



43rd Annual

LARVAL FISH

Conference

MAY 2019, PALMA DE MALLORCA

Program and abstracts

43rd Annual Larval Fish Conference

Melià Palma Marina, Mallorca – Palma

21-24 May 2019

PROGRAM AND ABSTRACTS

Scientific Committee

Ignacio Catalán (Spain, Local Organizer)

Patricia Reglero (Spain, Local Organizer)

Itziar Álvarez (Spain, Local Organizer)

Pilar Olivar (Spain)

Su Sponaugle (USA)

Marta Moyano (Germany)

Akinori Takasuka (Japan)

Raul Láiz (Spain)

Dominique Robert (Canada)

Welcome

Oceans, lakes, rivers...in the world are full of larvae, that very small life stage which most animals in the water bodies experience when they are only a few days old. Most will die and only some will make it to the future after flowing with the currents, finding food and avoiding the predators while developing the organs they need to live. We invite you to talk and hear about them and their different ways. And which better place than Mallorca, our island, surrounded by the Mediterranean Sea, a sea full of biodiversity and life! Come and enjoy sharing science and friendship with us. Welcome to the 43rd Annual Larval fish Conference in Mallorca.

Sponsors

We are grateful to the sponsors listed below for their support to organize this Conference,



General Information

Palma (<https://www.spain-holiday.com/Palma>)

Located on the south coast of Mallorca, Palma is an important holiday resort and commercial port. The city offers the island's best choice of hotels, restaurants and widest choice of entertainment. Despite having become a modern, vibrant city, Palma has managed to retain its old town and its ancient culture and charm. Palma's airport handles millions of visitors each year and plays a major role in the Balearic's tourism industry. Palma is also the location for the island's airport and the largest port in Mallorca. The port still has a working fishing fleet as well as a leisure marina for vessels of all sizes. There is also a sailing club. Almost half the entire population of the Balearic Islands lives in Palma, and during the summer months the numbers swell. Palma was recently voted the best place in Spain to live!

About town

Palma offers interesting narrow streets, quiet courtyards, and a lively harbour front with a nice selection of restaurants. If you are interested in Spanish history or just enjoy the harmony of an old town the many restored historic buildings will impress you. It is always enjoyable to walk through the lovely city of Palma.

Cultural attractions

Some of Palma's best attractions are to be found near the port, including the Royal Palace, the Stock Exchange and the Castle of Bellver that has dominated the skyline since the 14th century; however, Palma's pride and joy has to be the Cathedral, one of the world's finest and largest Gothic structures. The old town of Palma fans out from the cathedral and is a maze of narrow streets, flanked by ancient mansions and hidden squares.

The Cathedral

Built in golden limestone in Gothic style it was begun in the 13th century by Jaime I and stands in a dramatic location near the waterfront. It has high arches and elegant

columns. There are many interesting tombs including those of Jaime I and Jaime III of Mallorca. You will also find a museum inside the cathedral. The cathedral is closed on Sundays and holidays. In front of the cathedral is the Parc de la Mar with its impressive fountains and sculptures. Next to the cathedral is the Palau de l'Almudaina which was the Royal residence in the Middle Ages. It now houses an interesting museum.

The Castell de Bellver

About 2.5 km (1.5 miles) from the city centre this castle is a must-see. with a small admission charge. Built in 1309 it is the only castle in Spain that is totally circular in design. The castle began as a summer Royal residence and was later used as a prison. Look out for the graffiti on the walls carved by French prisoners of war. The castle also houses the principal museum and is often used for concerts. There is a small admission charge to the castle and it is closed on Sundays and public holidays.

The Arab Baths

These are open between 9.30am - 8pm and are very cheap to visit. They are hidden away in the tiny streets east of the cathedral. The baths date from the 10th century and are surrounded by well tended gardens. The interior of the baths is pretty much as it was built.

The Town Hall

This building is of 17th century construction and is charming and full of character. It is surrounded by stone benches on which the locals love to sit.

Activities

Palma offers an excellent variety of activity, with every kind of entertainment possible, from cinemas to theatres, operas and rock concerts. The only way to see the old town is by foot and you can be sure that around every corner is a quiet plaza or park to rest in.

Eating out

There are hundreds of bars and restaurant with cuisines from every corner of the globe.

Beaches

A long crescent of white sand lapped by cobalt blue and emerald green coloured water, the Bay of Palma is dotted with delightful seaside resorts, ideal for sailing, sunbathing and having fun. To the west of Palma, lies Cala Mayor and Sant Augustin, with hotels, restaurants and discos. Then Illetes, with three islands which can be seen from the beach. Portale Nous, where you can probably go scuba-diving, Magaluf, crowded and famous, with water sports, swimming pools and dolphin displays. To the east, Can Pastilla offers good sports facilities. Las Maravillas and S'Arenal have the Son Veri water park.

Cuisine

Traditional food is being rediscovered in the Balearics. It varies from island to island, but reflects the cuisine of Catalonia, with its combination of sweet and savoury, pork being the main ingredient although vegetable dishes and soups are also typical fare. Langosta a la parrilla which partners spiny lobster with local home made mayonnaise is one such dish. With your breakfast coffee you must try an ensaimada (a spiral yeast bun) either on its own or with apricot jam – delicious.

Climate

Mallorca enjoys a typical Mediterranean weather, with mild winters and hot summers. During the months of July and August, the weather is hot and beautifully sunny, boasting around 11 hours of sun daily. During the winter, the weather can get chilly, but is generally you can enjoy fine, mild weather on most days.

General Meeting Information

Venue

The 43rd Annual Larval Fish Conference is taking place at the Melià Palma Marina, located in Paseo Ingeniero Gabriel Roca, 29, Mallorca-Palma. The Larval Fish Identification Workshop is taking place at the Spanish Institute of Oceanography, located in Muelle de Poniente s/n, Mallorca-Palma.

Registration

On Monday 20nd there would be a table in front of the entrance to the plenary room, with a DESKTOP REGISTER sign where you can register from 7pm to 9pm. Registration will be opened during the whole day as the sessions are scheduled all the other days.

Oral presentations

With the exception of the keynote presentation, oral presentations are scheduled for 15 minutes (12 minutes for presentation + 3 minutes for questions). Presenters must prepare their talks in either PowerPoint (.ppt or .pptx) or PDF (.pdf) format. Talks will be run on laptops with Windows 10, with internet, sound and video (VLC) capabilities. Please ensure that unusual fonts, and any videos or sound files are embedded in the PowerPoint file (or transferred onto the presentation laptop). To save time between presentations, presenters will not be permitted to use their own laptop. Please, therefore, make sure that your talk gets uploaded to the conference laptop (in each room) prior to your session.

Please name your talk using the code in the program (under «CODE_AUTHOR»). E.g., «TUS2:5_Moyano, M»).

Student talks will be concentrated into sessions from Tuesday to Wednesday to allow the judges time to make their decisions prior to the awards reception on Thursday evening. As a result, some theme sessions may have presentations scattered in blocks throughout the four days of the meeting.

Paralell sessions in romos 7 and 8 will be held on Tuesday and Wednesday after lunch. The schedule of the talks will be strictly respected to facilitate following the program in both rooms.

Poster presentations

The poster session will be held Tuesday evening. The poster boards be available all day Tuesday. The stands for the posters will be dismantled on Wednesday. Please place your poster after the first coffee break on Tuesday in the board displaying the number assigned to your poster (see program). Posters must be no larger than 118.5×146 cm in overall size.

Ligthning Session

The lightning session is a fun initiative that will last 30 minutes during the poster's session. Several very fast presentations will address outreach activities related with the Early Stages of Fishes. It will be run by the EEC: Carolin Müller and Lysel Garavelli.

Workshops and Awards

Student Travel Awards

The ELHS offers a number of student travel awards. There are three awards given by the ELHS: the Sally Leonard Richardson Award for the best student paper presented at the Larval Fish Conference, the John H.S. Blaxter Award for the best student poster at the Larval Fish Conference, and the Elbert H. Ahlstrom Lifetime Achievement Award. The ELHS also awards Grace Klein-MacPhee Student Travel Grants to facilitate graduate student participation at the Larval Fish Conference.

Early Career Scientist Mentoring Session

The Early Career Committee hosts a workshop on «Ethics in Scientific Writing» on Wednesday 22nd, open to all Conference participants. Scientific writing always scores as a top priority in our post-conference survey, and this year we are aiming to

combine it with another controversial topic that is ethics in science. During this workshop the attendees will first get some tips on paper writing, followed by some specifics dos and don'ts on ethic-related issues such as co-authorship, plagiarism, and reviewing. The event will be chaired by Prof. Nadine Strydom from the Nelson Mandela University and it will be structured into an introductory talk followed by a hands-on exercise in break-out groups in which we will discuss these aspects using specific examples. Feel free to drop a line to Marta Moyano (marta.moyano@uni-hamburg.de) if you have specific issues/questions you may want to see discussed at the workshop.

This workshop is kindly sponsored by Marine Ecology Progress Series.

Larval Fish Identification Workshop

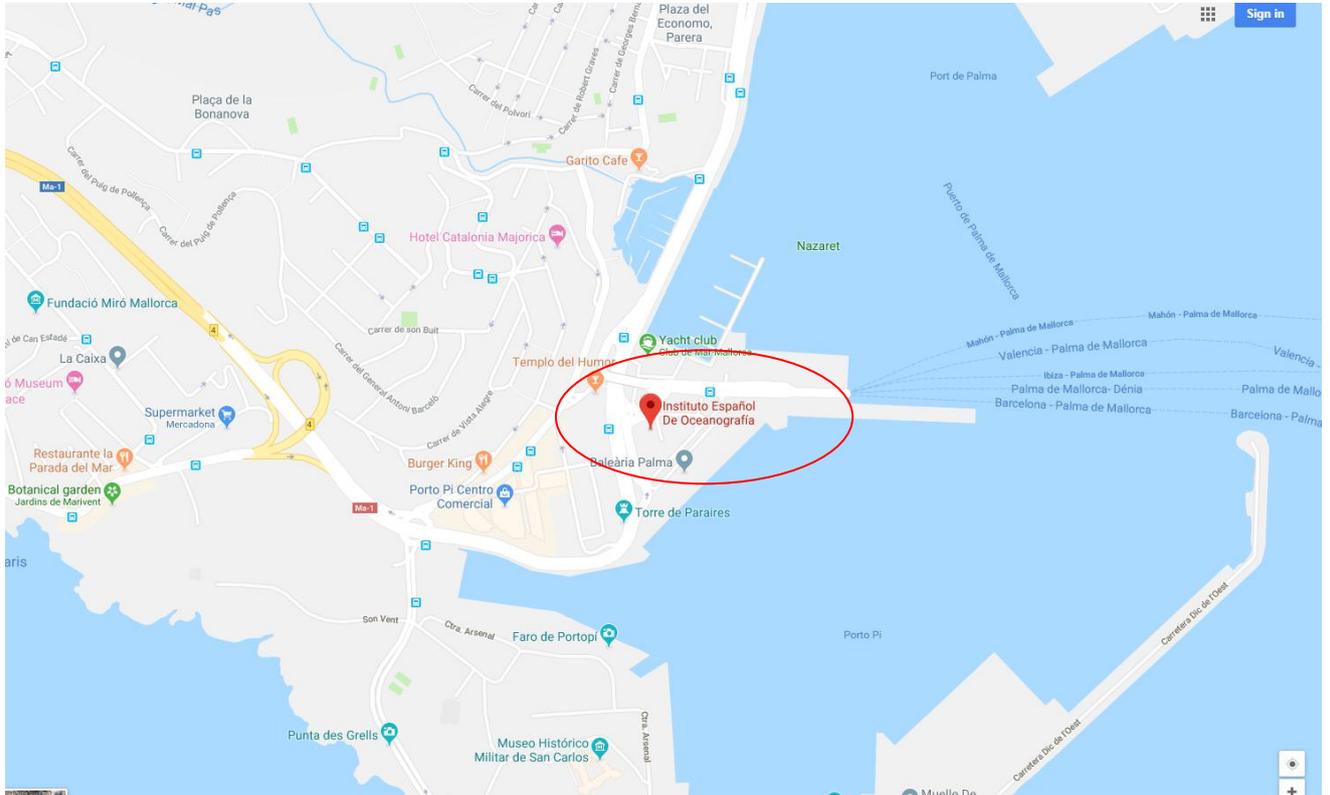
A one-day Larval Fish Identification Workshop will be held on the IEO centre, located at Muelle de Poniente s/n, Palma de Mallorca, close to the venue, on Monday 20 May from 15:00 to 18:00. Participation will be limited to 20 people, with students having priority. Please tick on the corresponding box at the registration page if you are attending!.

