and maintenance of the Soo Locks complex and hydro-electric facilities reduced and altered available spawning habitat and river flow. The magnitude of contemporary fish production exported from the Rapids is unknown. To remedy this information gap, we collected larval fish during day and night with replicate depth-stratified paired bongo and conical nets. Preliminary results suggest that larval export from the Rapids may share a positive relationship with mean sampling period discharge. Data analysis will continue into the summer of 2022.

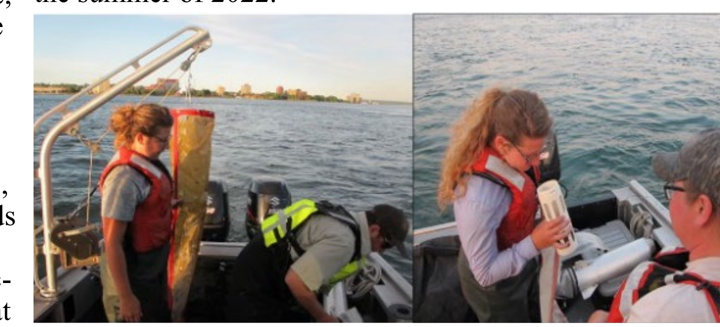

Fig. 15: Northern Michigan University graduate student Faith VanDrunen checking the catch in the cod bucket of a larval fish net fished below the St. Marys River Rapids. Credit USGS GLSC.

Spatial and Temporal Examination of Larval Lake Whitefish Prey Distribution, Abundance, and Utilization

Globally, coregonine fishes are experiencing population declines often attributed to low available zooplankton (prey resource) during the larval stage, which causes high larval mortality. To understand how prey availability relates to larval lake whitefish (*Coregonus clupeaformis*) survival in Lake Erie, The University of Toledo PhD candidate Zach Amidon, in collaboration with U.S. Geological Survey Great Lakes Science Center and The Nature Conservancy, collected spatial and temporal samples of zooplankton (in 2021) and larvae (2017, 2018, 2019, 2021) in Lake Erie's western basin. Prey biomass consumed in areas of low, medium, and high available prey biomass was compared to determine if prey density limited consumption. The most important larval prey resource was found to be copepods, and copepods were in greatest abundance nearshore where larval densities were also highest. However, larvae collected in areas with more food were not eating more, indicating that prey availability is unlikely limiting survival through means of starvation. Now that important prey resources have been identified, future work will focus on the relationship between prey abundance and larval growth, and survival.

Fig. 16: Left: Ph.D. candidate Zach Amidon deploying a bongo net in Lake Erie to collect larval fish. Right: Larval Lake Whitefish collected in western Lake Erie samples. Photo credit University of Toledo.

Examining the Diets of Age-0 Walleye from Western Lake Erie

In collaboration with the U.S. Geological Survey, The University of Toledo, the Ohio Division of Wildlife, and the Michigan Department of Natural Resources, Touhue Yang, a recent MS graduate student from The University of Toledo, successfully defended his thesis work comparing contemporary diets of western Lake Erie age-0 walleye (larval and young of year) with historical diets collected during the mid 1990s. In the last few decades, Lake Erie has experienced several unintentional introductions of aquatic invasive species (AIS) that have likely led to environmental and food web changes, potentially impacting age-0 walleye diet and growth. Fisheries managers desire an understanding of how diet composition and growth of age-0 walleye have changed in western Lake Erie since the 1990s in response to food web changes. Touhue's work found that during the pelagic larval stage, copepods dominated diets of recently hatched walleye in both contemporary and historical diets. During the demersal juvenile stage, his work found that diets of contemporary walleye were made up mostly of zooplankton benthic invertebrates and AIS prey, whereas diets of historical walleye were made up almost entirely of native fish prey. Consequently, walleye size at the end of their first growing season were smaller compared to historical walleye. Although walleye were smaller on average than historical walleye, the high proportion of non-empty stomachs and high numbers of demersal juvenile walleye at the end of the first growing season suggests fish were consuming enough prey items to avoid starvation. His results suggest that age-0 walleye are adapting to food web changes in western Lake Erie, but continued future analysis of age-0 walleye diet would provide confirmation on whether contemporary diets consistently contain less fish prey and more invertebrates and AIS because of food web changes or because of other complicating factors.

Fig. 17: The University of Toledo graduate student Touhue Yang processing a larval fish sample collected from Lake Erie's wester basin. Photo credit University of Toledo.

Making Use of USGS Great Lakes Science Center Larval Fish Sample Collection

The U.S. Geological Survey Great Lakes Science Center team has been busy pulling lake whitefish and walleye larvae from our Detroit River collection to contribute to a new collaborative research project with Drs. Yingming Zhao and Chris Wilson, research scientists with the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry and colleagues at multiple universities in Ontario, including Guelph, Queens, Windsor, Royal Military College of Canada, and The University of Toledo, Ohio. This work will use genetic markers to examine close kin recognition among groups and year-classes of larvae, identifying siblings who shared the same spawning habitats and identifying their source populations. This collaborative research attempts to estimate the number of sources of larvae in any collected location, and thus using the estimates for the entire western basin of Lake Erie, including the Detroit River, we can assess the contribution of different spawning sources/habitats to larval fish recruitment. Further, based on the ages/size and collection time, backtracking hydrodynamic algorithms can be developed to identify the spawning habitats and locations for walleye and lake whitefish.

