STAGES

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INSIDE THE ISSUE

NEWS FROM THE REGIONS 2
Southern Region 2
Western Region 3
European Region 5
Larval Fish of the Issue 6
Larval Fish Collection of the Issue 7
Announcements 9
RAMBLE ON 10
NEWSLETTER PRODUCTION TEAM 11

ELHS Back in the Days

20 years ago: Jeff Govoni was appointed as ELHS Historian/Archivist

30 years ago: LFC held with the American Society of Ichthyology and Herpetology at the University of Texas in Austin; the second joint meeting.

MESSAGE FROM THE PRESIDENT

Dear ELHS friends and colleagues:

I hope you all have been having a great winter. While the winter in Ohio has been rather mild, I am ready for warmer temperatures, more daylight, and certainly more sunshine, the latter of which is especially rare in the midwestern United States during wintertime.

I do not have a lot to write about at this time, as the Early Life History Section as a whole has been quiet and things are humming along. Ana Faria and Susana Garrido have been working hard to organize the upcoming Larval Fish Conference in Lisbon, Portugal (7-11 May 2023), which I know will be fantastic. A surge in registrations occurred, and we are optimistic that we will surpass the 100+ participant/presenter barrier very soon. If you have not yet registered for the meeting, I encourage you to do so ASAP. **The deadline for submitting abstracts and early bird registration rates is 20 March 2023.** You can find the meeting information and abstract submission portal at https://larvalfishconference.com/.

The venue (Calouste Gulbenkian Foundation) will be superb, with Ana and Susana managing to get a lot of in-kind support that will make the meeting well worth attending. If you are on the fence about whether to attend, please read my note in the last edition of STAGES, which offers many reasons why the Larval Fish Conference is well worth attending.

Besides helping Susana and Ana with the upcoming conference, I have been working with the Early Life History Section's Executive Committee to 1) update the Section's website, 2) identify ways to increase member contributions to the STAGES newsletter, and 3) plan the 47th Larval Fish Conference, which I will help coordinate and host at Sawmill Creek Resort on the shores of Lake Erie (Huron, Ohio USA) during 12-16 May 2024. I also will revisit this spring some initiatives that I mentioned at the last Larval Fish Conference, which include discussing ways into increase diversity and inclusiveness within the Early Life History Section, as well as increasing educational opportunities for students and professionals in our discipline.

I wish you a wonderful end to your winter and a happy, productive spring. Please consider joining me and many others at the 46th Larval Fish Conference, and do let me know if you have any thoughts on how to improve the ELHS section. I hope to see you in Lisbon in May!

Sincerely,

Stu Ludsin

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NEWS FROM THE REGIONS

SOUTHERN REGION
TRIKA GERARD

Low levels of sibship encourage use of larvae in western Atlantic bluefin tuna abundance estimation by close-kin mark-recapture

Globally, tunas are among the most valuable fish stocks, but are also inherently difficult to monitor and assess. Standardized larval surveys aim to measure relative spawning biomass of West Atlantic Bluefin tuna, *Thunnus thynnus* annually in the northern Gulf of Mexico (GoM). In a collaborative effort, The Early Life History Unit and the Sustainable Fisheries Division at NOAA's Southeast Fisheries Science Center (SEFSC) used Close-kin mark recapture to determine low levels of sibship within and among larval aggregations of Bluefin tuna in the GoM. Close-kin mark recapture is a genetics-based technique capable of identifying individuals in the population based on the DNA profiles of their closely related family members, including parent-offspring and sibling genetic matches. Application of close-kin mark recapture to Atlantic bluefin tuna is expected to solve two major uncertainties: 1) identify the origin of fish caught by U.S. fisheries and 2) estimate the absolute abundance of GoM spawning stock annually. These two pieces of genetics-based information will allow SEFSC to monitor the trends in domestic stock production, as well as the contribution to catches of other stocks that migrate to U.S. fishing areas.

The research leveraged biological sampling for bluefin tuna in the West Atlantic to build a genetic database of DNA profiles. Sampling from known spawning grounds in the Mediterranean Sea and GoM provided genetic baselines for the stocks, from which we identified stock-identification markers. The larval collections also provided a method of marking actively spawning fish each year without ever handling the large, mature tuna. Simply put, each larval fish contains the genotypes of its mother and father, and therefore contains the genetic tag of two spawning fish in the GoM. Sampling adult fish from the fishery provided the recapture event, after the spawning fish migrated and mixed with the unmarked population.