For any enquiry, please contact: larvalfc2019@gmail.com

Venue for the Larval Fish
Identification Workshop

(how to arrive from the Conference
venue)

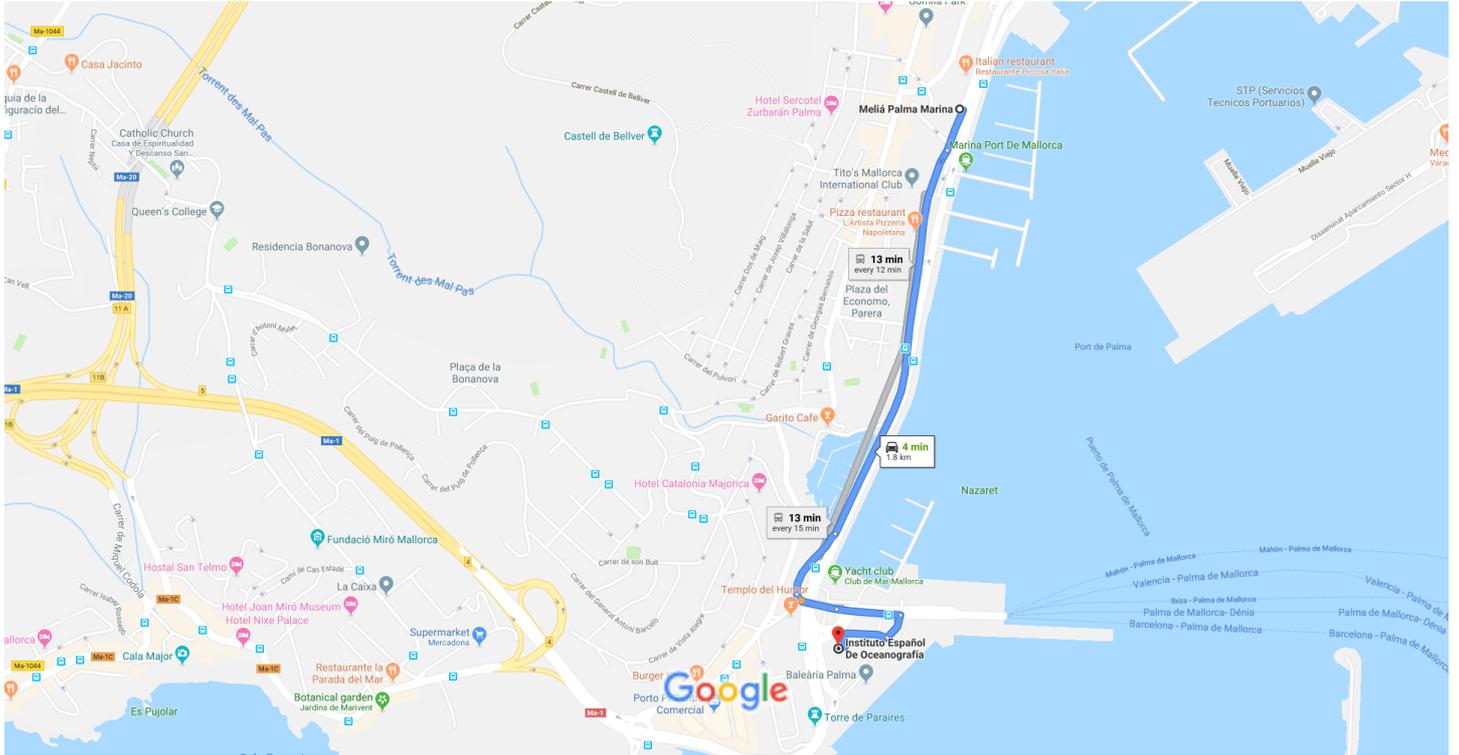
The larval Fish Identification Workshop will take place at the Spanish Institute of Oceanography at Muelle de Poniente s/n, Palma de Mallorca





Meliá Palma Marina to Instituto Español De Oceanografía

Drive 1.8 km, 4 min



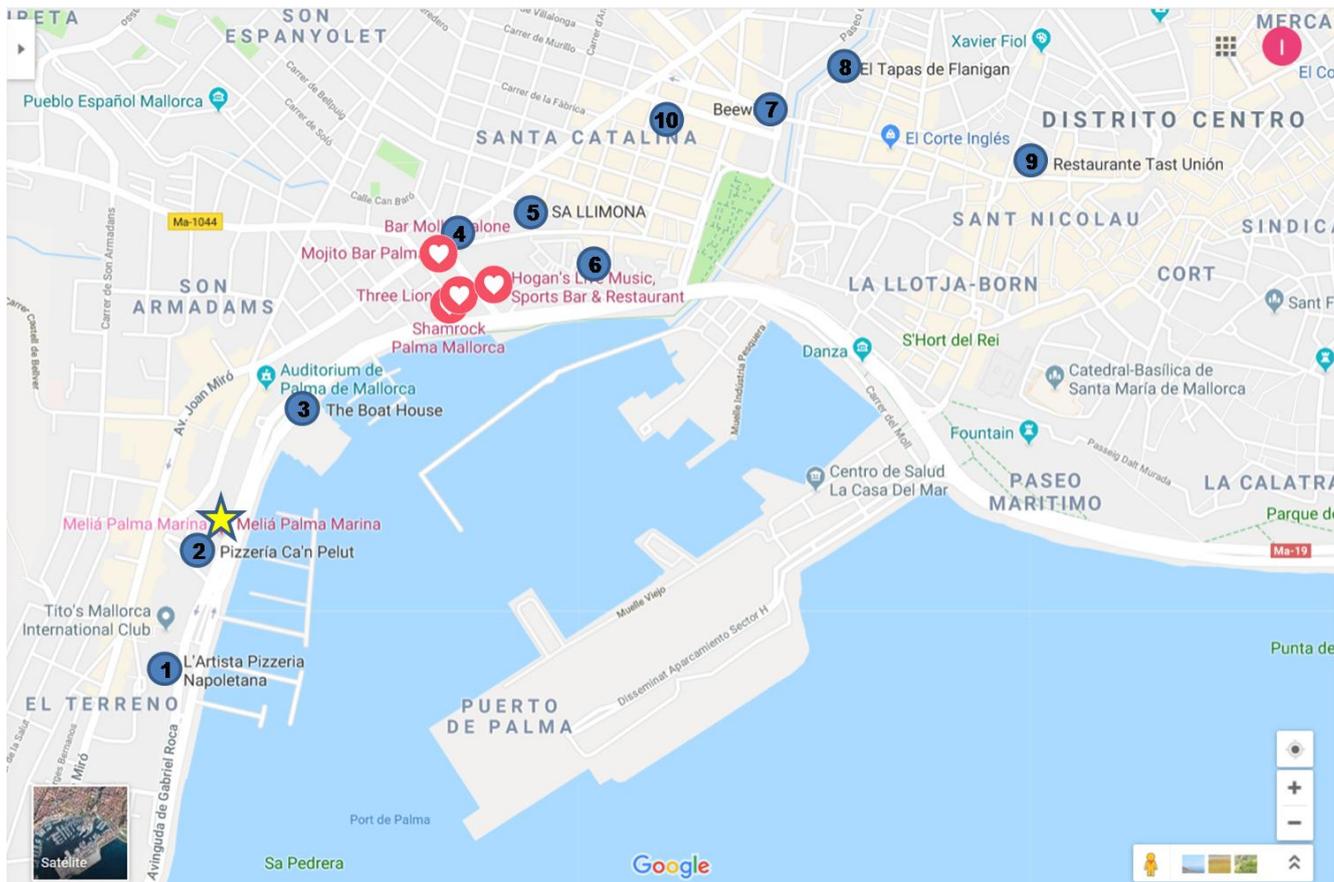
Map data ©2019 Google, Inst. Geogr. Nacional 200 m

 **via Avinguda de Gabriel Roca** 4 min
 Fastest route, the usual traffic 1.8 km

 **6:54 PM–7:07 PM** 13 min
 >  **104** > 

 **7:02 PM–7:15 PM** 13 min
 >  **102** > 

Where to eat and have a beer



MELIA PALMA MARINA (Venue)



RESTAURANTS AND TAPAS BARS:

- 1- L'Artista Pizzeria Napoletana (PIZZA)
- 2- L'Artista Pizzeria Napoletana (ITALIAN FOOD)
- 3- The Boat House (Terrace, Port views a little higher price)
- 4- Beewi Blue (TAPAS BAR)
- 5- Sa Llimona (Mallorca's Food and Tapas Bar)
- 6- Bar Marítimo (Terrace, from Paella to tapas, , closes late)
- 7- Beewi (TAPAS BAR)
- 8- El Tapas de Flanigan (TAPAS BAR)
- 9- Restaurante Tast Unión (TAPAS BAR)
- 10- Fabrica Street: full of Restaurants and Tapas bars, all Terraces



PUBS: Daily Live Music and Good ambient

Main topics and theme sessions

TOPIC 1. SETTLEMENT: QUANTIFICATION OF PROCESSES AND HABITATS

We welcome research and views on the quantification of settlement intensity and variability in space and time, identification of bottlenecks, as well of works on settlement habitat restoration or modification.

S1: Settlement in diverse seascapes. P. Puerta (Spain)/ P. Lenfant (France)

TOPIC 2. ENVIRONMENTAL AND ANTHROPOGENIC EFFECTS ON EARLY LIFE STAGES

This session aims at featuring new research on the impact extrinsic factors, both environmental (S2) and anthropogenic (e.g. ocean acidification, noise, microplastic) (S3) on the growth, distribution, diversity, connectivity and abundance, behavior (e.g. navigation, predator avoidance, food acquisition) and /or survival in ELHS of fish. The use of ELHS traits as indicators is also welcomed.

S2: Non-anthropogenic drivers of ELHS traits from genes to communities. C. Chambers & D. Margulies (USA)

S3: Anthropogenic impacts on ELHS. G.B. Nanninga (UK)

S4: Parental effects on ELHS. L. A. Fuiman (USA)

TOPIC 3. ELHS AND PREDATION: FROM MORTALITY TO FOOD WEB EFFECTS

We encourage the submission of works exploring the key role of predation, both from a perspective of fisheries recruitment (ELHS as prey, including growth-mortality paradigm etc, S5) and within the ecosystem, where ELHS act as predators of a largely understudied suite of plankton groups (S6). All sorts of approaches, from metabarcoding to modelling are welcome.

S5: Getting a handle on predation. P. Pepin & H. Murphy (Canada)

S6: ELHS within food webs. M. Peck (Germany)

TOPIC 4. THE BEHAVIORAL SIDE OF ELHS: FROM INDIVIDUALS TO ECOSYSTEMS

This session welcomes not only new advances on the study of behaviour (e.g. sensory apparatus, detection of pelagic signals, group behaviour, swimming speed) and its consequences on dispersal (e.g. orientation, navigation, transport, settlement, connectivity), but also emerging knowledge on fish personality, and their consequences for survival and management.

S7: Advances in ELHS behaviour: from individuals to populations. R. Faillettaz (USA)/ J. Alós (Spain)

TOPIC 5. IMPROVING ASSESSMENT AND MANAGEMENT MODELS: CONTRIBUTION OF ELHS RESEARCH

This broad topic session welcomes ELHS research advancing our understanding on key evolutionary and ecological aspects of distribution and survival (S8), new approaches and data needed to understand resilience (S9), best practices and innovations in modelling the pelagic to recruit transition (S10) and examples of improved fisheries assessment through ELHS data incorporation (S11).

S8: Ecological and evolutionary processes affecting fish ELHS distribution and survival. L. Cianelli & A. Neuheimer (USA)

S9: ELH and reproductive resilience. S. Lowerre-Barbieri (USA)

S10: Advances in modelling the pelagic-settling-recruiting ELHS. C. B. Paris (USA)

S11: Linking ELH to assessment. D. Álvarez-Berastegui & M. Hidalgo (Spain)

TOPIC 6. ONTOGENY, SYSTEMATICS AND NEW TECHNOLOGIES

We encourage the submission of papers that use classic and new approaches for the description, identification and quantification of the morphology of early life history stages of fishes, including the influence of changing environmental factors.

S12: Ontogeny, systematics, taxonomy and New Technologies. P. Konstantinidis & J Webb (USA)

OTHER CONTRIBUTED PAPERS

Any other contribution of high quality not fitting the schedule will be included here.

S.13: Other contributed papers. P.Reglero/I.Álvarez/I.Catalán (Spain)

Keynote speaker

Keynote speaker



Lorenzo Ciannelli

Professor, Fisheries Oceanography
College of Earth, Ocean, and Atmospheric Sciences
Oregon State University, Corvallis, OR, USA

Spatial, environmental, and temporal constraints on fish distribution during early life history stages

In this study, I will discuss and apply analytical methodologies to identify and quantify the spatial, temporal, and environmental constraints on distribution during a species' early life cycle. Examples will be shown by analyzing the spatial distribution of 10-15 well-monitored fish populations throughout their respective early life cycles. The methodology assumes that spatial and temporal configurations that are consistently repeated over time (e.g., during spawning, settlement or larval dispersal phases) are indicative of strong constraints. To allow extension of the analysis to data poor species (i.e., species for which we have life history information but lack survey data), I will conceptually and analytically relate constraints (intensity and timing) to life history traits of data-rich cases. Through this analysis, and its conceptual extension, we build capacity to study species adaptability and resilience to climate change utilizing analytical approaches that can account for potential bottlenecks affecting spatial distribution of a species during the early life