A second objective of this collaborative research includes estimating the spatial and temporal patterns of stable isotopes for the larval fish community in western Lake Erie to provide an implication of their trophic status and resource use. Nitrogen stable isotopes will be used to estimate the trophic levels of fish larvae from different species and measure changes with ontogenetic development of larvae of same species (e.g., yolk larvae vs first feeding or feeding if samples available). Using carbon stable isotopes, we will estimate the resource/habitat use of fish larvae from different species or same species from different spawning grounds throughout their ontogenetic development. Lastly, this work will identify the spatial and temporal patterns of N and C stable isotopes in the larvae fish community in western Lake Erie.

Recent Publications coauthored by Great Lakes Science Center scientists

Amidon, Z. J., DeBruyne, R. L., Roseman, E. F. & Mayer, C. M. 2021: Contemporary and historic dynamics of lake whitefish (*Coregonus clupeaformis*) eggs, larvae, and juveniles suggest recruitment bottleneck during first growing season. Ann. Zool. Fennici 58: 161–175. https://doi.org/10.5735/086.058.0405.

Amidon, Z., R.L. DeBruyne, E.F. Roseman, and C.M. Mayer. 2021. Evidence of Increased Lake Whitefish Spawning Distribution in Western Lake Erie. Advances in Limnology 66:163-172. DOI: 10.1127/adv_limnol/2021/00631612-166X/21/0063

Brown, T.A., S.A. Sethi, L.G. Rudstam, J.P. Holden, M.J. Connerton, D. Gorsky, C.T. Karboski, M.A. Chalupnicki, N.M. Sard, E.F. Roseman, S.E. Prindle, M.J. Sanderson, T.M. Evans, A. Cooper, D.J. Reinhart, C. Davis, and B.C. Weidel. 2021. Contemporary spatial extent and environmental drivers of larval coregonine distributions across Lake Ontario. Journal of Great Lakes Research. doi.org/10.1016/j.jglr.2021.07.009

DeBruyne, R.L., T.R. Tucker, C. Lloyd, A.S. Briggs, M. Belore, and E.F. Roseman. 2021. Distribution and Abundance of Pelagic Larval Yellow Perch in Lake St. Clair (US/Canada) and Adjoining Waters. Pages 89-111 IN J.C Bruner and R.L. DeBruyne (editors). Ecology, Management, and Culture of Yellow Perch, Walleye and Sauger. Springer Nature Series. DOI: 10.1007/978-3-030-80678-1_4

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Stewart, T.R., Mäkinen, M., Goulon, C., Guillard, J., Marjomäki, T.J., Lasne, E., Karjalainen, J. and Stockwell, J.D., 2021. Influence of warming temperatures on coregonine embryogenesis within and among species. Hydrobiologia, 848(18), pp.4363-4385.

Lake Huron 2022 Cooperative Science and Monitoring Initiative (CSMI) Update

Ralph Tingley (U.S. Geological Survey, Great Lakes Science Center (GLSC) Biologist), David B. Bunnell (GLSC Research Fisheries Biologist), Cory Brant (GLSC Biologist) and Jonathan Doubek (Assistant Professor, Lake Superior State University)

The study of early life history of fishes takes center stage in the U.S. Geological Survey (USGS)-led portion of the Lake Huron 2022 Cooperative Science and Monitoring Initiative (CSMI). This year's effort builds on CSMI 2017 results—to explore spatio-temporal variation in lower trophic levels across Lake Huron and their effects on larval fish production. In cooperation with the Center for Freshwater Research and Education at Lake Superior State University, nearshore sampling began after ice out and continued through June at four sites in the North Channel and four in the Southern Main Basin. Sample locations fill gaps in the spatial coverage of existing larval lake whitefish (*Coregonus clupeaformis*) sampling efforts by Tribal partners and other agencies. In more offshore waters, binational collaboration between the Environmental Protection Agency (EPA), USGS, National Oceanic and Atmospheric Organization, Fisheries and Oceans Canada, and Environment and Climate Change Canada has enabled larval fish community, zooplankton and water quality sampling in June and July at a finer temporal resolution (biweekly) than in 2017 (monthly). Specifically, this sampling is occurring in four regions that represent an even broader gradient of productivity in Lake Huron: Saginaw Bay, the North Channel (Thessalon), the Northern Main Basin (Boot Island), and the Southern Main Basin (Harbor Beach). The inclusion of Saginaw Bay expands the range in productivity sampled relative to 2017, which allows for further testing of the hypothesis that changing productivity would have a larger effect on larval fish growth and survival than on adult fishes. In addition, the EPA research team led a lake-wide sampling event in June that broadened the spatial extent of the 2017 design allowing for a comparison of lower food-web productivity across years.