Full- and half-siblings were found within both years, with 12% of 156 samples in 2016 and 56% of 317 samples in 2017 having at least one sibling. There were also two pairs of cross cohort half-siblings. Targeted sampling increased the number of larvae collected per sampling event but resulted in a higher proportion of siblings. The combined effective sample size across both years was about 75% of the nominal size, indicating that Gulf of Mexico larval collections could be a suitable source of juveniles for CKMR in Western Atlantic bluefin tuna. This work was collaboratively conducted with partners from the Commonwealth Scientific and Industrial Research Organization, Virginia Institute of Marine Sciences, University of Maine, Canada Department of Fisheries and Oceans, and NOAA Fisheries. The full publication can be found here.

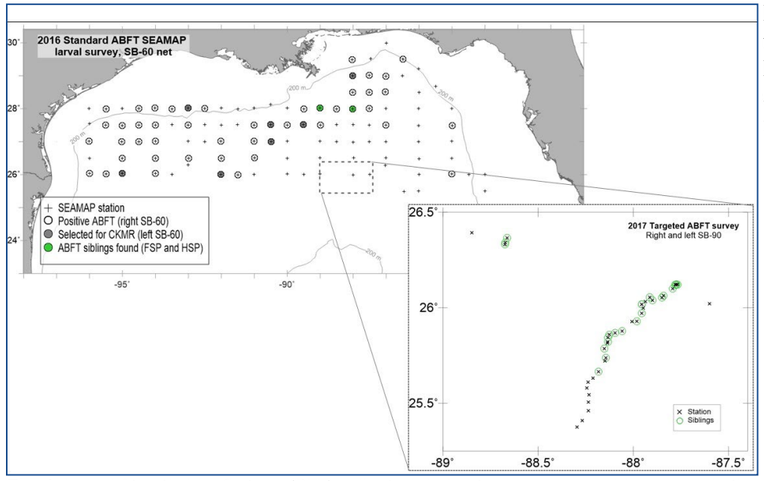

Fig. 1: Larval Atlantic bluefin tuna (BFT) collected during two oceanographic surveys in the northern GoM, (a) 2016 standard ichthyoplankton survey (b) Insert: 2017 targeted larval survey. Stations are indicated with a + or x, in 2016, positive BFT stations that were selected for close kin mark recapture (CKMR) are displayed with closed symbols (gray filled circle). Surveys found to have siblings (full sibling pairs and half sibling pairs) are denoted by green symbols.

WESTERN REGION
DAN MARGULIES

The contribution is from Megan Human, a contractor for NOAA's Southwest Fisheries Science Center (SWFSC) in La Jolla. Megan has been contributing a series entitled, "Fish of the Week" for the SWFSC Weekly Report. Each contribution covers the life history of one species with associated photos of the larval stages. Megan has provided three such species summaries from her series describing blob sculpin, Pacific blackdragon and roosterfish. This contribution was facilitated by Bill Watson of the SWFSC.

Blob Sculpin (*Psychrolutes phrictus*)

This specimen was collected during the 2010 Spring CalCOFI survey very offshore of Northern California (line 50.0 station 148.3). Blob sculpins have a distinctive tadpole-shape with a large, rounded head and abdomen tapering toward the tail, with an outer layer of loose flabby skin, and belly prickles. Early in development larvae begin to resemble adults, but typically have prickles more widely distributed over the body. Blob sculpin is a very deepwater fish (depth range 500 - 2800 m) found off the Pacific coast of the U.S. from the Bering Sea to Southern California, and can grow to about 2 feet in length.

The majority of photographs of adults you'll see of the Blob sculpin shows a pink face with a down-turned mouth and drooping 'nose'. This appearance is what lead the species name *phrictus* which means causing one to shudder. However, this condition is caused by the fact that their body is gelatinous with soft bones which helps them deal with the immense pressure they experience in the deep ocean. At depth they are grey in color with a large face and mouth and their body is covered in small fleshy threads called cirri. They are not targeted by any fishery and are typically only caught as bycatch during deep trawling.