Conference schedule

CONFERENCE SCHEDULE

May20, Monday

May 21, Tuesday

May 22, Wednesday

May 23, Thursday

May 24, Friday

	May 20, Monday	May 21, Tuesday	May 22, Wednesday	May 23, Thursday		May 24, Friday		
Arrival of participants	8:30-9:00	Breakfast at Hotel Registration at hotel		8:30-9:00	Breakfast at Hotel Registration at hotel			
	9:00-11:00	Plenary room(7)		9:00-11:00	Plenary room(7)			
	9:00-9:15 9:15-9:55	Welcome words and logistics L.Ciannelli (keynote)		9:00-9:15 9:15-9:30 9:30-9:45 9:45-10:00 10:00-10:15 10:15-10:30 10:30-10:45 10:45-11:00	9:00-9:15 9:15-9:30 9:30-9:45 9:45-10:00 10:00-10:15 10:15-10:30 10:30-10:45 10:45-11:00	9:00-9:15 9:15-9:30 9:30-9:45 9:45-10:00 10:00-10:15 10:15-10:30 10:30-10:45 10:45-11:00	9:00-9:15 9:15-9:30 9:30-9:45 9:45-10:00 10:00-10:15 10:15-10:30 10:30-10:45 10:45-11:00	
	10:00-10:15 10:15-10:30 10:30-10:45 10:45-11:00	TU S2:4_Chambers, C TU S2:5_Moyano, M TU S2:6_Margulies, D TU S2:7_Persson, A*		WE S4:1_Grønkvær, P WE S4:2_Garcia, C* WE S4:3_Folkvord, A WE S4:4_Hou, Z* WE S4:5_Fuiman, L WE S4:6_Lopes, A* WE S5:1_Pepin, P WE S5:2_Caie, P*	TH S11:1_Alvarez-Berasategui, D. TH S11:2_Deary, A TH S11:3_Murphy, H TH S11:4_Prino, A TH S11:5_Diaz Barroso, L TH S11:6_Khamassi, S. TH S11:7_Ospina-Alvarez, A TH S2:1_Catalan, I	9:00-9:15 9:15-9:30 9:30-9:45 9:45-10:00 10:00-10:15 10:15-10:30 10:30-10:45 10:45-11:00	FROTH:1_Venturelli, P FROTH:2_Wang, V FROTH:3_del Favero, J FROTH:4_Pekkoeva, S FROTH:5_van Damme, C FROTH:6_Blanco, E FR S8:5_Ferreira, S FR S8:6_Stige, L FR S8:7_Polte, P	
	11:00-11:30	Health break		11:00-11:30	Health break		11:00-11:15	FR S8:7_Polte, P
	11:30-13:00	Plenary room(7)		11:30-13:00	Plenary room(7)		11:15-11:45	Health break
	11:30-11:45 11:45-12:00 12:00-12:15 12:15-12:30 12:30-12:45 12:45-13:00	TU S2:8_Axler, K* TU S2:9_Döring, J TU S2:10_Swieca, K* TU S2:11_Martinez-Silva, M* TU S3:1_Rodríguez Magalhães, S* TU S3:2_Lestrade, O*		WE S5:3_Höfle, H WE S5:4_Fennie, H* WE S5:5_Ottmann, D* WE S5:6_Randall, J* WE S5:7_Akimova, A	11:30-11:45 11:45-12:00 12:00-12:15 12:15-12:30 12:30-12:45 12:45-13:00	TH S2:2_Castro, L TH S2:3_Allan, B TH S8:1_Neuheimer, A TH S8:2_Morissette, O TH S8:4_Geffen, A TH S1:5_Nash, R	Plenary room	
	13:00-14:15	Lunch at hotel		13:00-14:15	Lunch at hotel		13:00-14:15	Plenary: Closing
	14:15-15:45	Breakout A (ROOM 7)	Breakout B (ROOM 8)	14:15-15:45	Breakout A (ROOM 7)	Breakout B (ROOM 8)	14:15-14:45	END of the meeting
	14:15-14:30 14:30-14:45	TU S12:1_Rathnasuriya, I* TU S12:2_Teletchea, F	TU S10:1_paris, c TU S10:2_Dzoic, T	14:15-14:30 14:30-14:45	WE S3:9_Murray, C WE S3:10_Cross, E WE S3:11_Clemmesen, C	WE S1:1_Abadie, E WE S1:2_Lenfant, P WE S1:3_Gudeffin, A	14:15-14:30 14:30-14:45	TH S1:6_McBride, R TH S1:7_Szkudlarek-Pawelczyk, A
14:45-15:00 15:00-15:15 15:15-15:30 15:30-15:45	TU S12:3_Konstantinidis, P TU S6:1_Gleiber, M* TU S6:2_Bernal, A TU S6:3_Corso, A*	TU S10:3_Shropshire, T* TU S10:4_Tripp, A* TU S3:3_Müller, C* TU S3:4_Nanninga, G	14:45-15:00 15:00-15:15 15:15-15:30 15:30-15:45	WE S3:12_Cominassi, L* WE S3:13_Sswat, M WE S3:14_N.Strydom	WE S1:4_Guerreiro, M* WE S1:5_Di Pane, J* WE S12:4_Franz, G*	15:45	get ready!	
15:45-16:15	Health break		15:45-16:15	Health break		16:30-23:30	EXCURSION+Dinner SON TERMENS. Buses depart from the Conference Hotel	
16:15-18:15	Breakout A (ROOM 7)	Breakout B (ROOM 8)	16:15-17:00	Breakout A (ROOM 7)	Breakout B (ROOM 8)			
16:15-16:30 16:30-16:45 16:45-17:00	TU S6:4_Burns, C* TU S7:1_Leis, J TU S7:2_Majoris, J	TU S3:5_Xie, S TU S3:6_Tiedemann, M TU S3:7_Ward, J	16:15-16:30 16:30-16:45 16:45-17:00	WE S3:15_Sciberras, M WE S3:16_Scholey, V	WE S12:5_Thieme, P* WE S12:6_Gaillard, M WE S12:7_Webb, J			
17:00-17:15	TU S7:3_Follana Berná, G*	TU S3:8_Loepky, A*	17:00-17:15					
17:15-17:30	TU S7:4_Campos-Candela, A	TU S3:6_Koffi-About, S*	17:15-17:30					
17:30-17:45	TU S7:5_Faria, A	TU S9:1_Lowerre-Barbieri, S	17:30-19:30	Early Career Scientist Mentoring Session: Workshop 2"WRITING AND ETHICS"				
17:45-18:00 18:00-18:15	TU S7:6_Failletaz, R TU S7:7_Faria, A	TU S9:2_Stock, B* TU S9:3_Asch, R		EXCOMM meeting				
19:30-20:30	Pre-dinner Social, poster session+lightning session							
19:30-20:30	Pre-dinner Social, poster session+lightning session							
19:30-20:30	Pre-dinner Social, poster session+lightning session							



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MAY 2016
PALMA DE MALLORCA



15:00-18:00
Workshop 1. Larval Identification Workshop at IEO

19:30-20:30 Ice Breaker at the Hotel. Registration desk available 19:00-21:00

*candidate for best student presentation

Daily Schedule and order of talks



DAILY SCHEDULE AND ORDER OF TALKS

Codes: In "ROOM", PL=plenary (ROOM 7) * stands for best student presentation contestant

TUESDAY 21

SLOT	ROOM	CODE_AUTHOR SURNAME_NAME (presenter if other)	SESSION	CONVENERS	COUNTRY	TITLE
9:00-9:15	PL(7)	Welcome and Logistics				
9:15-9:55	PL(7)	TUI:0_Ciannelli_Lorenzo	<i>INVITED TALK</i>		United States	SPATIAL, ENVIRONMENTAL, AND TEMPORAL CONSTRAINTS ON FISH DISTRIBUTION DURING EARLY LIFE HISTORY STAGES
10:00-10:15	PL(7)	TUS2:4_Chambers_Chris	S2: Non-anthropogenic drivers of ELHS traits: from genes to communities.	C. Chambers/ D.Margulies	United States	EXPERIMENTAL EVALUATION OF PLASTICITY AND RESILIENCY TO ENVIRONMENTAL DRIVERS IN THE EARLY LIFE-STAGES OF SUMMER FLOUNDER PARALICHTHYS DENTATUS

10:15-10:30	PL(7)	TUS2:5_Moyano_Marta		Germany	LINKING SHORT-TERM PHYSIOLOGICAL MEASUREMENTS TO LONG-TERM CHANGES IN POPULATION PRODUCTIVITY: THE THERMAL BIOLOGY OF ATLANTIC HERRING
10:30-10:45	PL(7)	TUS2:6_Margulies_Daniel		United States	LABORATORY-BASED COMPARATIVE STUDIES OF THE EFFECTS OF ENVIRONMENTAL AND CLIMATE VARIABLES ON EARLY LIFE STAGES OF YELLOWFIN TUNA AND PACIFIC BLUEFIN TUNA IN PANAMA AND JAPAN
10:45-11:00	PL(7)	TUS2:7_Persson_Anna*		United Kingdom	PHYSICAL DRIVERS OF ABUNDANCE AND DISTRIBUTION OF JUVENILE FLATFISHES IN SOUTHWEST ENGLAND
11:00-11:30 Health break					
11:30-11:45	PL(7)	TUS2:8_Axler_Kelia*	S2: Non-anthropogenic drivers of ELHS traits: from genes to communities.	United States C. Chambers/ D.Margulies	VARIABILITY IN ICHTHYOPLANKTON DISTRIBUTIONS, FITNESS, AND TROPHODYNAMICS ACROSS RIVER PLUMES IN THE NORTHERN GULF OF MEXICO
11:45-12:00	PL(7)	TUS2:9_Döring_Julian		Germany	FRESH SUBMARINE GROUNDWATER DISCHARGE AUGMENTS FISH GROWTH IN A TROPICAL COASTAL ENVIRONMENT
12:00-12:15	PL(7)	TUS2:10_Swieca_Kelsey*		United States	IMPLICATIONS OF A TIDALLY MODULATED RIVER PLUME ON FINE-SCALE LARVAL FISH TROPHIC INTERACTIONS
12:15-12:30	PL(7)	TUS2:11_Martinez-Silva_Maria*		Canada	PHYSIOLOGICAL INDICATORS OF GROWTH: HOW GENOMICS CAN HELP US TO BETTER UNDERSTAND CROSS X TRAIT IN COMMERCIAL FISHES?
12:30-12:45	PL(7)	TUS3:1_Rodrigues Magalhães_Sabrina*	S3: Anthropogenic impacts on ELHS.	Portugal G.B.Naninga	FISH LARVAE AND MICROPLASTICS IN AN URBAN ESTUARY: TEMPORAL AND SPATIAL PATTERNS OF THE RATIO FISH LARVAE : MICROPLASTICS

12:45-13:00	PL(7)	TUS3:2_Lestrade_Olivia*			United States	MICROPLASTIC ABUNDANCE AND FREQUENCY OF INGESTION BY SARGASSUM-ASSOCIATED JUVENILE FISHES IN THE NORTHERN GULF OF MEXICO
13:14:15 Lunch						
BREAKOUT ROOM A(7)						
14:15-14:30	A(7)	TUS12:1_Rathnasuriya_Ishara*	S12: Ontogeny, systematics and new technologies	P.Konstantinidis/ J.Webb	Sri Lanka	SPECIES COMPOSITION AND DIVERSITY OF FISH LARVAE IN SRI LANKAN WATERS FROM A COMBINED MORPHOLOGICAL AND DNA BARCODING APPROACH
14:30-14:45	A(7)	TUS12:2_Teletchea_Fabrice			France	A CONCEPTUAL FRAMEWORK FOR EARLY LIFE STAGES OF FISHES TO STUDY HETEROCHRONIES AND STAGE TERMINOLOGY
14:45-15:00	A(7)	TUS12:3_Konstantinidis_Peter			United States	THE DRASTIC ONTOGENETIC TRANSFORMATION OF THE TELESCOPE FISHES OF THE GENUS GIGANTURA (AULOPIFORMES: GIGANTURIDAE)
15:00-15:15	A(7)	TUS6:1_Gleiber_Miram*	S6: ELHS within food webs.	M.Peck	United States	FOOD WEB CONSTRAINTS ON LARVAL GROWTH IN SUBTROPICAL CORAL REEF AND PELAGIC FISHES
15:15-15:30	A(7)	TUS6:2_Bernal_Ainhoa			Chile	TROPHODYNAMICS OF ICHTHYOPLANKTON IN THE SEA OF CHILOÉ (NORTHERN PATAGONIA, CHILE)
15:30-15:45	A(7)	TUS6:3_Corso_Andrew*			United States	THE IMPACTS OF CLIMATE CHANGE ON ANTARCTIC LARVAL FISHES
15:45-16:15 Health break						
16:15-16:30	A(7)	TUS6:4_Burns_Corinne*			Canada	INTERANNUAL VARIABILITY OF TROPHODYNAMICS OF LARVAL DEEPWATER REDFISH, <i>Sebastes mantella</i> , IN THE GULF OF ST. LAWRENCE

16:30-16:45	A(7)	TUS7:1_Leis_Jeffrey	S7: Advances in ELHS behavior: from individuals to populations	R.Faillettaz/ J.Alós	Australia	IS CRITICAL SPEED OR <i>IN SITU</i> SPEED THE BEST MEASURE OF SWIMMING IN LARVAL FISHES?
16:45-17:00	A(7)	TUS7:2_Majoris_John			United States	LARVAL ORIENTATION BEHAVIOR BEGINS SHORTLY AFTER HATCHING AND MAY CONTRIBUTE TO RESTRICTED DISPERSAL IN A CORAL REEF FISH
17:00-17:15	A(7)	TUS7:3_Follana Berná_Guillermo*			Spain	THE EFFECT OF BEHAVIOURALLY MEDIATED FISH VULNERABILITY ON EARLY-LIFE PRODUCTION AND DISPERSAL.
17:15-17:30	A(7)	TUS7:4_Campos-Candela_Andres (J. Alós)			Spain	OPTIMAL EARLY-LIFE STRATEGIES UNDER DIFFERENT FOOD AND PREDATION-RISK SCENARIOS
17:30-17:45	A(7)	TUS7:5_Faria_Ana			Portugal	LACK OF PERSONALITY AT THE JUVENILE STAGE IN A TEMPERATE REEF FISH
17:45-18:00	A(7)	TUS7:6_Faillettaz_Robin			United States	LARVAL FISH BEHAVIOR NUANCES HJORT'S ABERRANT DRIFT HYPOTHESIS
18:00-18:15	A(7)	TUS7:7_Faria_Ana			Portugal	TELL ME SAND-SMELT, WHAT ARE YOU SMELLING?

BREAKOUT ROOM B(8)

14:15-14:30	B(8)	TUS10:1_Paris_Claire	S10: Advances in modelling the pelagic-settling-recruiting ELHS.	C. Paris	United States	RELEVANCE AND IMPLEMENTATION OF WAYFINDERS TO MODULATE DISPERSAL KERNELS AND POP CONNECTIVITY IN BIOPHYSICAL MODELS
14:30-14:45	B(8)	TUS10:2_Dzoic_Tomislav			Croatia	FROM SPAWNING AREAS TOWARDS NURSERIES: GILTHEAD SEA BREAM ICHTHYOPLANKTON CONNECTIVITY IN THE ADRIATIC SEA

14:45-15:00	B(8)	TUS10:3_Shropshire_Taylor*		United States	ESTIMATES OF FOOD LIMITATION EXPERIENCED BY PELAGIC FISH LARVAE IN THE GULF OF MEXICO
15:00-15:15	B(8)	TUS10:4_Tripp_Ashley*		Canada	DISTINCT OTOLITH MICROCHEMISTRY SIGNATURES OF LARVAL CAPELIN (<i>Mallotus villosus</i>) FROM NEWFOUNDLAND AND NUNAVUT
15:15-15:30	B(8)	TUS3:3_Müller_Carolin*	S3: Anthropogenic impacts on ELHS.	Germany	TO FEED OR NOT TO FEED - THE CASE OF MICROPLASTIC UPTAKE IN JUVENILE SEABREAM
15:30-15:45	B(8)	TUS3:4_Nanninga_Gerrit		United Kingdom	PHENOTYPE-DEPENDENT VARIATION IN MICROPLASTIC INGESTION RATES
15:45-16:15 Health break					
16:15-16:30	B(8)	TUS3:5_Xie_Songguang	S3: Anthropogenic impacts on ELHS.	China, People's Republic of	ICHTHYOPLANKTON ASSEMBLAGES IN THE MAINSTEM OF THE YANGTZE RIVER: THREATS AND CONSERVATION IMPLEMENT
16:30-16:45	B(8)	TUS3:6_Tiedemann_Maik		Norway	EXPLORING FACTORS THAT HAVE SUPPRESSED RECENT RECRUITMENT LEVELS IN NORWEGIAN SPRING SPAWNED HERRING. ARE THE CLUES IN THE FIELD STUDIES?
16:45-17:00	B(8)	TUS36_Koffi-About_Samy*		France	DO OTOLITHS RECORD PHYSIOLOGICAL STRESSES OF RESTOCKED YOUNG EELS?
17:00-17:15	B(8)	TUS3:7_Ward_Jessica		United States	EXPOSURE TO HARMFUL ALGAL BLOOMS IMPAIRS PREY RECOGNITION AND FORAGING SUCCESS IN A LARVAL FRESHWATER FISH
17:15-17:30	B(8)	TUS3:8_Loepky_Alison*		Canada	ANTHROPOGENIC INFLUENCES ON OTOLITH CALCIUM CARBONATE COMPOSITION THROUGHOUT ONTOGENETIC DEVELOPMENT OF A FRESHWATER PRIMITIVE FISH SPECIES

17:30-17:45	B(8)	TUS9:1_Lowerre-Barbieri_Susan	S9: ELH and reproductive resilience.	S.Lowerre-Barbieri	United States	WHAT DOES SEX HAVE TO DO WITH IT? REPRODUCTIVE RESILIENCE AND PRODUCTIVITY IN EXPLOITED MARINE FISHES
17:45-18:00	B(8)	TUS9:2_Stock_Brian*			United States	3-DIMENSIONAL ADVECTION, DIFFUSION, AND MORTALITY OF EGGS AND LARVAE DISPERSING FROM A NASSAU GROUPER (<i>Epinephelus striatus</i>) SPAWNING AGGREGATION OBSERVED WITH A NOVEL PLANKTON IMAGING SYSTEM
18:00-18:15	B(8)	TUS9:3_Asch_Rebecca			United States	ARE RELATIONSHIPS BETWEEN LARVAL FISHES AND OCEANIC CONDITIONS RESILIENT TO CLIMATE REGIME SHIFTS?