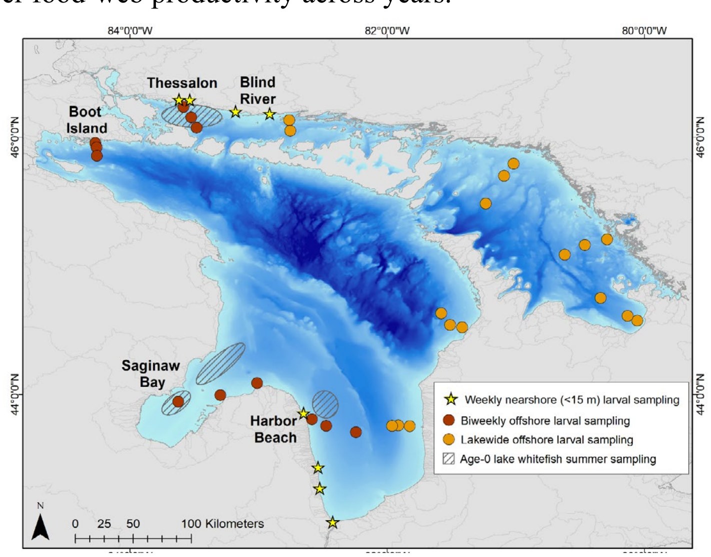

Fig. 18: Lake Huron CSMI 2022 sample stations for weekly nearshore larval sampling (inclusive of beach and small vessel tows), intensive (biweekly) and lake-wide offshore larval sampling, and age-0 lake whitefish bottom trawling and gillnetting. Biweekly offshore locations were also sampled as part of the June lake-wide event.

Within these aforementioned sampling efforts, USGS and its partners prioritized tracking early life history of lake whitefish from hatch out in spring through the late summer. The goal of this multi-method sampling effort is to increase the understanding of early life history diets and growth in lake whitefish under contemporary conditions. Regular fish sampling is being paired with food-web monitoring to test the hypothesis that lake whitefish recruitment is declining due to declining spring zooplankton availability in the nearshore, or with changes in the benthic invertebrate community following dreissenid mussel invasion. Bag-seining is also currently being conducted to capture juvenile lake whitefish in the beach habitat. Finally, exploratory bottom trawling and gill netting with large vessels near Thessalon, Harbor Beach, and Saginaw Bay is now underway for age-0 lake whitefish that are hypothesized to move to more offshore habitats where optimal thermal habitats (~15 – 18°C) may persist. Long-term plans include examination of variation in age-0 lake whitefish diet composition and growth across regions and throughout the first six months of life as well as comparing fish densities with environmental and zooplankton variables to examine primary drivers of whitefish abundance.

Fig. 19: GLSC student contractor Renee Renauer-Bova awaiting the word to deploy a paired bongo net for nearshore larval fish sampling off the coast of Port Sanilac (Photo credit: GLSC biological technician Stacy Provo).

Fig. 20: A mix of aquatic invertebrates and larval fishes collected during the first week of the pelagic life stage while sampling near the mouth of the Blind River (Photo credit: Jon Doubek).

Fig. 21: A coregonine larva, along with an invasive spiny water flea (*Bythotrephes longimanus*), captured in the North Channel (Photo credit: Simon Freeman, undergraduate student in Fisheries and Wildlife at Lake Superior State University).

Fig. 22: Age-0 lake whitefish captured using a bottom trawl in inner Saginaw Bay (Photo credit: Renee Renauer-Bova).

WESTER REGION
DAN MARGULIEAS

IATTC's Early Life History Group Announces Updated Website for Achotines Laboratory

Daniel Margulies, Vernon Scholey, Yole Buchalla and Susana Cusatti, Inter-American Tropical Tuna Commission, 8901 La Jolla Shores Drive, La Jolla, CA 92037 USA

The Inter-American Tropical Tuna Commission's (IATTC's) Early Life History (ELH) Group reports that the website for their Achotines Laboratory in Panama has received a major update and expansion.

The updated Achotines Laboratory website can be found here:

https://www.iattc.org/en-US/About/Achotines-Lab

The updated website contains new descriptions of tuna research projects conducted by the ELH Group, including over 40 new photos and 3 video segments (including an intro video set to music!).

The updated website describes past and present tuna research conducted at the Achotines Laboratory, covering the period from 1986 to present. The research includes early studies on coastal species such as black skipjack tuna, bullet/frigate tunas, and sierra mackerel (field and laboratory studies) and the transition of the research to studies of multiple life stages of yellowfin tuna, including 25 years of sustained captive spawning of yellowfin and multiple early life stage laboratory investigations.

The research has been conducted mostly by the ELH Group but also includes important collaborative studies with universities and government researchers, most notably ongoing joint studies conducted with Kindai University of Japan and the University of Miami's Aquaculture Program.

The Achotines Laboratory website is part of a larger update to the main website of the IATTC, and readers can learn about the research programs of the IATTC through links from the Achotines Laboratory page to the main IATTC website.

PACIFIC RIM REGION
AKINORI TAKASUKA

I am so glad that the current issue includes a variety of topics from the Pacific Rim. I express my best thanks to the former Pacific Rim Representative, Dr. Iain Suthers for his great contribution. Iain provided four news articles from Australia. A news from Japan also follows these.