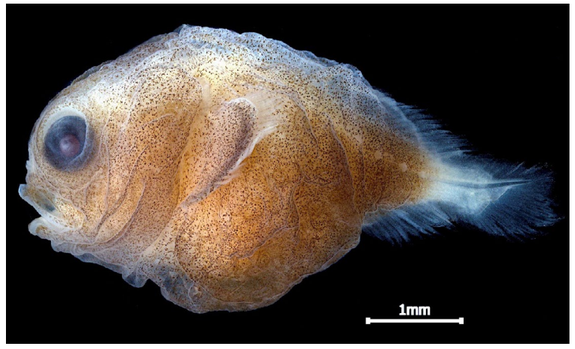

Fig. 2: Preflexion stage of *Psychrolutes phrictus*

Fig. 3: Postflexion stage of *Nematistius pectoralis*

Roosterfish (*Nematistius pectoralis*.)

This specimen was collected off Panama (lATTC, nightlight station, 91-VIII-DI). It is a postflexion larva 12.5mm long that was used for the original drawing in the species description in CalCOFI Atlas 33 it is the only species in the family Nematistiidae, although ichthyologists have debated whether it should belong within the family Carangidae (Jacks and Pompanos). The first seven dorsal-fin spines become elongate and heavily pigmented in early postflexion stage larvae, making identification easy. This striking character continues into adulthood where the spines continue to elongate and become thread-like, forming a comb when erected from their sheath. This "rooster comb" is the origin of the fishes name.

As adults roosterfish are considered a game fish and are highly prized by sport anglers. They can reach weights in excess of 100lbs, but the average is 12-25lbs. They are not considered good eating so most fish are released after they are caught.

The photo was taken with a Canon 77D with a Canon MP-E 65mm f/2.8 1-5X Macro Lens and a stackshot macro rail, and processed using Helicon. (Photo credit: Megan Human)

Pacific Blackdragon (*Idiacanthus antrostomus*)

This specimen was collected from an extremely offshore sample during one of the summer CalCOFI surveys in 1960. At this time, cruises were being conducted monthly in order to study the ecological aspects of the Pacific sardine collapse off California.

The Pacific Blackdragon fish undergoes a dramatic morphological change as it develops as well as marked sexual dimorphism. During its larval stage they are extremely slender and their gut begins detaching from the body as seen in the above photo. Further through development the gut will continue to grow and begin to trail behind their body. The head is flattened and the elliptical eyes are borne on long stalks supported by a cartilaginous rod. At metamorphosis the cartilaginous rods supporting the eye stalks are reabsorbed, the pectoral fins are lost and females become extremely elongate with black, scaleless skin, large jaws with fanglike teeth and a chin barbel used as a lure. Males remain small in size, lack teeth, paired fins, and a chin barbel. The males are short lived and do not hunt but rather live until they are able to reproduce.

The photo was taken with a Canon 77D with a Canon MP-E 65mm f/2.8 1-5X Macro Lens and a stackshot macro rail, and processed using Helicon. (Photo credit: Megan Human)

Fig. 4: Preflexion stage larva and the head of an adult Pacific dragonfish

The complexity of recruitment drivers in Western Baltic herring

Marta Moyano, Catriona Clemmesen, Myron A. Peck, Patrick Polte

Atlantic herring (*Clupea harengus*) is arguably one of the best-studied species worldwide (Peck et al. 2021). Early research on processes and mechanisms controlling the year-class success in this species resulted in seminal recruitment hypotheses, such as the critical period and member-vagrant, and was important in the establishment of the International Council for the Exploration of the Sea (ICES) (Geffen 2009; Sinclair 2009). Much of this research has been motivated by large population changes that impacted the commercial exploitation of the species. This is now the case for Western Baltic Spring Spawning (WBSS) herring, at stock that has had poor recruitment since the early 2000s. This long-term, low recruitment has promoted intense research. Substantial knowledge on recruitment drivers has been gained in these past two decades, using a wide variety of approaches, including laboratory and field experiments, field monitoring and modeling (Fig. 5). We have now synthesized the available literature on the topic (Moyano et al. 2023), as this case study exemplifies the power of using a holistic approach to understand the complex array of bottom-up and top-down processes and factors influencing life cycle closure in marine fish.