18:30-20:30 Poster Session+Lightning Session (B-8). Drinks and some fingerfood served from 19:00

WEDNESDAY 22

SLOT	ROOM	CODE_AUTHOR SURNAME_NAME (presenter if other)	SESSION	CONVENERS	COUNTRY	TITLE
9:00-9:15	PL(7)	WES4:1_Grønkjær_Peter	S4: Parental effects on ELHS.	L.Fuiman	Denmark	HOW BIG IS YOUR MOTHER? DETERMINING MATERNAL SIZE FROM STABLE ISOTOPES OF INDIVIDUAL WILD CAUGHT LARVA
9:15-9:30	PL(7)	WES4:2_García_Cristina*			Spain	MATERNAL EFFECTS ON EGG AND LARVAL SIZE OF EUROPEAN HAKE IN THE GALICIAN SHELF
9:30-9:45	PL(7)	WES4:3_Folkvord_Arild			Norway	RESPIRATION RATES OF HERRING LARVAE AT DIFFERENT SALINITIES AND EFFECTS OF PARENTAL ENVIRONMENTAL HISTORY

9:45-10:00	PL(7)	WES4:4_Hou_Zhenxin*			United States	TRANSFER OF FATTY ACIDS FROM MATERNAL DIET TO OFFSPRING IN A MARINE FISH
10:00-10:15	PL(7)	WES4:5_Fuiman_Lee			United States	MATERNAL DIET MAY ALTER ENERGETIC AND STRUCTURAL COMPONENTS OF YOLK THAT SUPPORT OFFSPRING DEVELOPMENT IN RED DRUM (<i>Sciaenops ocellatus</i>)
10:15-10:30	PL(7)	WES4:6_Lopes_Anna*			Portugal	FISH REPRODUCTIVE BEHAVIOUR: IMPAIRED BY GLOBAL CHANGES?
10:30-10:45	PL(7)	WES5:1_Pepin_Pierre	S5: Getting a handle on predation.	P.Pepin/H.Murphy	Canada	DIVING INTO A PROBABILISTIC VIEW OF PREY-PREDATOR INTERACTIONS OF LARVAL FISH
10:45-11:00	PL(7)	WES5:2_Caie_Phoebé*			New Zealand	LIVE FAST, DIE YOUNG: PATTERNS OF SELECTIVE PREDATION CHANGE WITH ONTOGENY BUT NOT DENSITY IN A MARINE FISH.

11:00-11:30 Health break

11:30-11:45	PL(7)	WES5:3_Höffle_Hannes	S5: Getting a handle on predation.	P.Pepin/H.Murphy	Norway	THE DEATH OF SEBASTES: A GENERIC MODEL FOR THE EARLY LIFE OF OVOVIVIPAROUS FISH
11:45-12:00	PL(7)	WES5:4_Fennie_Hamilton*			United States	COHO SALMON PREDATION ON PELAGIC JUVENILE ROCKFISH: DO EARLY LIFE HISTORY TRAITS PLAY A ROLE?
12:00-12:15	PL(7)	WES5:5_Ottmann_Daniel*			Spain	ARE EPHYRAE OF <i>Pelagia noctiluca</i> IMPORTANT PREDATORS OF LARVAL TUNA?
12:15-12:30	PL(7)	WES5:6_Randall_Jessica*			Canada	OCCURRENCE OF ICHTHYOPLANKTON IN AUTUMN HERRING DIETS OF EASTERN NEWFOUNDLAND
12:30-12:45	PL(7)	WES5:7_Akimova_Anna			Germany	IMPORTANCE OF THE SPATIOTEMPORAL PREDATOR DYNAMICS FOR MODEL-DERIVED ESTIMATES OF MARINE FISH EARLY-LIFE STAGE SURVIVAL

13:00-14:15 Lunch

BREAKOUT ROOM A(7)

14:15-14:30	A(7)	WES3:9_Murray_Chrisopher	S3: Anthropogenic impacts on ELHS.	G.B.Nananga	United States	A FACTORIAL EVALUATION OF THE COMBINED EFFECTS OF ACIDIFICATION AND HYPOXIA IN ATLANTIC SILVERSIDE OFFSPRING
14:30-14:45	A(7)	WES3:10_Cross_Emma			United States	DIEL AND TIDAL CYCLES OF CO2 AND DISSOLVED OXYGEN CONDITIONS PROVIDE PHYSIOLOGICAL REFUGE TO A COASTAL FORAGE FISH, <i>Menidia menidia</i> , UNDER ACIDIFICATION AND HYPOXIA
14:45-15:00	A(7)	WES3:11_Clemmesen_Catriona			Germany	DOES FOOD AVAILABILITY INFLUENCE COD LARVAE PERFORMANCE AND SURVIVAL UNDER OCEAN ACIDIFICATION?
15:00-15:15	A(7)	WES3:12_Cominassi_Louisse*			Germany	FOOD AVAILABILITY MODULATES THE IMPACTS OF OCEAN ACIDIFICATION AND WARMING ON FISH GROWTH
15:15-15:30	A(7)	WES3:13_Sswat_Michael			Germany	OCEAN ACIDIFICATION AFFECTS SURVIVAL OF HERRING LARVAE VIA FOOD WEB ALTERATION
15:30-15:45	A(7)	WES3:14_Strydom_Nadine			South Africa	HUMAN IMPACTS ON SHALLOW-WATER FISH NURSERIES IN SOUTH AFRICA: CHANGING PARADIGMS AND POLICY

15:45-16:15 Health break

16:15-16:30	A(7)	WES3:15_Sciberras_Marija	S3: Anthropogenic impacts on ELHS.	G.B.Nananga	Spain	INFLUENCE OF SEAGRASS HABITAT STRUCTURE ON THE GROWTH OF JUVENILE ANNULAR SEABREAM
16:30-16:45	A(7)	WES3:16_Scholey_Vernon			Panama	RESEARCH ACTIVITIES AT THE INTER-AMERICAN TROPICAL TUNA COMMISSION ACHOTINES LABORATORY

BREAKOUT ROOM B(8)

14:15-14:30	B(8)	WES1:1_Abadie_Etienne	S1: Settlement in diverse seascapes	P.Puerta/ P.Lenfant	France	USING ECOLOGICAL ENGINEERING IN A PORT FOR FISH NURSERY RESTORATION
14:30-14:45	B(8)	WES1:2_Lenfant_Philippe		France	JUVENILE RELEASE TO ENHANCE AND SUSTAIN FISH NATURAL POPULATIONS	
14:45-15:00	B(8)	WES1:3_Gudeffin_Anais		France	A COMMON TERMINOLOGY OF EARLY LIFE HISTORY STAGE OF FISH AND ITS DIRECT APPLICATION ON A MARINE FRAMEWORK DIRECTIVE NETWORK	
15:00-15:15	B(8)	WES1:4_Guerreiro_Milene*		Portugal	IMPORTANCE OF NURSERIES AREAS FOR EARLY LIFE STAGES OF FISH AT CENTRAL COAST OF PORTUGAL	
15:15-15:30	B(8)	WES1:5_DiPane_Julien*		France	ONTOGENIC SHIFTS IN THE NUTRITIONAL CONDITION AND ENERGY ALLOCATION STRATEGY OF LARVAL PLAICE (<i>Pleuronectes platessa</i>)	
15:30-15:45	B(8)	WES12:4_Franz_George*	S12: Ontogeny, systematics and new technologies	P.Konstantinidis/ J.Webb	Germany	THE DEVELOPMENT OF THE CAUDAL SKELETAL ELEMENTS OF <i>Tetraodon cucutia</i> AND IMPLICATIONS ON ITS GENUS ASSOCIATION
15:45-16:15 Health Break						
16:15-16:30	B(8)	WES12:5_Thieme_Philipp*			Germany	SKELETAL DEVELOPMENT OF <i>Mugil cephalus</i> (MUGILIFORMES)
16:30-16:45	B(8)	WES12:6_Gaillard_Mélanie			France	NO-KILL IN RESTOCKING PROGRAMS: ADVANCES IN NON LETHAL DETECTION OF FLUOROCHROMES IN MARKED JUVENILES, GLASS EEL CASE STUDY
16:45-17:00	B(8)	WES12:7_Webb_Jacqueline			United States	THE LATERAL LINE SYSTEM OF LARVAL TELEOSTS: NEW PERSPECTIVES ON STRUCTURAL AND FUNCTIONAL DIVERSITY
17:30-19:30 Workshop: Writing and Ethics -A(7)						
EXCOMM meeting -B (8)						

THURSDAY 23

SLOT	ROOM	CODE_AUTHOR SURNAME_NAME (presenter if other)	SESSION	CONVENERS	COUNTRY	TITLE
9:00-9:15	PL(7)	THS11:1_Alvarez_B erasategui_Diego	S11: Linking ELH to assessment.	D.Álvarez/ M.Hidalgo	Spain	LINKING OPERATIONAL FISHERIES OCEANOGRAPHY AND LARVAL ECOLOGY FOR ADVANCING IN THE STUDY OF EARLY LIFE STAGES AND IMPROVE FISHERIES ASSESSMENT
9:15-9:30	PL(7)	THS11:2_Deary_Ali son			United States	A SYNTHESIS OF THE EARLY LIFE HISTORY OF TWO FORAGE FISHES IN THE US ARCTIC DURING A RECORD SEA ICE MINIMUM IN 2017
9:30-9:45	PL(7)	THS11:3_Murphy_ Hannah		Canada	USING THE EARLY LIFE HISTORY STAGE IN THE DEVELOPMENT OF A CAPELIN (<i>Mallotus villosus</i>) FORECAST MODEL	
9:45-10:00	PL(7)	THS11:4_Primo_An a		Portugal	PELAGIC LARVAL GROWTH AND RECRUITMENT SUCCESS OF FLATFISH SPECIES IN THE MONDEGO ESTUARY	
10:00-10:15	PL(7)	THS11:5_Díaz Barroso_Lara		Spain	IDENTIFYING SEA SURFACE DYNAMIC PROCESSES DRIVING THE EARLY LIFE STAGES OF TUNAS IN THE BALEARIC SEA, APPLICATION TO FISHERIES ASSESSMENT.	
10:15-10:30	PL(7)	THS11:6_Khamassi, S. (Dominique_Rober t)		Canada	IMPORTANCE OF GROWTH-DEPENDENT MORTALITY DURING THE JUVENILE STAGE IN ATLANTIC MACKEREL OF THE GULF OF ST. LAWRENCE, CANADA	
10:30-10:45	PL(7)	THS11:7_Ospina- Álvarez_Andrés		Spain	BRIDGE OVER TROUBLED WATER: ACHIEVING CONSERVATION AND FISHERIES TARGETS IN A NETWORK OF MPAS AND OPEN ACCESS AREAS CONNECTED BY LARVAL DRIFTERS.	

10:45-11:00	PL(7)	THS2:1_Catalán_Ignacio	S2: Non-anthropogenic drivers of ELHS traits: from genes to communities.	C. Chambers/D. Margulies	Spain	CRITICALLY EXAMINING THE KNOWLEDGE BASE REQUIRED TO MECHANISTICALLY PROJECT CLIMATE IMPACTS: A CASE STUDY OF EUROPE'S FISH
11:00-11:30 Health break						
11:30-11:45	PL(7)	THS2:2_Castro_Leonardo	S2: Non-anthropogenic drivers of ELHS traits: from genes to communities.	C. Chambers/D. Margulies	Chile	ASSESSING EFFECTS OF SEASONAL VARIATIONS IN SALINITY ON HATCH RATES AT THE MOLECULAR LEVEL: FROM GENE EXPRESSION AND ENZYMES TO HATCH SUCCESS IN <i>Engraulis ringens</i> EGGS
11:45-12:00	PL(7)	THS2:3_Allan, B (Stiansky_Martina)			New Zealand	USING QUANTITATIVE MOLECULAR DETECTION METHODS TO IDENTIFY REGIONS OF HIGH PREDATION PRESSURE ON LARVAL NORWEGIAN SPRING SPAWNING HERRING (<i>CLUPEA HARENGUS</i>) ALONG THE NORWEGIAN CONTINENTAL SHELF BY ATLANTIC MACKEREL (<i>Scomber scombrus</i>).
12:00-12:15	PL(7)	THS8:1_Neuheimer_Ana	S8: Ecological and evolutionary processes affecting fish ELHS distribution and survival.	L. Ciannelli/A. Neuheimer	Denmark	SESSION INTRODUCTION: ECOLOGICAL AND EVOLUTIONARY PROCESSES AFFECTING FISH ELHS DISTRIBUTION AND SURVIVAL.
12:15-12:30	PL(7)	THS8:2_Morissette, O. (Pascal_Sirois)			Canada	DECIPHERING JUVENILE REALISED THERMAL NICHE OF LAKE TROUT BY SIMS HIGH-RESOLUTION OTOLITH $\Delta 18O$ THERMOMETRY

12:30-12:45	PL(7)	THS8:4_Geffen_Audrey (Nash_Richard)			Norway	AGE, GROWTH AND DRIFT OF OVER-WINTERING LEMON SOLE, <i>Microstomus kitt</i> , LARVAE IN THE NORTHERN NORTH SEA: BACKGROUND INFORMATION FOR INVESTIGATING PROBABLE LOCATIONS OF SPAWNING AND NURSERY GROUNDS
12:45-13:00	PL(7)	THS1:5_Nash_Richard	S1: Settlement in diverse seascapes	P.Puerta/ P.Lenfant	Norway	SETTLEMENT VARIABILITY IN TIME AND SPACE: WHAT EUROPEAN PLAICE CAN TELL US.