News from Australia

Iain Suthers

School of Biological, Earth & Environmental Sciences (BEES), and Sydney Institute of Marine Science (SIMS) University of New South Wales (UNSW), Sydney, Australia

**i.suthers@unsw.edu.au*

Closure of Australia's larval fish monitoring

After 8 years of informal operation and funded for the past 3 years, Australia's Larval Fish Monitoring Sub-facility for the Integrated Marine Observing System will cease operations on 30th June 2022. The reasons have never been provided in writing or in person, but it was all part of a "refresh" of IMOS and includes the removal of the mooring array that monitors the East Australian Current. Tony Miskiewicz has completed all larval ID's up to the end of 2021, and both Tony and Indy Riley are currently going through the final data quality control before sending off the dataset for upload to the AODN. Our data is publicly available but a new data exploration tool is being developed. Three east coast stations (Brisbane, Sydney, Hobart) have kindly agreed to continue with simplified sampling.

Some of our major outputs are the historical larval fish database of 218 taxa (mostly families, some with commercial species; Smith et al 2018 https://doi.org/10.1038/sdata.2018.20).

Most importantly has been the discovery of the first fisheries recruitment signals on the east coast of Australia; by transport in the East Australian Current and how onshore wind events contribute to estuarine fisheries landings 3 to 4 years later.

Schilling HT, et al. (2022) Coastal winds and larval fish abundance indicate a recruitment mechanism for southeast Australian estuarine fisheries. Fisheries Oceanography, 31: 40–55. https://doi.org/10.1111/fog.12561

Schilling H, et al. (2020) Multiple spawning events promote increased larval dispersal of a predatory fish in a western boundary current. Fisheries Oceanography, 29: 309–323. https://doi.org/10.1111/fog.12473

Another significant finding was that viable genetic sequences can be extracted from larval fish preserved in 5% formalin for up to six months, now published in the Journal of Experimental Marine Biology and Ecology. It was previously thought that DNA extraction from formalin-fixed specimens was all but impossible, and this discovery could vastly improve and streamline larval fish sampling while at sea and in the laboratory. Co-author Tony Miskiewicz will be presenting this research in Portugal this month at the IX Iberian Congress of Ichthyology.

Appleyard, et al. (2022) Genetic and morphological identification of formalin fixed, preserved larval fishes; can we have the best of both worlds? Journal of Experimental Marine Biology and Ecology, 553, p.151763. https://doi.org/10.1016/j.jembe.2022.151763

A new paper on Australia's father of fisheries research, Harald Dannevig (1879–1914)

The Norwegian Johan Hjort and his contemporaries were principal players in the early 20th century development of marine science in Europe. Harald Dannevig (Fig. 23) was also part of this talented cohort, but his scientific career played out in Scotland and Australia from 1894 until 1914. Dannevig's work in Australia was of great significance for scientific and fisheries development and widely supported by the public at that time, but his achievements were largely forgotten at the outset of World War I with the loss of Dannevig, his research ship and crew in the Southern Ocean, returning from Macquarie Island. His 94 research cruises to determine suitable trawling grounds covered approximately 7000 km of coastline and led to the identification of 263 new species of marine life, including 96 new fish species.

Hjort and Harald Dannevig's father, Gunder, were involved in a long struggle to determine the effectiveness of releasing hatchery reared cod into Norwegian fjords. While Harald Dannevig's work in Scotland was largely based on aquaculture and larval rearing, he became an expert in trawling and the commercial fishing industry. His first position in Australia as Supervisor of fisheries investigations in the state of New South Wales was originally based on his transport of 800 live European fish, but he soon concluded that exploitation of wild fisheries was a much more viable alternative. He built the first aquaculture ponds at the Cronulla site in 1904, and wrote a major review on the iconic freshwater fish Murray cod.

Fig. 23: Dannevig and crewman demonstrating the Ekman reversing bottle on a voyage from Melbourne to Eden. Photo by Captain J.K. Davis. Courtesy State Library of Victoria, John King Davis Collection.

There are a number of interesting parallels in the lives of Hjort and Dannevig. They were both appointed to head the Fisheries Directorates of their respective nations, Hjort in 1900 and Dannevig as founding Australian Director of Fisheries in 1908. They conducted major fisheries research investigations using almost identical ships and equipment. Hjort's major investigation with the 'Michael Sars' coincided with that of Dannevig and the 'FIS Endeavour', which was locally built in Sydney Harbour based on the plans of Michael Sars. They both trained others in the use of oceanographic equipment. Dannevig trained Antarctic explorers in 1909 in hydrographic work which was of major scientific significance to Australian Antarctic research.

Professor G O Sars at Christiania University in Norway was a major influence for Hjort as a colleague, and for Dannevig as a student. Sars' understanding of fisheries oceanography influenced them both and was likely the stimulus for Dannevig's (1907) paper on the relationship between lagged fisheries landings in local Sydney estuaries and the incidence of onshore wind events (Schilling et al. 2022). In our understanding of larval transport and fisheries recruitment, this was a world first. Dannevig's name is given to a range of fauna and to a small island outside Melbourne, where the Endeavour would have regularly steamed past.