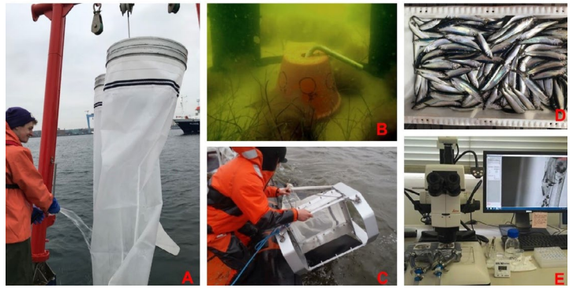

Fig 5. Research on Western Baltic herring. A) Routine sampling with the framework of the Kiel Canal time series; B) Field experiment on predation rates on herring eggs; C) Sampling in Greifswald Bay as part of the Rugen time series; D) Herring spawners collected by fishermen in the Kiel Canal; E) Experimental setup for studying cardiac rates in herring larvae at the University of Hamburg.

Our literature review suggests that no single, dominant driver is responsible for the recent low recruitment in WBSS herring, but that there are several interacting factors that impact different life stages in different ways (Fig. 6). Among all factors, habitat compression of the spawning beds (linked to eutrophication and coastal modification) and warming (indirectly leading to changes in spawning phenology, prey abundance and predation pressure) have had major effects. Other factors, such as the increased frequency of extreme climate events (e.g. storms) and mass algal blooms as well as new predators in the system (e.g. round goby *Neogobius melanostomus*), are also important. Unfortunately, our understanding of the extent of these interactions is still limited, hampering our ability to quantify their cumulative effect on herring recruitment. For example, the combination of warming and habitat degradation is leading to an earlier spawning in a more spatially-restricted habitat, which magnifies the negative effects of storms, chemical contamination, predation, or mass algal blooms on egg development and hatching success. Additional work in the field and laboratory is needed to elucidate the magnitude of these interactions. Such information could be then applied to parameterize numerical models, which can be used to generate and test hypotheses on the most influential factors and/or most uncertain processes in field data (Ihde and Townsend 2017).

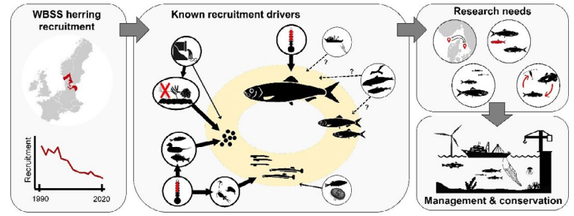

Fig 6. Graphical abstract showing the major recruitment drivers impacting each life stage and the main research needs relevant for stock assessment and conservation of Western Baltic Spring Spawning herring. Left – location of the WBSS stock, middle – life cycle of herring and recruitment drivers (in circles), - right – four research needs. See Moyano et al. (2023) for details.

Despite the significant advances in knowledge compiled in this review on the ecology of WBSS herring and the potential drivers impacting the recruitment process, it is still difficult to precisely identify the bottleneck in survival and life cycle closure. Also, it is difficult to translate the research outcomes into a clear, unified set of equations / indicators useful for stock assessment and advice. However, we identify clear priorities for future work to address four main knowledge gaps. From a management standpoint, research on migration pathways and meta-population structure should be prioritized. Another two key aspects are life-stage specific impacts of multi-stressors, and predator-prey interactions. Some of this work is already underway and will be well represented at the next Larval Fish Conference in Lisbon, so stay tuned!

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LARVA OF THE ISSUE

Fig 7. Postflexion stage of *Loweina rara*

This larval *Loweina rara* specimen (Myctophidae) was collected by the VIMS Zooplankton Ecology Lab through the Bermuda Atlantic Time-series Study (BATS) in the vicinity of Bermuda. It was photographed using a Nikon Z7 mirrorless camera through a Leica MZ12 via a 1.0x plan-apochromatic objective. The specimen was lighted using dark field and side illumination. The image is not stacked but the extended depth of field was achieved via a narrow aperture (large *f*-stop number). By Miguel Montalvo and Tor Mowatt-Larssen

LARVAL FISH COLLECTION OF THE ISSUE

Australian Museum larval fish collection

Tony Miskiewicz 1,2, Amanda Hay 1

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2 School of Biological, Earth & Environmental Sciences, University of New South Wales, Sydney, NSW, 2052, Australia

The Australian Museum in the Sydney CBD was established in 1827 and is Australia's oldest natural history museum. The Ichthyology collection consists of both adult and larval fish specimens. It is most likely the largest in the Southern Hemisphere and is the fourth largest collection of Primary Type species in the world (Eschmeyer et al. 2011 Catalog of Fishes). The overall size of the collection is estimated to be

Fig 8. Bays in the ichthyoplankton collection in the Australian Museum.

approximately 194,086 lots made up of 650,000 adult and 1,000,000 larvae specimens. Smaller sections of the collection include cleared and stained lots, otoliths, skeletal material and taxidermied skins. The collection, of which close to 100 percent is digitized, also consists of 2,678 Type species (5,200 lots) dating back to the 1800s.