13:00-14:15 Lunch

14:15-14:30	PL(7)	THS1:6_McBride_Richard			United States	A MULTI-LIFE-STAGE APPROACH TO EXAMINE THE GEOGRAPHIC RANGE EXTENSION OF A MARINE FISH (SERRANIDAE: <i>Centropristis striata</i>) AROUND A BIOGEOGRAPHIC FAUNAL BREAK (CAPE COD, EAST COAST USA)
14:30-14:45	PL(7)	THS1:7_Szkudlarek-Pawelczyk_Agnieszka			Poland	PERCH LARVAE (<i>Perca fluviatilis</i> L.) DISTRIBUTION AS A SPAWNING SITES INDICATION IN THE SZCZECIN LAGOON, BALTIC SEA

16:30-23:30 approx. Excursion+dinner. Buses will depart from the Conference hotel at 16:30

FRIDAY 24

SLOT	ROOM	CODE_AUTHOR SURNAME_NAME (presenter if other)	SESSION	CONVENERS	COUNTRY	TITLE
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9:00-9:15	PL(7)	FROTH:1_Venturelli_Paul	S13: Other Contributed Papers.	Ignacio/ Patricia/ Itziar	United States	WE GOT IT, SO WE ARE DOING IT: COMPARATIVE ANALYSIS OF THE EARLY LIFE STAGES OF FRESHWATER FISHES BASED ON THE STOREFISH DATABASE
9:15-9:30	PL(7)	FROTH:2_Wang_Verena		United States	COMMUNITY ASSEMBLAGE STRUCTURE AND VERTICAL DISTRIBUTION PATTERNS OF DEEP-PELAGIC ICHTHYOPLANKTON IN THE NORTHERN GULF OF MEXICO	
9:30-9:45	PL(7)	FROTH:3_del Favero_Jana		Brazil	REGIME SHIFTS IN SMALL PELAGIC FISH POPULATIONS REVEALED BY ICHTHYOPLANKTON ABUNDANCE IN THE SOUTHWESTERN ATLANTIC	
9:45-10:00	PL(7)	FROTH:4_Pekkoeva_Svetlana		Russia	FATTY ACID PROFILE OF THE LIPID SAC OF POST LARVAL <i>Leptoclonus maculatus</i> (STICHAEIDAE FAMILY) IN SVALBARD WATERS	
10:00-10:15	PL(7)	FROTH:5_van Damme_Cindy		Netherlands	SAMPLING THE EARLY LIFE HISTORY STAGES OF FISHES	
10:15-10:30	PL(7)	FROTH:6_Blanco, E (Reglero_Patricia)		Spain	METABOLIC RATES IN ATLANTIC BLUEFIN TUNA LARVAE: FIRST DATA AND METHODOLOGICAL CHALLENGES	
10:30-10:45	PL(7)	FRS8:5_Ferreira_Sofia	S8: Ecological and evolutionary processes affecting fish ELHS distribution and survival.	L.Ciannelli/ A.Neuheimer	Norway	MATCH-MISMATCH DYNAMICS BETWEEN CALANUS FINMARCHICUS AND <i>Gadus morhua</i> IN THE BARENTS SEA AND THE NORWEGIAN SEA
10:45-10:11	PL(7)	FRS8:6_Stige_Leif		Norway	DENSITY- AND SIZE-DEPENDENT MORTALITY IN FISH EARLY LIFE STAGES	
11:00-11:15	PL(7)	FRS8:7_Polte, Patrick		Germany	REDUCED PRODUCTIVITY OF A COMMERCIALY IMPORTANT FISH POPULATION: A RESPONSE TO SHIFTING REGIONAL WINTER REGIMES	

11:15-11:45 Health break

11:45_

12:00

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PL(7)

Poster contributions

POSTER CONTRIBUTIONS

NOTES: Please use the poster number to identify your poster slot. * stands for candidate to the best student poster.

SESSION	POSTER NUMBER	FIRST AUTHOR (PRESENTER IF DIFF)	COUNTRY	TITLE
S13: Other Contributed Papers.	1	Rodríguez, J	Spain	THE SOUTHERN BAY OF BISCAY: A SPAWNING GROUND FOR <i>Thunnus thynnus</i> AND <i>Sarda sarda</i> ?
	2	Rodríguez, J	Spain	COMMUNITY STRUCTURE OF ICHTHYOPLANKTON IN THE NE ATLANTIC IN SPRING, UNDER CONTRASTING HYDROGRAPHIC CONDITIONS
	3	Russo, S*	Italy	MORPHOMETRIC AND BIOCHEMICAL ANALYSIS HIGHLIGHTING DIFFERENT EUROPEAN ANCHOVY LARVAL SUBPOPULATIONS IN THE SICILIAN AND MALTESE SHELVES.
	4	Torri, M	Italy	<i>Sardina pilchardus</i> LARVAE IN SICILY: STRONG POPULATION STRUCTURE INDICATED BY MORPHOMETRIC AND BIOCHEMICAL APPROACHES.
	5	Zaragoza Vilanova, N	Spain	SPATIAL AND SEASONAL DIFFERENCES IN THE VERTICAL DISTRIBUTION OF CEPHALOPOD PARALARVAE IN THE WESTERN MEDITERRANEAN
S1: Settlement in diverse seascapes	6	Faillietaz, R	États-Unis	SPATIO-TEMPORAL PATTERNS OF LARVAL FISH SETTLEMENT IN THE NORTHWESTERN MEDITERRANEAN SEA
	7	Grønkjær, P	Denmark	DIFFERENCES IN DAILY GROWTH RATES BETWEEN TWO ECOTYPES OF COEXISTING JUVENILE ATLANTIC COD <i>Gadus morhua</i> INCREASE DURING SETTLING.
	8	Ottmann, D*	Spain	SETTLEMENT PATTERNS OF GROUND FISHES IN PROTECTED AND FISHED NEARSHORE WATERS ALONG THE NORTHERN CALIFORNIA CURRENT SYSTEM
S10: Advances in modelling the pelagic-	9	Orenes, V*	Spain	LARVAL DISPERSAL PATTERNS IN THE DUSKY GROUPER (<i>Epinephelis marginatus</i> , LOWE 1834) BETWEEN MARINE PROTECTED AREAS ALONG THE SOUTHEASTERN IBERIAN COAST
S11: Linking ELH to assessment.	10	Amato Peres, H*	Canada	IS WINTER MORTALITY OF YOUNG-OF-THE-YEAR STRIPED BASS IN THE ST. LAWRENCE ESTUARY SIZE-SELECTIVE?
S12: Ontogeny, systematics and new	11	Catanese, G	Spain	APPLICATION OF HIGH-THROUGHPUT SNPS GENOTYPING FOR ASSESSING THE ORIGIN OF <i>Engraulis encrasicolus</i> EGGS
	12	Konstantinidis, P	United States	THE FISHES OF THE SOUTHERN OCEAN EDITION II: A FOCUS ON THE DIVERSITY OF ANTARCTIC LARVAL FISHES
	13	Mateos-Rivera, A*	Norway	DETERMINING SPAWNING IN THE NORTH SEA USING VISUAL AND MOLECULAR TAXONOMIC METHODS
S2: Non-anthropogenic drivers of ELHS traits:	14	de Carufel, V	Canada	LARVAL ECOLOGY OF NORTHERN SAND LANCE IN WEST GREENLAND
	15	Olivar Buera, M (V.Raya)	Spain	CHANGES IN VERTICAL LOCATION IN THE WATER COLUMN OF MESO- AND BATHYPELAGIC SPECIES THROUGH DEVELOPMENT: BEHAVIOUR VS HYDROGRAPHY
	16	Raya, V*	Spain	WHAT FACTORS DETERMINE THE SPATIO-TEMPORAL DISTRIBUTION OF <i>Coris julis</i> AND <i>Thalassoma pavo</i> LARVAE IN THE NORTHWESTERN MEDITERRANEAN SEA?

	17	Sabatés, A (V. Raya)	Spain	ROLE OF UNSTABLE WINTER DYNAMICS SHAPING THE FISH LARVAL DISTRIBUTION IN THE NORTHWESTERN MEDITERRANEAN
S3: Anthropogenic impacts on ELHS.	18	Mandić, M	Montenegro	ICHTHYOPLANKTON COMMUNITY STRUCTURE IN BOKA KOTORSKA BAY (SOUTHERN ADRIATIC SEA)
	19	Smith Sanchez, N*	Germany	JELLIES BEG TO DISAGREE: ENHANCING FISH PRODUCTION VIA ARTIFICIAL UPWELLING?
	20	Torres, A	Spain	FISHERY OF THE TRANSPARENT GOBY, <i>Aphia minuta</i> , AND ASSOCIATED SPECIES ON THE FISHING GROUND OFF BALEARIC ISLANDS (WESTERN MEDITERRANEAN): A SUCCESSFUL
	21	Uriarte, A (J.Quintanilla)	Spain	INCIDENCE OF THE MICROPLASTIC FIBRES IN THE DIET OF BLUEFIN TUNA POST-FLEXION LARVAE IN THE NW MEDITERRANEAN SEA
S4: Parental effects on ELHS.	22	Johnstone, C	Spain	GENETIC SIMILARITIES BETWEEN ATLANTIC BLUEFIN TUNA <i>Thunnus thynnus</i> LARVAE SPAWNED IN THE NW-MEDITERRANEAN AND IN THE GULF OF MEXICO
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Lightning Session

Lightning Session Talks LFC 2019

Presenter	Talk	Email
Fabrice Teletchea	Why and how to promote aquaponics in junior high school?	fabrice.teletchea@univ-lorraine.fr
Jana M. Del Favero	Chat with Neptune: Undressing the formal language of scientific text, discussing gender bias in academy and promoting life as a marine scientist	delfaverojana@gmail.com
Su Sponaugle	MEZCAL Artist-at-Sea program	su.sponaugle@oregonstate.edu
Hannah Murphy	Engagement with harvesters in Newfoundland and Labrador	Hannah.Murphy@dfo-mpo.gc.ca
Kelsey Swieca	Plankton Portal: A citizen science program to engage the public in ichthyoplankton	swiecak@oregonstate.edu
Alison L. Deary	Building trust with indigenous communities: Lessons learned from the Alaska Fisheries Science Center	alison.deary@noaa.gov
Chris Chambers	Outreach and informal education through one-on-one sharing with science-trajectory students	chris.chambers@noaa.gov

Abstracts

ORAL CONTRIBUTIONS

WES1:1

USING ECOLOGICAL ENGINEERING IN A PORT FOR FISH NURSERY RESTORATION

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In intact marine coastal ecosystems, natural mortality rate of juvenile fish is about 90%, but without suitable habitats, the mortality can reach 100%. Unfortunately, shoreline infrastructures (harbors, bulkheads, piers) are increasingly prevalent, directly affecting the Essential Fish Habitats (EFH) of juvenile. Mitigating these impacts is crucial to restore the connectivity and life cycle of aquatic populations. Since six years, Ecocean and Perpignan University are involved in research projects aiming to develop and optimize an artificial fish nursery : the Biohut®. Ports are often perceived as nature-depleted zones with few opportunities for life to develop due to habitat homogenization. However, their ecological functions can be enhanced thanks to 3D artificial small habitats like the Biohut®. By providing food and shelter to the young fish and crustaceans, this micro-habitat enables them to survive and grow during this critical life-stage, up to a size where they can join adult populations. The projects have brought two main conclusions in the Mediterranean context 1) Micro-habitats present a marine biodiversity (fish and invertebrates) comparable to natural zone (species, abundance, ecological succession) regarding simple structures like docks. 2) Eco-engineering can improve the potential of underwater artificial infrastructures to provide opportunities for young fish to grow and feed. The Biohut® is now used as a remediation tool in 22 harbors in the Mediterranean. Since 2017, a pilot project in the Oresund, in Denmark, shows similar preliminary results, that could overtake the results of the Mediterranean ports, with various commercial species. The talk will highlight the need to protect and restore shoreline habitats such as ports to maintain fish populations in addition with Marine Protected Areas, and will present the strong results of the projects in France and in Denmark from 2013 to today.

WES5:7

IMPORTANCE OF THE SPATIOTEMPORAL PREDATOR DYNAMICS FOR MODEL-DERIVED ESTIMATES OF MARINE FISH EARLY-LIFE STAGE SURVIVAL

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Predation is one of the key processes controlling the survival of early-life stages and recruitment success of marine fish stocks. The spatial variability of predation mortality is challenging to quantify and empirical estimates of the spatiotemporal dynamics of predator-prey interactions are rare. We employed an individual-based model (IBM) to investigate how the spatial redistribution of predators may impact the survival of pre-recruit Atlantic cod (*Gadus morhua*) in the North Sea. We integrated a wealth of field data on the seasonal distribution (1991-1997), diet and abundance of key planktivorous and piscivorous predators of cod eggs, larvae, pelagic and demersal juveniles within a coupled IBM simulating drift, settlement, somatic growth and mortality of cod. Heterogeneous predator distributions (based on field survey data) resulted in 1- to 2-order of magnitude higher estimates of survival compared to assuming a homogeneous distribution of predators. Heterogeneous predator simulations also predicted low survival (<1%) of cod progeny originating from known spawning grounds in the northwestern and central North Sea, but relatively high survival (>6%) in the Southern Bight and north-eastern North Sea. Sensitivity experiments demonstrated that the seasonal and annual redistribution of predators was more influential to annual changes in cod survival than changes in predator standing stocks (biomass) or hydrographic variability (at least for the period of time considered in our study). This model study highlights the importance of obtaining field data on the distribution and abundance of potential predators on the early-life stages of commercially important fish species and incorporating this knowledge into tools to inform spatially-explicit fisheries management and marine spatial planning.

THS2:3

USING QUANTITATIVE MOLECULAR DETECTION METHODS TO IDENTIFY REGIONS OF HIGH PREDATION PRESSURE ON LARVAL NORWEGIAN SPRING SPAWNING HERRING (*Clupea harengus*) ALONG THE NORWEGIAN CONTINENTAL SHELF BY ATLANTIC MACKEREL (*Scomber scombrus*).