For further reading:

Suthers et al. (2021) Novel fisheries investigations by Harald Dannevig: some parallels with Johan Hjort on the other side of the world. ICES J. Marine Science. https://doi.org/10.1093/icesjms/fsaa001

A new digitized record of Nishikawa et al. (1985) — a historical, near global distribution of larval pelagic fishes

Knowing the distribution of fish larvae can inform fisheries science and resource management in several ways, by: 1) providing information on spawning areas; 2) identifying key areas to manage and conserve; and 3) helping to understand how fish populations are affected by anthropogenic pressures, such as overfishing and climate change. With the expansion of industrial fishing activity after 1945, there was increased sampling of fish larvae to help better understand variation in fish stocks. However, large-scale larval records are rare and often unavailable. Here we digitize data from Nishikawa et al. (1985), which were collected from 1956–1981 and are near-global (50°N–50°S), seasonal distribution maps of fish larvae of 18 mainly commercial pelagic taxa of the families Scombridae, Xiphiidae, Istiophoridae, Scombrolabracidae, and Scomberesocidae. Data were collected from the Pacific, Atlantic, and Indian Oceans. We present four seasonal 1°x1° resolution maps per taxa representing larval abundance per grid cell and highlight some of the main patterns. Data are made available as delimited text, raster, and vector files.

Buenafe, K. C. et al. (2022) A global, historical database of tuna, billfish, and saury larval distributions. Scientific Data, in press, 14 Jun22

The larval fish size spectrum and the recruitment potential (M/G ratio)

A recent paper highlights the "recruitment potential" of larval fish cohorts, which is the biomass-specific Growth – Mortality ratio (G/M). This ratio was championed by Ed Houde (1997) and by a number of his students. There is growing appreciation that both growth and mortality need to be combined to forecast rates of larval recruitment into larger size classes, but G and M are rarely measured simultaneously. The M/G ratio is part of the growth-mortality paradigm of recruitment, but has been overlooked in recent syntheses of fish recruitment. This is partly because M and G are hard to measure simultaneously and there are significant obstacles in upscaling from the cohort M/G snapshot to recruitment for a fish stock. If M/G could be estimated more simply and easily over fine and large scales, there could be considerable insights for recruitment studies and in fisheries forecasts. In this paper, we outline an hypothesis relating the M/G ratio to the plankton biomass size-spectrum (i.e. the size-frequency distribution of planktonic particles), which summarises the structure and function of pelagic ecosystems. We show that the ratio is mathematically the slope of the zooplankton size frequency distribution (size-spectrum), using the original formulation of the McKendrick von Foerster (MF) partial differential equation. An exciting implication is that we could determine the M/G ratio from the biomass size frequency distribution of particular larval species, without having to age the larvae. We discuss some of the limitations of this hypothesis, and what is needed to test the relationship between zooplankton size-spectra and larval fish M/G ratios.

Suthers, I. et al. (2022) The Mortality/Growth ratio of larval fish and the slope of the zooplankton size spectrum. Fish and Fisheries, https://doi.org/10.1111/faf.12633

Larval sampling used to understand Japanese eel spawning ecology

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The larval sampling research effort to unveil the spawning ecology of the Japanese eel, *Anguilla japonica*, began in the 1930s and has continued at times for more than 80 years. Here, we briefly outline the findings of the long-term more-recent research efforts made by a team of scientists over the years that were led by Katsumi Tsukamoto, and introduce a part of the results since the 2014 cruise using a combination of larval sampling and other methods.

The larval distribution narrowed down the areas of spawning to be along the western side of the seamount chain of the West Mariana Ridge, south of a salinity front or within low salinity water, and only during about 3 days near new moon (Tsukamoto et al., 2011; Aoyama et al., 2014) of each month (egg and preleptocephalus catches, larval otolith back-calculation) of the spawning season (April-August). The three landmarks such as seamounts, salinity structure and new moon have enabled determining likely spawning locations in each new moon period, and Japanese eel eggs were collected in the area during five research cruises conducted in 2009–2017.

Fig. 24: Photographs of a Japanese eel egg (top) and newly hatched preleptocephalus (bottom) collected during the 2014 cruise (from Takeuchi et al., 2021).