The geographic coverage of the collection is primarily that of the Indo-Pacific region, however it includes fish specimens from all continents and oceans. Particular strengths include New South Wales, Great Barrier Reef, temperate rocky reefs, mesopelagic waters from the upper slope to 1000m depth and Indo-Pacific Islands. Most of the collection has been fixed in 10% formaldehyde then transferred to 70% ethyl alcohol for long term storage. In recent years, many frozen and alcohol-fixed tissues have been added to the collection for use in genetic studies.

The Museum holds an extensive larval fish collection with a similar range to the adult collection. Collection methods of larvae include neuston and oblique plankton tows, midwater trawls, light trapping, crest nets and beach seining. Prior to 1979, the larval fish collection was very small, comprising lots of freshwater larvae and samples from marine collection events including larvae collected by John Paxton during midwater trawling for myctophids off NSW and PNG. The number of lots in the larval collection rapidly expanded after 1979 with the arrival of Jeff Leis, who brought a collection of larvae from Hawaii. Jeff has also undertaken extensive larval sampling of tropical fish at Lizard Island on the northern Great Barrier, the Coral Sea and French Polynesia. His work on larval behaviour provided many larvae from light traps (mostly from Lizard Island) and crest nets (Tuamotu and Society Islands), and reared larvae series from NSW, Taiwan and France. He has also incorporated material from John Russell collected in Queensland estuaries, Dave Williams (midwater trawl and plankton nets) and Peter Doherty (light

Fig 9. Storage lot of larval fishes. This method prevents the small vials from falling dry.

traps) from the Australian institute of Marine Science researchers, and Norm Milward, and particularly Bob Hartwick (bycatch from his box jellyfish midwater trawls) from James Cook University, in the GBR lagoon. These studies were the basis of the three identification books (Leis and Rennis 1983, Leis and Trnski 1989 and Leis and Carson-Ewart 2000) on Indo Pacific coral reef and shorefish larvae.

During the 1980s to the present, numerous researchers including Tony Miskiewicz, Francisco Neira, Tom Trinski, Iain Suthers, Mike Kingsford, Charles Gray, Lynnath Beckley, Ana Lara Lopez and Kim Smith undertook larval fish studies in temperate estuaries and marine waters along the east and west coasts of Australia. These studies included special and temporal studies in individual or multiple estuaries, multi-year surveys in coastal waters and various oceanographic

cruises to assess larval assemblages in large scale western boundary currents and their associated eddies. Larvae collected during these studies have been incorporated into the collection and were the basis of the larval identification for temperate Australian larvae (Neira et al 1998). A summary

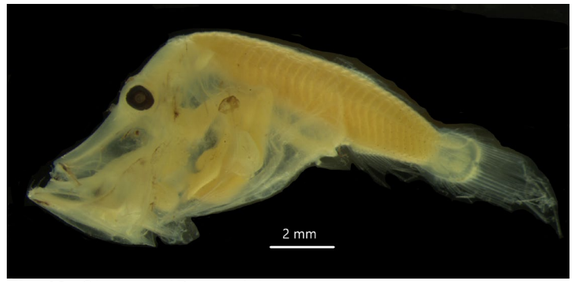

Fig. 10. *Gigantura* (*Rosaura*) *indica*

of these sampling events is provided in Smith et al (2018). Many of these temperate samples were incorporated into the collection due to funding obtained by Jeff Leis and the previous Ichthyology Collection Manager (Mark McGrouther), Australian Fishing Research Development Corporation grant, 1994-95. Regional Larval Fish Archives - Preservation of an Important Fisheries Resource. Most of the registration of these samples was undertaken by John Pogonoski.