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The ability to quantify predation pressure on larvae of commercially important fish species has long been a research target of fisheries scientists worldwide. However, difficulties lie in the design and implementation of a cost and labour effective method that will quantify a process that has considerable spatiotemporal variability. At present many of the established techniques rely on visual inspection of predator stomach contents. However, not only is this challenging owing to limitations in correctly identifying consumed fish larvae, it is also labour intensive. Therefore, a key challenge was to develop an assay that could accurately and rapidly identify and quantify predation pressure. Using Norwegian Spring-Spawning herring (NSSH) larvae (*Clupea harengus*) and their purported predator, Atlantic mackerel (*Scomber scombrus*), as model organisms, we developed a digital droplet polymerase chain reaction assay to rapidly identify and quantify the molecular remains of herring larvae in mackerel stomach contents along the NSSH larval drift route off the Northern Norwegian coast. Using stomach content data from two surveys demonstrated significant variability both between stations and between fish sampled at the same station. Comparison of the ddPCR results with trawl results for mackerel and NSSH larvae raised important questions about the spatiotemporal overlap of predator and prey populations, and the ability of DNA-based predation assays to evaluate the magnitude of predation as a contributor to NSSH larval mortality. The quantitative molecular assay shows great promise as a cost-efficient and specific tool to correctly identify and quantify predation pressure. Understanding the mechanisms underlying the high variability in late larval mortality is critically important for the sustainable management of fish stocks, especially where climate change is a major environmental driver of stock dynamics.

THS11:1

**LINKING OPERATIONAL FISHERIES OCEANOGRAPHY AND LARVAL ECOLOGY FOR
ADVANCING IN THE STUDY OF EARLY LIFE STAGES AND IMPROVE FISHERIES
ASSESSMENT**

Diego Alvarez-Berastegui, Manuel Hidalgo, Patricia Reglero, Rosa Balbín, Baptiste Mourre, Walter jr. G Ingram, Raul Laiz-Carrión, Alejandro Orfila, Ismael Hernandez, Lara Díaz-Barroso, Joaquín Tintoré, Francisco Alemany

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The study of the response of fish populations during early life stages to environmental variability has been a main interest of fisheries ecology during the last decades. The results of these studies highlighted the relevance of mesoscale oceanography for improving the calculation of larval abundance indices and recruitment scenarios. At the same time operational oceanography has been advancing fast, propelled by the implementation of new multi-platform observing systems and also by the improvement of the data quality, quantity and accessibility. Linking both research fields, larval ecology and operational oceanography, offers now a new potential to integrate environmental variability and larval ecology processes to provide direct information for fisheries assessment and conservation. However, in order to achieve this objective a number of gaps and challenges have to be resolved. Here we present successful case studies applied in both large pelagic (i.e. tuna) and demersal (i.e. hake) species to illustrate the state of the art, and to identify the important gaps, that must be approached by aligning the developmental strategies on early life ecology research, the ocean observing systems and the fisheries assessment bodies.

TUS9:3

ARE RELATIONSHIPS BETWEEN LARVAL FISHES AND OCEANIC CONDITIONS RESILIENT TO CLIMATE REGIME SHIFTS?

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Species distribution models (SDMs) are used to project changes in organism abundance, occurrence and phenology under climate change. An often untested assumption of SDMs is that relationships between organisms and the environment are stationary or resilient to change. To test this assumption, we examined whether oceanic variables that influence the distribution of 43 larval fish species remained steady between cool and warm phases of the Pacific Decadal Oscillation (PDO) in the California Current. Generalized additive models were constructed for each PDO phase using temperature, salinity, dissolved oxygen and zooplankton volume as predictors of fish occurrence. We assessed non-stationarity in SDMs with three metrics: 1) changes in variables included in SDMs; 2) changes in whether a variable had a linear or non-linear form; 3) changes in the rank order of residual deviance explained by variables. Across all metrics, 88% of species exhibited a change in model form, indicating that a SDM developed during one PDO phase was not applicable to the other phase. Most changes were due to shifts in the relative importance of oceanic variables. Also changes in variables included in SDMs occurred disproportionately among fishes that are demersal as adults. Changing relationships with oceanic variables could indicate that demersal fishes are resilient to a wide range of conditions. Alternatively, this may reflect a reduced capacity for demersal fishes to undergo range shifts such that there is an observed change in the relationship between fishes and the environment because oceanic conditions changed without a concurrent response from fishes. This lack of responsiveness could imply poor resilience of species when confronted with accelerating future climate change. Lastly widespread shifts in the relationship between fishes and the environment across climate regimes suggest that non-stationarity may hamper our ability to reliably project how species respond to future changes.

TUS2:8

**VARIABILITY IN ICHTHYOPLANKTON DISTRIBUTIONS, FITNESS, AND
TROPHODYNAMICS ACROSS RIVER PLUMES IN THE NORTHERN GULF OF MEXICO**

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River plumes discharging into continental shelf waters of the northern Gulf of Mexico have the potential to influence patchiness of larval fishes, prey, and gelatinous predators. Using a high-resolution plankton imaging system, we sampled larval fishes, copepods, and planktonic predators (chaetognaths, hydromedusae, and ctenophores) across multiple low salinity features produced by freshwater pulses exiting the mouth of Mobile Bay (Alabama, USA) during the high-flow month of April 2016. Full water column profiles were used to quantify changes in the vertical and horizontal structure of ichthyoplankton and zooplankton distributions enabling a fine-scale examination of the predator and prey fields across plumes. The outflow was further targeted with a multinet sampler to capture the effects of entrainment within a plume at the scale of an individual fish larva. Each net tow was classified as having sampled one of two distinct water masses based on known salinity values: either "plume" (<25 psu) or "non-plume" (>32 psu). No differences in larval fish density were detected between water masses during the study period, but size frequency distributions of larval striped anchovy (*Anchoa hepsetus*) and sand seatrout (*Cynoscion arenarius*) indicated that larger individuals were present in non-plume waters but absent from plumes. Sagittal otolith microstructure analysis revealed that recent growth of both focal species was significantly lower in plumes than non-plume waters during the last two and three full days of life. Furthermore, both species captured from plume waters were in poorer morphometric condition (e.g., skinnier at length) than their non-plume counterparts. Taken together, these results indicate that plume waters are an unfavorable environment for certain fish larvae. Such spatially resolved trophodynamic data may improve our understanding of population replenishment dynamics under changing coastal oceanographic conditions.

TUS6:2

TROPHODYNAMICS OF ICHTHYOPLANKTON IN THE SEA OF CHILOÉ (NORTHERN PATAGONIA, CHILE)

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The structure of the zooplankton community in the Inland Sea of Chiloé, surrounded by fjords and channels, is affected by the seasonal dynamics of primary production and water masses in the region. Variations in the freshwater discharge from rivers and fjords ice-melting may modify the isotopic signature of plankton in the ocean. Since the particulate terrigenous carbon is less enriched in $\delta^{13}\text{C}$ than marine carbon, lower $\delta^{13}\text{C}$ values could be expected in marine zooplankton closer to shore and in periods with higher freshwater inflow. We collected mesozooplankton (e.g. copepods, euphausiids and amphipods) and ichthyoplankton (mainly larvae of *Maurolicus parvipinnis*, *Sebastes oculatus*, *Merluccius* spp. and mesopelagics) at inshore and offshore sites to compare the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ signatures between late winter and spring, and to quantify the trophic structure of the ichthyoplankton community. The inshore area was characterized by a dominance of the oceanic carbon production. The terrestrial matter was mostly retained near the fjords, although very negative $\delta^{13}\text{C}$ values at the outermost site might indicate a strong influence of allochthonous carbon. Conversely, more enriched organic carbon values of POM in inshore than in offshore waters could be related to phytoplankton blooms in spring, when dissolved inorganic carbon is massively used for carboxylation and less involved in the photosynthetic isotope fractionation. The trophic structure corresponded to the classical food web during both seasons. The range of $\delta^{15}\text{N}$ values for fish larvae was wider in late winter than spring, thus larvae probably consumed a wider assortment of prey in the colder period. In spring, fish larvae might be fueled by herbivorous crustaceans, which in turn prey on diatoms. The highest $\delta^{15}\text{N}$ values were found in *Merluccius* spp. and the lowest in clupeid. The overlap between larval isotopic niches may be indicating that potential prey is not limiting in the area.

FROTH:6

**METABOLIC RATES IN ATLANTIC BLUEFIN TUNA LARVAE: FIRST DATA AND
METHODOLOGICAL CHALLENGES**

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Atlantic bluefin tuna is an emblematic scombrid species, but many physiological aspects during the larval stages are still unknown. The mechanisms of how fish larvae balance growth and activity are of great interest since metabolic costs are very high compared to juveniles and adults. However, there is a lack of information about metabolic costs in scombrid larvae. This lack of data is probably related to the challenges associated to larval handling before and during respirometry trials. In this study for the first time, we: i) estimate the relationship between routine metabolic rate and the larval dry weight (mass scaling exponent) at 26°C, ii) measure metabolism under light and darkness and iii) explore the influence of nutritional status (RNA:DNA ratio) on the inter-individual variability in metabolic rates. The relationship between metabolism and size (ranging from 0.6 to 23 mg) was near isometric (slope, $b=0.99$), in contrast to the allometric relationship observed in most species ($b=0.87$). Our results show no significant differences in oxygen consumption under light and darkness. A possible regulation (decrease) of their swimming activity with the consequent decrease in the oxygen consumption in light situations is discussed. Nutritional condition did not explain the inter-individual differences in oxygen consumption. This study first reports metabolic rates of Atlantic bluefin tuna larvae and discusses the challenges of performing bioenergetics studies with early life stages of Scombrids.

TUS6:4

**INTERANNUAL VARIABILITY OF TROPHODYNAMICS OF LARVAL DEEPWATER REDFISH,
SEBASTES MENTELLA, IN THE GULF OF ST. LAWRENCE**

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Overfishing and decades of poor recruitment caused Gulf of St. Lawrence deepwater redfish, *Sebastes mentella*, stock to crash in the mid-1990s and biomass remained low until recent years. Unprecedentedly high recruitment of the 2011 cohort has allowed redfish populations to rebound to a record high level, and plans of reopening the fishery are presently underway. Little is known about the early life history of redfish in this region and the mechanisms behind this extreme recruitment event are unknown. Starvation is considered one of the three primary agents of mortality that determine recruitment success in marine fishes. Knowledge of larval redfish feeding behavior and preferences may help to understand variability of recruitment success of this population. The primary objective of the present study is to characterize the trophodynamics of larval redfish in the Gulf of St. Lawrence by identifying frequently consumed prey taxa during early larval development and calculating prey taxa preference as well as dietary niche breadth across larval size classes and collection years. A total of 572 preserved larvae collected in early June of each year between 1997 and 2000 were measured for standard length, mouth gape width, and anal body depth. Larval guts were then dissected under a microscope to count, identify to the lowest taxonomic level, and measure individual consumed prey items. Larval redfish exhibit generalist feeding strategies by preying on taxa in proportions relative to their occurrence in the surrounding environment. Larvae across all years and size classes frequently consumed copepod eggs, which contributed a large proportion of carbon to the larval diet. Annual changes in the timing of copepod reproduction due to abiotic environmental factors may contribute to differences in larval growth, survival, and recruitment as a result of variable feeding success.

WES5:2

LIVE FAST, DIE YOUNG: PATTERNS OF SELECTIVE PREDATION CHANGE WITH ONTOGENY BUT NOT DENSITY IN A MARINE FISH.

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Phenotypic variation is prevalent in the early life-history stages of many organisms, and provides the basis for selective mortality on size and growth-related traits of older life stages. Densities of organisms can vary widely at important life history transitions, raising additional questions about the interplay between selection and density-dependent processes. We evaluate density dependence in patterns of selective mortality for a temperate reef fish. Specifically, we exposed pre-settlement and post-settlement stages of the common triplefin (*Forsterygion lapillum*) to a natural predator, and evaluated patterns of selective mortality on early life-history traits as a function of ontogenetic stage and density. We used otoliths to reconstruct the traits of fish that survived versus fish that were consumed, and estimated selection by analysing the relationship between absolute fitness and standardised traits. Absolute fitness was negatively correlated with size and larval growth rate for pre-settlement fish, and this was consistent across the range of densities evaluated. Post-settlement fish experienced no selective mortality. Absolute fitness was equal across density treatments, suggesting mortality was density-independent. These results suggest that patterns of selection change with ontogeny, but may be stable across densities when mortality is density-independent. Shifts in selective mortality for species with distinct life-stages can mask and complicate relationships between traits and fitness, and the importance of such traits may be underappreciated for earlier life stages.

TUS7:4

OPTIMAL EARLY-LIFE STRATEGIES UNDER DIFFERENT FOOD AND PREDATION-RISK SCENARIOS

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Early-life behaviours that drive space-use constitutes a state variable of marine fish that deserves special attention given its determinant role in eco-evolutionary processes. Juvenile space-use co-variates with life-history and diverse physiological traits, and the interactions among them and the food and predator's landscapes shape optimal early-life strategies and its co-evolution. Explicit mechanisms shaping optimal early-life strategies have been, however, poorly explored in different relevant ecological scenarios, particularly due to the lack of proper frameworks describing such mechanistic links and ecological interactions. Here we have used a recent framework to link individual behaviour and life-history based on dynamic energetic budgets to explore optimal early-life strategies under different food and predation-risk scenarios. We have used dynamic optimization to explore optimal co-variation patterns at the individual level within different eco-evolutionary contexts. We fitted our model for a marine prototypical species and assumed that evolutionary forces lead juveniles to optimize their behavioural and associated life-history performance according with different pay-off functions. Our theoretical optimization model predicts that juvenile marine fish has lower searching rates, low tendencies to explore novel areas and has larger home ranges in comparison with adult stages. However, these general predictions are extremely shaped by the ecological context, and the way we pre-define ecological trade-offs. Our model predictions were contrasted with space-use empirical data in juvenile and adult marine fish. Despite the specific predictions obtained here, we provide a novel mechanistic tool connecting space-use for juvenile fish behaviour with bioenergetics functioning and ecological pay-offs that would help in exploring the arising patterns emerging at different eco-evolutionary scenarios.