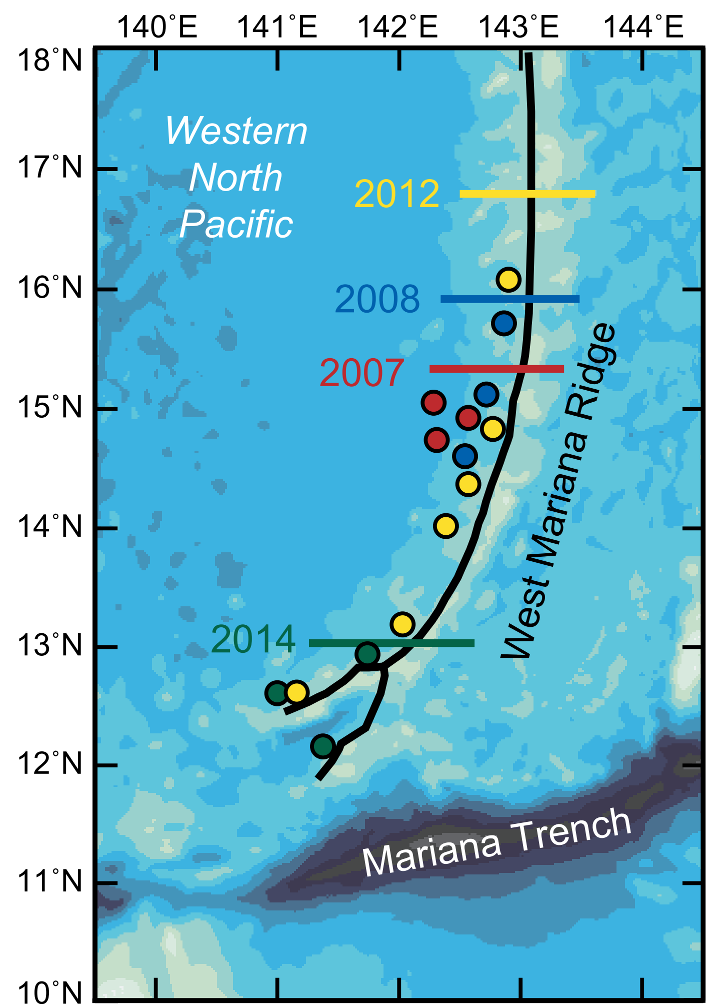

Fig. 25: Schematic diagrams of the types of geographic patterns of Japanese eel spawning locations. Each color shows hypothetical spawning locations (circles) based on preleptocephali catches and the location of the salinity front and the low salinity water mass (solid lines) in different years (2012: yellow, 2008: blue, 2007: red, 2014: green). 2009 and 2011 were similar to in 2014. Redraw from Takeuchi et al. (2021).

During a 2014 research cruise, we used the three landmarks to identify the likely spawning area and then collected three eggs and 245 newly hatched preleptocephali of the Japanese eel (Fig.24). The collections suggested that spawning occurred in at least two locations, south of the salinity front and at the far-southern part of the ridge during the May 2014 new moon period, but no spawning occurred farther north along the seamount ridge based on a lack of preleptocephali catches there (Fig. 25; Takeuchi et al., 2021). However, the previous collections of the preleptocephali in other months and years showed that spawning occurred much farther north and across a wider range of latitudes in low salinity without distinct fronts (Tsukamoto et al., 2011; Aoyama et al., 2014), as reviewed by Takeuchi et al. (2021). The larval distribution and range of likely spawning was from about 16°N as a northern limit to about 12°N as a southern limit. The Japanese eel seems to form multiple spawning sites within approximately 16–12°N depending on the salinity structure along the West Mariana Ridge.

During the most recent cruises, in addition to net sampling for Japanese eel larvae, we used underwater camera systems, hydroacoustic systems (Takeuchi et al., 2021), eDNA detections of spawning events (Takeuchi et al., 2019), and genetic parentage analyses. These methods provide new insights on Japanese eel spawning ecology as will be reported more soon (Takeuchi et al., in revision- and under review-not shown).

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Takeuchi, A., Watanabe, S., Yamamoto, S., Miller, M.J., Fukuba, T., Miwa, T., Okino, T., Minamoto, T., Tsukamoto, K. (2019) First use of oceanic environmental DNA to study the spawning ecology of the Japanese eel *Anguilla japonica*. *Marine Ecology Progress Series*, 609: 187–196. https://doi.org/10.3354/meps12828

Takeuchi, A., Higuchi, T., Watanabe, S., Yama, R., Fukuba, T., Okamura, A., Miller, M.J., Okino, T., Miwa, T., Tsukamoto, K. (2021) Several possible spawning sites of the Japanese eel determined from collections of their eggs and preleptocephali. *Fisheries Science*, 87(3): 339–352. https://doi.org/10.1007/s12562-021-01519-4

Tsukamoto, K., Chow, S., Otake, T., Kurogi, H., Mochioka, N., Miller, M.J., Aoyama, J., ... et al. (2011) Oceanic spawning ecology of freshwater eels in the western North Pacific. *Nature Communications*, 2:179. https://doi.org/10.1038/ncomms1174

LARVA OF THE ISSUE

Larvae of the family Xenisthmidae genus *Allomicrodesmus* captured by bongo net within 1 km of Osprey Reef in the Coral Sea. Top, 3.4 mm preflexion larva; bottom, 7.4 mm postflexion larva (from Leis et al 1993, *Copeia* {1}: 186-196). Xenisthmids are small, gobioid, coral-reef fishes from the West Indo-Pacific. Their larvae are characterized by a number of morphological features that are either very rare or unique to the family. These include: blade-like extensions of pterygiophores of the dorsal and anal fins, spines on the lower portion of the cleithrum, a small spine at the angle of the lower jaw, spines on the branchiostegal rays, and ontogenetic posterior migration of the very prominent gas bladder. By Jeff Leis