Samples in the larval collection comprise a combination of individual taxa organized by family, genus and species, depending on ID level, and mixed lots containing mixed samples of larvae. Data on all the lots are accessible in the Museum database. The individual samples in small vials are then stored in larger jars in a compactus system. The majority of samples are formalin fixed and preserved in 70% ethanol. More recently, lots of ethanol fixed larvae have been added to the collection and these are the basis for an ongoing

Fig. 11: *Hippocampus breviceps*

project of CO1 barcoding to assist specific identification of larvae in the collection. Work is ongoing to update identifications of larvae previously identified to family or generic level and to examine larvae from mixed samples to make them more accessible in the collection. On average, 1,000 lots of larvae are accessioned into the collection on a yearly basis.

The collection provides a basis for research in temporal changes in larval communities in the Australian region in relation to climate change. The numerous specimens are also the basis for studies to identify larvae of different species for publication of larval developmental series of species and specimens to assess ontogenetic changes in morphological characters in larvae which can be used in studies assessing relationships among fish groups. Larval specimens in the collection are available for study by bona-fide researchers. Over 10,100 larval lots from the collection have been cited

Fig. 12: *Platycephalus caeruleopunctatus*

as material examined in range of publications including peer reviewed papers, books and theses.

Accessioning larval (and adult) specimens into an active research collection is an enormous task, carried out with limited resources. Thanks to wonderful volunteers, dedicated staff, retired fellows, research associates and cake, the collection continues to be well curated as time goes by.

Any questions please contact Amanda Hay, Ichthyology Collection Manager Amanda.hay@austmus.gov.au or Tony Miskiewicz, Ichthyology Research Associate tonymisk@yahoo.com

https://australian.museum/learn/collections/natural-science/ichthyology/

Reference

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ANNOUNCEMENT

If you have not yet registered and submitted your abstract to the LFC46 2023, it is not too late. Register by March 20th (11:59 pm WET) before price increases!

We have been busy planning an exciting week! There will be a workshop on Larval Fish ID, a fun early career event, an excursion to the amazing Oceanário de Lisboa, a delightful banquet, and lots of other social events, including a welcome reception, the famous Flag auction, Raffles and a surprise that will make this LFC46 memorable! Also, as you know, presenters at this year's LFC will have the opportunity to submit their papers (oral or poster) to a Special Issue of Marine Ecology Progress Series.

For more details, visit our webpage www.larvalfishconference.com

Looking forward to see you in Lisbon!

Ana and Susana

A *Larval Fish Session* will be part of the XI Indo-Pacific Fish Conference to be held in Auckland, NZ, 22-24 November 2023.

The session, *Larval fishes - solving phylogenetic, life-cycle and ecological questions*, will be co-chaired by me, Jeff Leis (University of Tasmania), Lynnath Beckley (Murdoch University), and Ainhoa Bernal (Instituto de Ciencias del Mar)

Most marine bony fishes have a two-phase life history with pelagic larvae that differ in morphology, ecology and habitat from the adults. These phases operate in separate evolutionary theatres, and ecologically, effectively function as separate species. Larval morphological features provide characters for phylogenetic analysis and aspects of life history are determined during the larval phase, including recruitment and scale of genetic and demographic connectivity. Although larval survival is necessary for persistence of species, larvae are often neglected by researchers and managers focused on adults. This session will address many of the unanswered questions about the pelagic larval phase of Indo-Pacific fishes.

Those interested in the larval fish session should contact one of the session co-chairs.

Abstract Submission closes on 11 June 2023

The conference website is - https://www.ipfc11-asfb.ac.nz/

Cheers,

Jeff

RAMBLE ON

We cannot wait to see you all at the 46th Larval Fish Conference in Lisbon in May and/or the 11th Indo-Pacific Fish Conference in Auckland in November, which includes an early life history session (see announcements on pages 9-10).

Although this issue is on the "thinner" side, we would like to get back to the habit of publishing three issues per year. We all enjoy reading about the exciting news from around the world, so please don't hesitate to send your contribution to your regional representative or directly to one of us if you don't have a rep. Contributions can be cruise reports, field trips, published articles, ongoing projects, etc.

Ali is settling in at a new place and a new position as the Center Director of the Abernathy Fish Technology Center | U.S. Fish & Wildlife Service. She is really looking forward to engaging with the Section with her new freshwater focus! Nalani and I are getting ready to teach a larval fish workshop, organized by Lorenzo Ciannelli, on the wonderful island of Ischia off the coast of Naples, Italy in two weeks. We will report back in the next issue how it went and whether Naples is the birthplace of the pizza and if it is really the best in the world!

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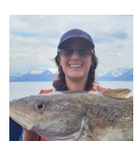

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