THS2:2

ASSESSING EFFECTS OF SEASONAL VARIATIONS IN SALINITY ON HATCH RATES AT THE MOLECULAR LEVEL: FROM GENE EXPRESSION AND ENZYMES TO HATCH SUCCESS IN *Engraulis ringens* EGGS

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The Peruvian anchovy (*Engraulis ringens*) is one of the most important commercial fishes along the Humboldt Current. It is distributed from northern Peru (6°S) to the northern Chilean Patagonia (47°S), a wide latitudinal range where environmental conditions, such as salinity, vary markedly. Previous studies have shown that hatch rates vary within the latitudinal range and also along the spawning season. In this study we assessed the effects of changes in salinity in the expression of the gene and protein of the hatching enzymes, in anchovy eggs collected off Central Chile (36°30'S) incubated at salinities normally occurring during the spawning season (range 27-35 psu). The expression of the gene of the hatching enzyme was measured by semiquantitative RT PCR at different times during the egg development. A primary polyclonal antibody was produced to identify and quantify the enzyme, which was first observed by Dot blot and then quantified utilizing Western Blot. Changes in the enzyme expression were quantified as the egg developed. The location of the enzyme in the chorion and embryo was visualized utilizing immunobiochemistry assays. The hatching success variations among salinity treatments were estimated by hatching rates. Results show that the hatching enzyme expression increased as the embryo developed. The hatching enzyme were detected on the yolk sac and also in the chorion. The highest expression of the gen hatching enzyme and of the enzyme itself, along with the hatching rates at the different experiments, were obtained in the lower incubating salinity, 27 psu. Thus, the change in salinity of the seawater in the area during the spawning period could affect gene expression of the hatching enzyme and later protein expression. The results agree with previous field observations in the winter season when lower salinities and higher anchovy eggs hatch rates have been determined. Financial support: FONDECYT 1161131 and COPAS Sur-Austral CONICYT PIA CCTE AFB170006

THS2:1

**CRITICALLY EXAMINING THE KNOWLEDGE BASE REQUIRED TO MECHANISTICALLY
PROJECT CLIMATE IMPACTS: A CASE STUDY OF EUROPE'S FISH**

Ignacio A Catalan, Dominik Auch, Pauline Kamermans, Beatriz Morales-Nin, Natalie Angelopoulos, Patricia Reglero, Tina Sandersfeld, Myron Peck

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An amalgam of empirical data from laboratory and field studies is needed to build robust, theoretical models of climate impacts that can provide science-based advice for sustainable management of aquatic living resources. Using a semi-systematic literature review, Gap Analysis and multi-level meta-analysis, we assessed the status of empirical knowledge on the direct effects of climate change on 37 high-value species targeted by European fisheries and aquaculture sectors operating in marine and freshwater regions. In this presentation, we focus on the results of early life stages of fish. Knowledge on potential climate change-related drivers (single or combined) on several responses (vital rates) across four categories (exploitation sector, region, life stage, species), was considerably unbalanced as well as biased, including a low number of studies i) examining the interaction of abiotic factors, ii) offering opportunities to assess local adaptation, iii) targeting lower-value species. The meta-analysis revealed that projected warming would increase mean growth rates and metabolism. Decreased levels of dissolved oxygen depressed rates of growth and metabolism across coherent species groups (e.g., small pelagics, etc.) while expected declines in pH reduced growth in most species groups. The meta-analytical results were influenced by the study design and moderators (e.g., life stage, season). Although meta-analytic tools have become increasingly popular, when performed on the limited available data, these analyses cannot grasp relevant population effects, even in species with a long history of study. We recommend actions to overcome these shortcomings and improve mechanistic (cause-and effect) projections of climate impacts on fish.

TUS2:4

EXPERIMENTAL EVALUATION OF PLASTICITY AND RESILIENCY TO ENVIRONMENTAL DRIVERS IN THE EARLY LIFE-STAGES OF SUMMER FLOUNDER *Paralichthys dentatus*

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Many life-history traits are plastic and vary with environmental conditions. This is especially true for traits expressed in the early life-stages (ELS) of marine fishes. In nature, trait variation may be a consequence of current environmental driver(s) and/or represent an adaptive response to past conditions. Drivers of import include thermal regimes (climate change), elevated CO₂ (ocean acidification), and reduced dissolved oxygen (DO). Many of these same drivers may occur at extreme levels due to human activities and are also of interest in an aquaculture context where response plasticity is fundamental to identifying optimal conditions for production. By definition, performance optima occur in a subset of the range of possible values of these drivers. A first step in understanding environmentally driven performance - its shape, consequence, and likelihood - is to move from testing the null hypothesis that of no effect of the environmental driver on the biological response on interest to an advanced null-hypothesis study that examines the extent and shape of the response. Here we describe experimental, high treatment-level frequency methods suited to address questions about ELS plasticity and optimal production. Using summer flounder *Paralichthys dentatus* as a test species, our responses included rates of fertility, development, growth, and survival. Fertilization rate decreased with increasing temperature and increasing CO₂; embryonic period duration and length at hatching decreased with increasing temperature; survival to hatch decreased with CO₂ and at near the thermal tolerance extremes; and larval ontogenetic rate increased but settlement size decreased with increasing temperature and increasing CO₂. The ecological and aquaculture consequences of these responses are currently being analyzed but it is the high treatment-frequency approach that reveals the functional form of these responses and makes such analyses possible.

TUI:0 INVITED KEYNOTE SPEAKER

**SPATIAL, ENVIRONMENTAL, AND TEMPORAL CONSTRAINTS ON FISH DISTRIBUTION
DURING EARLY LIFE HISTORY STAGES**

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In this study, I will discuss and apply analytical methodologies to identify and quantify the spatial, temporal, and environmental constraints on distribution during a species' early life cycle. Examples will be shown by analyzing the spatial distribution of 3-5 well-monitored fish populations throughout their respective early life cycles. The methodology assumes that spatial and temporal configurations that are consistently repeated over time (e.g., during spawning, settlement or larval dispersal phases) are indicative of strong constraints. To allow extension of the analysis to data poor species (i.e., species for which we have life history information but lack survey data), I will conceptually relate constraints (intensity and timing) to life history traits of data-rich cases, including migration distance, longevity, time of maturation, pelagic larval duration, sensory abilities, social structure. Through this analysis, and its conceptual extension, we build capacity to study species adaptability and resilience to climate change utilizing analytical approaches that can account for potential bottlenecks affecting spatial distribution of a species during the early life.

WES3:11

**DOES FOOD AVAILABILITY INFLUENCE COD LARVAE PERFORMANCE AND SURVIVAL
UNDER OCEAN ACIDIFICATION?**

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In a series of experiments using eggs and larvae of different cod stocks and a variation of parental treatment (i) directly from the wild, ii) acclimated to higher CO₂ levels for 6 weeks and iii) F4 aquaculture generation - the effect of end-of-the-century CO₂ levels (~1100 μ atm ppm) on cod larval survival, growth and development was analyzed. Additionally, the effect of different food levels was studied to evaluate potential mitigating effects of surplus energy supply. In all experimental trials survival of cod larvae was negatively affected by increased CO₂ levels. 6 week parental acclimation to ~1100 μ atm pCO₂ buffered larval mortality and led to an increase in survival compared to the control group, but only if the larvae were not energy limited. Indications of tradeoffs between growth of the larvae and ossification of the skeletal structure and gill formation using offspring of parents directly from the wild were observed. Larvae under energy limitation were significantly larger and had further developed skeletal structures in the elevated CO₂ treatment, but showed comparatively smaller functional gills indicating a mismatch between size and function. By comparing the responses of growth, development and survival from the different experiments, some answers to the question whether food availability can shape direct OA effects on cod larvae will be given.

WES3:12

FOOD AVAILABILITY MODULATES THE IMPACTS OF OCEAN ACIDIFICATION AND WARMING ON FISH GROWTH

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When organisms are unable to feed *ad libitum* they may be more susceptible to the negative effects of environmental stressors due to trade-offs in energy partitioning. Ocean acidification and warming (OAW) are simultaneously occurring and, to date, no study has examined the effect of OAW and feeding level on fish. We reared seabass (*Dicentrarchus labrax*) at 15 or 20°C and at ambient or high PCO₂ (650 versus 1750 µatm (Δ1000) PCO₂ ; pH = 8.1 or 7.6) at *ad libitum* feeding and observed no discernible effect of PCO₂ on the final size-at-age of juveniles after 303 (20°C) and 399 (15°C) days. A feeding trial was then conducted including a restricted ration treatment (25% *ad libitum*) for 19 and 38 days at 20 and 15°C, respectively. At 20°C, fish fed restricted rations obtained positive weight growth only at ambient PCO₂ and did not grow at Δ1000 (0.50 versus -0.03% weight d⁻¹). Growth was faster for *ad libitum* fed fish but significantly faster at ambient PCO₂ compared to Δ1000 (1.47 versus 0.69% d⁻¹). At 15°C, ration but not PCO₂ level impacted growth rate, with expectedly higher growth with *ad libitum* feeding. Differences in food conversion efficiency at 20°C suggested that slower growth was not merely a consequence of lower food intake but higher costs. Post-prandial changes in stomach pH were also influenced by PCO₂ as well as ration level (both causing slower returns of stomach pH to pre-feeding levels) at both temperatures. Digestive enzymes of the intestinal membrane were affected by temperature. At 20°C the metabolic response is higher with higher enzyme activities. Enzymes with an alkaline optimal were influence by PCO₂. Our study highlights the importance of incorporating feeding level into experimental designs examining OAW and suggests that the majority of studies using *ad libitum* feeding may not be suitable to detect impacts of ecological significance.

TUS6:3

THE IMPACTS OF CLIMATE CHANGE ON ANTARCTIC LARVAL FISHES

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The Western Antarctic Peninsula (WAP) is one of the most rapidly warming regions on Earth, with an annual mean air temperature increase of 2.8°C since 1950. This warming has led to dramatic ice changes in the WAP, including marine glacier retreat and a shortened annual sea ice season. A climate gradient has developed along the WAP, with a warmer northern region and a cooler southern region. Considerable research efforts have been focused on understanding how these changes are affecting aspects of the WAP marine ecosystem, such as krill, penguin, and phytoplankton species. However, the responses of fishes to these changes is relatively unknown. The ichthyofauna has a significant role in the WAP food web, often serving as alternatives to krill as prey for higher predators. It is important to quantify the potential effects of a changing environment on WAP fishes, especially during their critical early life stages, in order to forecast their population dynamics and food web stability. The ongoing Palmer Antarctica Long-Term Ecological Research Program provides a 25-year time series of larval fishes sampled off the WAP. Specimens are identified to species and archived at the Virginia Institute of Marine Science Nunnally Ichthyology Collection. In this study, we examine the dynamics of species in relation to environmental factors (e.g., sea surface temperature, sea ice extent, phytoplankton densities, and copepod abundances). Preliminary results indicate a shift in species composition, with abundances of some Antarctic fishes (e.g., *Pleuragramma antarctica*) decreasing in the northern region and increasing in the south. While abundances of sub-Antarctic fishes (e.g., *Lepidonotothen squamifrons*) remain stable. Potential impacts of these shifts on the WAP food web will be further explored in this study. The development of Marine Protected Areas encompassing the WAP are currently being debated, and the results of this study may help inform such management decisions.

WES3:10

DIEL AND TIDAL CYCLES OF CO₂ AND DISSOLVED OXYGEN CONDITIONS PROVIDE PHYSIOLOGICAL REFUGE TO A COASTAL FORAGE FISH, MENIDIA MENIDIA, UNDER ACIDIFICATION AND HYPOXIA

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Rising carbon dioxide concentrations, recently exceeding 400 μatm , are rapidly acidifying and depleting oxygen in our oceans. Current understanding of organism responses to this environmental phenomenon are based mainly on static conditions despite community metabolism in coastal systems causing fluctuating pCO_2 and dissolved oxygen (DO) conditions on diel and tidal timescales. Long-term monitoring of our sampling site in Mumford Cove, CT, revealed pH and dissolved oxygen fluctuate on tidal and diel rhythms which reach extremes of 6.9-7.9 pH and 1-8 mg L^{-1} of dissolved oxygen concentrations in Late Summer. Two experiments were conducted in summer 2018 assessing the impact of fluctuating $\text{pCO}_2 \times \text{DO}$ conditions on the early life stages of the Atlantic silverside, *Menidia menidia*, to increase the environmentally realistic nature to multistressor experiments. We found an increase in embryo and larval survival, hatch length and also in larval growth under fluctuating conditions compared to static conditions. This indicates that fluctuations may benefit coastal organisms by providing periodic physiological refuge from stressful conditions, which could promote species adaptability to climate change.

THS11:2

**A SYNTHESIS OF THE EARLY LIFE HISTORY OF TWO FORAGE FISHES IN THE US ARCTIC
DURING A RECORD SEA ICE MINIMUM IN 2017**

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The Arctic is warming at a rate twice that of the global average, which has resulted in significant reductions in sea ice age, thickness, volume, and extent. The phenology of sea ice is also changing with ice forming later in the season and receding earlier. Arctic gadids, particularly Arctic Cod and Saffron Cod, are the dominant component of the fish community in the Chukchi Sea and are ecologically important forage fishes that link planktonic food webs to upper level consumers. For both species, reproduction, growth, and development is attributed to the availability of suitable pelagic habitat along the shelf, which is driven by sea ice dynamics. The biological consequences of shifting sea ice phenology on Arctic gadid early life history (ELH) is challenging to forecast due to a lack of seasonal ichthyoplankton data. In 2017, we conducted a study as part of the Arctic Integrated Ecosystem Research Program to characterize the distribution and abundance of Arctic Cod and Saffron Cod ELH stages from spring through fall in the Chukchi Sea, which is the first ever seasonal synthesis of these stages. ELHS Arctic Cod were caught in the highest densities south across the shelf (off Point Hope) in June but were concentrated to the north (offshore of Icy Cape) by August. The highest densities of ELHS Arctic Cod were observed nearshore in the northern Chukchi Sea (Barrow Canyon). Although more rare, ELHS Saffron Cod were most dense in the northern Chukchi Sea (Hanna Shoal and Barrow Canyon), but further offshore than Arctic Cod. On average, Arctic Cod in late summer were larger (29.5 mm standard length (SL)) than Saffron Cod (18.2 mm SL). Results indicate that Arctic and Saffron Cod are affected by seasonal sea ice differently, suggesting species-specific phenological responses to sea ice dynamics. This baseline information on the relationships between Arctic gadid ELH stages and sea ice can be used to evaluate impacts of future sea ice losses in the changing Arctic.