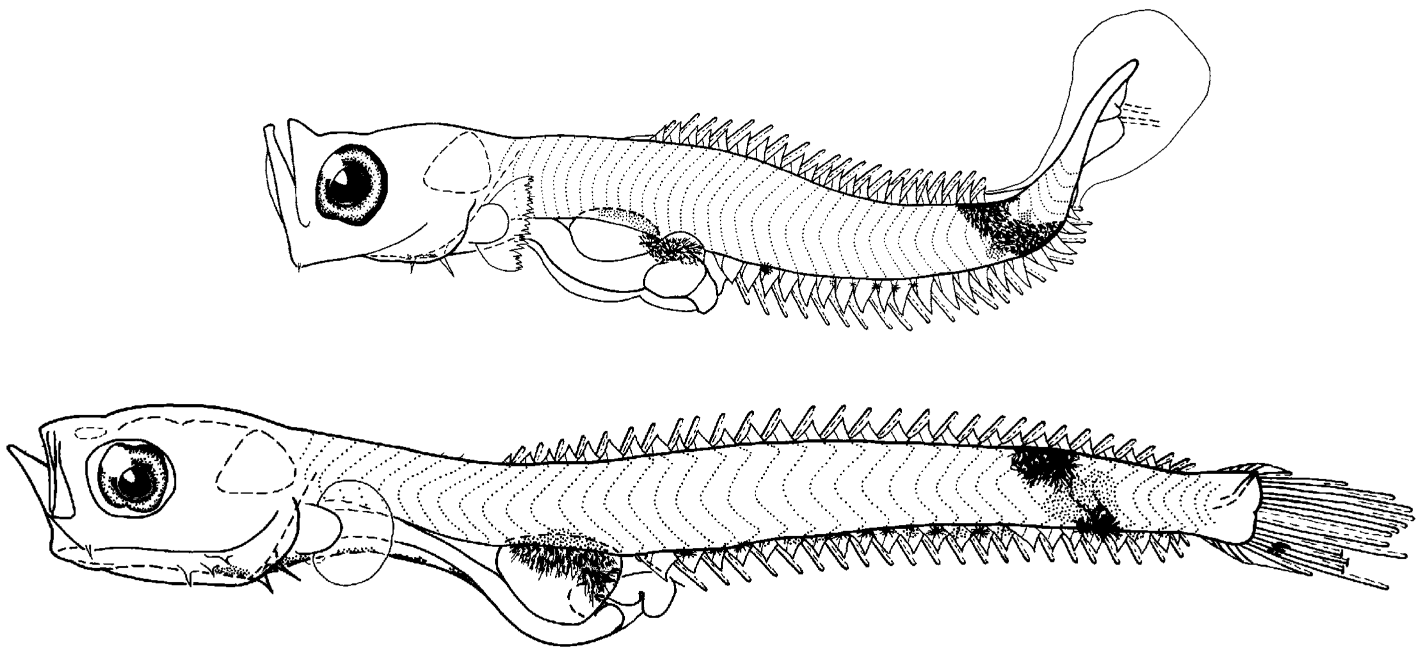

Fig. 26: *Allomycrodesmus* sp. larvae. The preflexion larva is 3.4mm and the postflexion 7.4mm long. Images are not to scale. Images from Leis et al. (1993).

LARVAL FISH COLLECTION OF THE ISSUE

A tale of two ichthyoplankton collections in Seattle

Laurel Nave-Powers, Jenna Barrett, and Ali Deary
University of Washington, School of Aquatic and Fishery Sciences
Alaska Fishery Sciences Center, National Oceanic and Atmospheric Administration

The University of Washington Burke Museum Fish Collection (UWFC) has a long-standing connection to the Alaska Fishery Sciences Center (AFSC) Archive, located at the National Oceanic and Atmospheric Administration (NOAA) facility in Seattle. This symbiotic relationship between a federal and academic institution creates a unique opportunity for scientists to access a larger volume of specimens, aiding in the expansion of ichthyological knowledge. It is mutually beneficial to both the UWFC and AFSC Archive as both get easy access to the specimens and data, while solving the problem of limited space at the AFSC Archive. The housing of the specimens at the UWFC also allows access to researchers from around the world and with an excellent website where researchers can browse the early life history collections available at UWFC without leaving home (https://www.burkemuseum.org/collections-and-research/biology/ichthyology/collections-database/search.php).

The unique relationship between the AFSC Archive and UWFC began in the early 1980s with Dr. Theodore W. Pietsch, the curator at the UWFC from 1978 to 2015, and Dr. Ann Matarese, AFSC's Ecosystems and Fisheries Oceanography Coordinated Investigations (EcoFOCI) program. Together, Matarese and Pietsch secured a funding relationship between NOAA Fisheries and the UWFC that would live on to present day (Pearson Maslenikov 2021). Since the beginning of this collaboration, the UWFC has grown to hold over 13 million specimens, of which 74% were received from NOAA Fisheries. Of those 13 million, roughly 9 million are early life history specimens, 95% of which were transferred and integrated into the UWFC from the AFSC Archive (Pearson Maslenikov 2021). Among the ichthyoplankton specimens at UWFC are individuals from 404 species in 208 genera and 87 families (as of 2019). The specimens transferred from the AFSC Archive are largely caught in the northeastern Pacific Ocean including the Gulf of Alaska, eastern Bering Sea, and Chukchi Sea, during annual EcoFOCI surveys. The transfer of ichthyoplankton ensures quality curation for these specimens, as well as complete and accurate metadata associated with each individual.

A vital component of successful research is having long-term, consistent data. The symbiotic relationship between the AFSC and the UWFC supports this notion and demonstrates an award-winning historical ichthyoplankton dataset (PICES Ocean Monitoring Service Award to EcoFOCI 2021). The 8-year transfer process begins at sea. Each year, EcoFOCI conducts surveys from spring to early fall throughout the northeastern Pacific Ocean. Among the many different types of ecosystem data collected during the annual surveys are ichthyoplankton samples. These are the samples that eventually end up archived at the UWFC, but there is extensive processing that occurs before samples reach that point. First, the samples are sent to the Plankton Sorting and Identification Laboratory in Sczcecin, Poland (ZSIOP). Samples are sorted and separated into vials by cruise, station, gear type, net and haul number, and then species. Later in the year, EcoFOCI receives the vials of ichthyoplankton, both fish eggs and larvae, and EcoFOCI scientists verify all of the specimen and survey details on the physical vials and digital datafiles. The samples are temporarily archived at AFSC for 7 years. At the 8th year after collection, it is time to transfer the samples out of the AFSC Archive! The transfer is led by a UW graduate student who works closely with AFSC scientists to inventory all of the ichthyoplankton vials collected in that year, fix any data discrepancies, finalize the data, and assign UW catalog numbers to each vial. Once samples are moved from AFSC Archive to UWFC, many undergraduate early career researchers have the chance to experience the amazing sample reserves while they fit the vials into the expansive cabinets at UWFC.

Fig. 27: Jenna Barrett and Laurel Nave-Powers showcasing a small portion of the UWFC larvae transferred from the AFSC.

Not only does the partnership between the UWFC and the AFSC Archive guarantee quality specimens and data allowing for essential early life history research, it also fosters relationships between the researchers at each institution. This is particularly important for the mentorship of early career scientists. The ichthyoplankton transfer has a strong history of funding a graduate student from the UW School of Aquatic and Fishery Sciences (SAFS) to lead the transfer each year. Undergraduate students are also involved in the transfer once the specimens reach the UWFC. The students gain experience and knowledge in how both collections function. Skills such as database management and the archival and curation of a collection are important and widely applicable, especially when learned across two collections with such a large number of specimens. As a result of the relationship between the UWFC and the AFSC Archive, many students have also participated in survey cruises with AFSC. This provides excellent field experience, as well as insight into the research that is being done because of EcoFOCI's surveys. The engagement of students in the transfer process also gives them the opportunity for networking in both an academic and federal environment and builds a much broader research network for early career researchers to draw from when considering the next step in their career and looking for opportunities.

The 60-plus years of larval samples held at the UWFC inspires a myriad of research avenues. There are well preserved specimens for morphological work as well as excellent developmental series. Genetic samples are also available to further define phylogeny and explore potential speciation between differing communities. Every year, EcoFOCI also collects extensive physical, chemical, and supplemental biological data. This allows for tracking ecosystem function over time, during major physical events (i.e., marine heatwaves), and throughout a shifting climate. While this is significant for tracking ecological implications from climate change, it is also useful to apply long-term ichthyoplankon trends to recruitment within and between populations to maintain major commercial fisheries and culturally important ecosystems. Due to the sharing of the collection between the AFSC and the UWFC, these projects are conducted by academics, students, early career researchers, and professionals from all over the world. Overall, the breadth of the UWFC ichthyoplankton archives supports ecological, cultural, and economic scientific expansion as well as connectivity within the scientific community. The extent of this would not be possible without the continuing relationship between the UWFC and AFSC. More of these connections between institutions would do much to further the preservation of ichthyoplankton, data, and collaboration between researchers.

References

Pearson Maslenikov, K. 2021. Specimens by the Millions: Managing Large, Specialized Collections at the University of Washington Burke Museum Fish Collection. Ichthyology and Herpetology 109:397-406.

ANNOUNCEMENT

Percis V Symposium

The Fifth International Percid Fish Symposium will be held in České Budějovice, Czech Republic, EU, in September 18-23, 2022, organized by the Biology Centre of the Czech Academy of Sciences, Institute of Hydrobiology, Fish Ecology Unit. Topical sessions will include: Biology of perch (*Perca fluviatilis, P. flavescens, P. schrenkii*), pikeperch, walleye, sauger, (*S. lucioperca, S. volgensis, S. vitreus, S. canadensis*), ruffe (*Gymnocephalus* spp.) and related species; Early life history and ontogeny; Population dynamics; Behavior and evolution; Fish stock management; Aquaculture; Hydroacoustics in Percid research; Physiology and genetics (eDNA including); Predators and parasites; Interactions with other species; and Percids as invasive fishes. Details on the venue, accommodations, and field trips can be found at https://www.percis-v.eu/. Participants will also have the opportunity to publish their contributions in Ecology of Freshwater Fish or Aquaculture, Fish and Fisheries.

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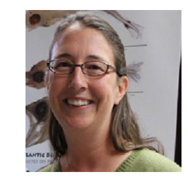

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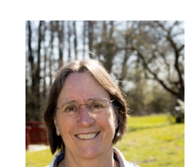

RAMBLE ON

Dear Early Life History Researchers and Enthusiasts,

We are happy to present you the latest edition of the STAGES newsletter. We had to combine the first two isues of volume 43 because we did not receive enough content for the February issue. Ed Roseman and the North Central Region and Akinori Takasuka and the Pacific Rim Region made up for with lots of exciting news.
Please welcome Olivier Morissette as our new Social Media coordinator. Olivier replaces Dominique Robert who did a fantastic job in the past.

We also have a correction concerning Geoff Moser's obituary in the last volume written by Eric Hilton and Bruce Mundy. Bruce Mundy's address is incorrect in the article. The correct address is:

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We hope your enjoying the summer.

Simon & Peter