FROTH:3

**REGIME SHIFTS IN SMALL PELAGIC FISH POPULATIONS REVEALED BY
ICHTHYOPLANKTON ABUNDANCE IN THE SOUTHWESTERN ATLANTIC**

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Long-term fluctuations of different small pelagic fish populations (SPF) have been studied worldwide, mainly in the Pacific and in the Southeastern Atlantic. However, there have been no such studies for the two dominant pelagic fish species in ichthyoplankton samples from the Southeastern Brazilian Bight: the Brazilian sardine (*Sardinella brasiliensis*) and the Argentine anchovy (*Engraulis anchoita*). Regime shifts in SPF from Brazil were identified based on historical ichthyoplankton data set available in the Biological Collection "Prof. E. F. Nonato" (15 oceanographic cruises during the late austral spring, beginning of summer, from 1970 to 2008) and the Brazilian sardine landing data from FAO FishStatJ (annually, from 1950 to 2016). We have used the Sequential T-test Analysis of Regime Shifts (STARS) to show that the *S. brasiliensis* production shift occurred in 1987, when the mean production dropped from 133,557 tonnes to 61,913 tonnes. This coincided with the shift detected in January /1988 to the *S. brasiliensis* larval abundance (from 18.45 to 5.56 larvae m⁻²) and to the observed drop for this species egg abundance (from 15.94 to 7.32 eggs m⁻²). The *S. brasiliensis* fluctuations were out-of-phase with the ones observed for *E. anchoita* egg and larval abundance. The changing point detected during January/1988 for *E. anchoita* mean egg abundance showed an increase from 8.80 to 24.74 eggs m⁻² and an increase in the *E. anchoita* mean larval abundance from 10.66 to 19.55 larvae m⁻². For the first time, a regime shift is reported for both ichthyoplankton and fish production of SPF from the Southwestern Atlantic. Ongoing studies are investigating impacts of climate variability and local environmental conditions on the Brazilian SPF regime shifts.

WES1:5

**ONTOGENIC SHIFTS IN THE NUTRITIONAL CONDITION AND ENERGY ALLOCATION
STRATEGY OF LARVAL PLAICE (*Pleuronectes platessa*)**

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Condition indices aim to integrate the physiological status of fish larvae and to inform on both the level of starvation and potential of survival. Histological indices reveal direct effects of starvation whereas biochemical indices such as lipid classes or RNA/DNA ratios are used as proxies of condition, giving information on the amount of energy reserves and growth rate respectively. We combined these three indices to evaluate ontogenic variations of growth performance, lipid dynamics and nutritional condition of plaice larvae caught in the field during winter 2017 in the English Channel and North Sea. RNA/DNA ratios showed that larvae with a size of 9 mm or more (stage 4) had a lower mean growth rate than those smaller than 9 mm (stages 2 and 3). A significant increase in the proportion of triglycerides also occurred after 9 mm, indicating energy storage. Histological indices indicated that most of the larvae were in good condition, even younger ones with low lipid reserves. There was, however, an increase in the proportion of healthy individuals over ontogeny, especially with respect to lipidic liver vacuoles which were larger and more numerous for stage 4 larvae. Taken together, condition indices allowed us to identify the ontogenic shift in the energy allocation strategy of plaice larvae. Young larvae (stages 2 and 3) primarily allocated energy towards somatic growth. The decrease in growth performance for stage 4 was not related to poor condition but linked to a higher proportion of energy allocated to lipid storage. Since the quantity of lipid reserves is particularly important for plaice larvae to withstand starvation during metamorphosis, this shift could be considered a critical period for larval survival and recruitment success.

THS11:5

IDENTIFYING SEA SURFACE DYNAMIC PROCESSES DRIVING THE EARLY LIFE STAGES OF TUNAS IN THE BALEARIC SEA, APPLICATION TO FISHERIES ASSESSMENT.

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To maximize survival of early life stages marine species adapt their reproductive strategies to spawn in favorable habitats. Factors like surface hydrodynamic processes condition the early life stages forcing larval and shaping trophic and predation ecology. For example, mesoscale oceanography plays a key role in the reproductive ecology of big migratory top predators such as tunas, but it is still poorly understood how the dispersion/retention patterns and the surface mixing processes shape spawning and larval habitats. Identifying those habitats and characterizing their particular environmental conditions allow understanding species ecology and habitat relationships. The principal objective in this study is to describe which the oceanographic particularities in the Balearic Sea affecting the spawning ecology of pelagic species and its application for a better characterization of the larval habitats of Bluefin tuna (*Thunnus thynnus*). Using a high resolution hydrodynamic model and the Finite Size Lyapunov Exponents we analyze the dispersion/retention patterns and the surface mixing processes in the region. On the one hand, the results show for that during spring-summer, when most tuna species spawn, the Balearic Sea presents higher retention ratios and lower surface mixing than other areas in the Western Mediterranean. And for other hand, the results show that identification of larval habitats of Bluefin tuna, used for fisheries assessment, improve when seascapes of surface mixing are considered. This study highlights the importance of linking species ecology and oceanography to advance on fisheries sustainability and conservation, besides it would be applicable to improve the assessment of tuna species in other geographical areas.

TUS2:9

**FRESH SUBMARINE GROUNDWATER DISCHARGE AUGMENTS FISH GROWTH IN A
TROPICAL COASTAL ENVIRONMENT**

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Fresh submarine groundwater discharge (fresh SGD), the efflux of terrestrial groundwater directly into the ocean, is an ubiquitous pathway for nutrient-rich freshwater to coastal ecosystems, altering their hydrography, hydrochemistry, and primary productivity. Yet only little is known about the effects of fresh SGD on the fitness of higher trophic levels such as teleost fish. Here we show that somatic growth rates were significantly higher and settlement to reef habitat took place significantly earlier in juvenile grey demoiselle *Chrysiptera glauca* exposed to fresh SGD as compared to strictly marine conditions. Contrary to expectations, feeding conditions were better in the marine habitat. We propose that physiological effects rather than food availability allow marine fish to grow faster when exposed to fresh SGD, thereby increasing their survival potential. This effect would directly link changes in groundwater on land to variations in marine primary and secondary consumer biomass at the coast.

TUS10:2

**FROM SPAWNING AREAS TOWARDS NURSERIES: GILTHEAD SEA BREEM
ICHTHYOPLANKTON CONNECTIVITY IN THE ADRIATIC SEA**

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A significant increase of wild Gilthead Sea Bream (GSB) (*Sparus aurata*) population has been documented in the coastal areas of the Adriatic Sea in recent years. In addition, highly abundant and temporally stable GSB aggregations were noted in vicinities of semi-offshore tuna farms where GSB showed enhanced reproductive potential and strong reliance on tuna baitfish composed of a variety of small pelagic species. In May 2016 wild GSB offspring were collected in their natural nursery grounds, brackish areas of Pantan and Rača. Genetic analysis showed their connection with species sampled near two aquaculture areas in front of Brač and Ugljan, suggesting these sites as GSB spawning grounds. A coupled modelling system ROMS (Regional Ocean Modeling System) - Ichthyop was set up to test correlation between genetic and transport connectivity of GSB. Two different ROMS setups were used: one for the whole Adriatic Sea with resolution of 2.5 km and one for smaller domain encompassing eastern coastal area of the middle Adriatic Sea with resolution of 1 km. Results of forward and backward simulations showed connectivity between nurseries and fish farms considered as spawning grounds. Most of the passive particles were transported with the Eastern Adriatic Current, which strengthened during February presumably under the influence of the sirocco wind. Introduction of lethal temperature parameterization in Ichthyop model demonstrated negative impact which environment may have on ichthyoplankton transport and its survival during strong bora events. Lagrangian coherent structures (LCS) were used as a proxy for assessment of the transport in the sea. Particle distribution boundaries were highlighted with repulsive LCS, whereas attractive LCS pointed to the areas where most of the transport occurred.

TUS7:6

LARVAL FISH BEHAVIOR NUANCES HJORT'S ABERRANT DRIFT HYPOTHESIS

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Historically, the mortality of early-life stages of marine fishes was supposed to be mostly caused by poor feeding during a critical period and aberrant drifting away from favorable recruitment areas. While fish larvae may display remarkable swimming abilities, Hjort's aberrant drift hypothesis has rarely been tested. In this study, we measured critical swimming speed (U_{crit}) of settlement-stage larvae of six coastal, warm temperate Mediterranean fish species, for which no data were previously available (Sparidae: *Boops boops*, *Diplodus annularis*, *Spicara smaris*, *Spondylisoma cantharus*; Pomacentridae: *Chromis chromis*; Mugilidae sp.). Their swimming speeds were comparable with those of other temperate species, but also with the speeds of tropical species, which are considered as very fast swimmers. Mugilidae were the fastest (29.2 cm s^{-1}), followed by Pomacentridae (22.8 cm s^{-1}) and Sparidae (11.6 cm s^{-1}). Most larvae swam in an inertial regime (Reynolds number > 1000). Those swimming speeds were then implemented in a Lagrangian model of the competency period of these species, set in the same area (the Ligurian Sea) and at the same time (June 2014) as the observations. In this modeling experiment, directional swimming strongly increased the proportion of successful settlers, independent of mesoscale hydrological structures. A second modeling experiment was conducted with similar settings but in the Gulf of Mexico, where pre-settlement stage larvae of regularly caught offshore. Fish larvae could settle on the coast from as far as tens of kilometers offshore, in just 4 d. These findings suggest that aberrant drift is unlikely to occur for strong swimming temperate larvae and show that larval behavior should be considered on equal footing with ocean currents when assessing larval fish dispersal.

TUS7:5

LACK OF PERSONALITY AT THE JUVENILE STAGE IN A TEMPERATE REEF FISH

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Behavioural studies have traditionally examined average behaviour, where individuals are only featured as data points. However, in the last 10-15 years, behavioural ecology has shifted the research focus to the understanding of consistent between-individual behavioural differences, a study field that has become known as animal personality. Considering that personality has great influence on organisms' fitness, understanding variation and flexibility of personality will have major ecological implications. Recent studies have challenged the previously assumed stability of personality types across lifetimes, highlighting the need to better understand how repeatability (within life history stages) and consistency (between life history stages) differ throughout ontogeny. Here, we run a laboratory experiment that examined the consistency of measures of boldness in young stages of a temperate reef fish, the two-spotted goby (*Gobiusculus flavescens*, Gobiidae) at the critical phase of transition between pelagic larval and benthic juvenile habitats. Boldness is probably the most commonly studied personality dimension and consistency of risk-taking behaviours have been documented for adults of this species but have not been tested for earlier stages. Behavioural assays included the emergence test (where latency to leave shelter, time spent in shelter and time spent out of shelter was measured) and the open field test (where time spent close to the edge of the arena and in the central part of the arena were measured). A total of 36 juvenile fish, ranging from 2.1 to 3.2 cm, were tested twice in each assay. Results show evidence of lack of personality at this stage, as none of the traits was repeatable due to low inter-individual variation in behaviour. Behavioural flexibility is likely to be necessary for animals that undergo complex life history transitions, such as the transition between planktonic and benthic environments that this species experience.

TUS7:7

TELL ME SAND-SMELT, WHAT ARE YOU SMELLING?

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The use of sensory cues to navigate and orient to habitats has been a major research question in the field of ecological research in the last decades. Fish larvae can use a set of sensory cues to detect and discriminate between potential settlement sites. Many previous studies have shown that fish are able to respond to a variety of chemical signals, such as habitat and conspecifics, and consequently locate a critical nursery habitat. However, the use of olfactory cues for habitat selection has been mostly addressed for coral-reef fishes, with a clear lack of literature regarding the use of olfactory cues in marine, temperate fish species. Here we first investigated the ability of sand-smelt (*Atherina presbyter*) larvae to discriminate between odours from different rocky reefs; and then tested the ability to discriminate between chemical signals of conspecifics from its own site and conspecifics from another site (kin recognition). Water and schools of sand-smelt larvae were collected in three different rocky reefs. Results suggest that even nearby reefs smell different and that fish larvae can tell the difference. Fish also exhibited a strong preference for conspecific cues from conspecifics of their natal reef when tested against odours of conspecifics of the "foreigner" reefs. Moreover, results suggest that both cues are equally relevant. This evidence comes from the fact that the combination of reef odour with conspecific odours is more attractive to sand smelt larvae than each cue in isolation, and when conspecific and reef cues are tested against each other, there is no clear preference for neither cues. Preference for conspecific cues was further investigated to test whether larvae responded to diet or habitat-related odours. Results suggest that both are equally relevant.

WES5:4

COHO SALMON PREDATION ON PELAGIC JUVENILE ROCKFISH: DO EARLY LIFE HISTORY TRAITS PLAY A ROLE?

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Predation is thought to be a major source of mortality in the early life stages of fishes and a driving force in shaping fish populations. Theoretical, modeling, and laboratory studies have generated hypotheses that larval fish size, age, growth rate, and development rate affect their susceptibility to predation. Empirical data on predator selection in the wild are challenging to obtain, and most selective mortality studies must repeatedly sample populations of survivors to indirectly examine survivorship. While valuable on a population scale, these approaches can obscure selection by particular predators. In May 2018, along the coast of Washington, USA, we simultaneously collected surviving juvenile copper rockfish and juvenile copper rockfish consumed by juvenile coho salmon (*Oncorhynchus kisutch*). We used otolith microstructure analysis to test whether juvenile coho salmon were age-, size-, and or growth-selective predators of juvenile copper rockfish. Results indicated that juvenile rockfish consumed by salmon were significantly younger than surviving (unconsumed) juvenile rockfish, suggesting that earlier parturition dates may be improve copper rockfish survival during the transition from their pelagic to benthic phases. However, in contrast to predictions of the growth-mortality hypothesis, consumed rockfish were those that grew faster and attained larger sizes-at-age than survivors. These findings highlight nuances of the predator-prey relationship that may change across space, time, and species.

FRS8:5

**MATCH-MISMATCH DYNAMICS BETWEEN *Calanus finmarchicus* AND *Gadus morhua*
IN THE BARENTS SEA AND THE NORWEGIAN SEA**

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A key factor determining the survival of larval fish is the prey-predator time and space overlap (match-mismatch hypothesis, MMH). The MMH offers a mechanistic explanation for the fluctuations in fish recruitment, i.e. the number of fish entering the fishery. However, testing the MMH is challenged by a lack of high-resolution data and little is known about how the MMH mechanistically explains population and ecosystem dynamics across species and regions. Our main objective is to develop new metrics that acknowledge the roles of zooplankton mismatch in both space and time to allow us to quantify the ability of the MMH to globally understand fish recruitment dynamics. We will present here our method for quantifying the interannual variability in overlap between prey and predator via a case study of *Calanus finmarchicus* (prey) and *Gadus morhua* larvae (predator) from the southwestern Barents Sea and northeastern Norwegian Sea. The data underlying our study stem from the ichthyoplankton surveys from the Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO, Murmansk, Russia) from 1959 through 1993. Our method allows us to fill sampling gaps in observations of stage-specific abundance of *C. finmarchicus* and *G. morhua* to calculate a metric of predator-prey overlap. We then compare interannual variability of the overlap with the abundance of older *G. morhua* to assess where and when match-mismatch dynamics explain the survival of cod in early life stages. Finally, we discuss our results regarding future climate scenarios and implications for fish dynamics.

WES4:3

RESPIRATION RATES OF HERRING LARVAE AT DIFFERENT SALINITIES AND EFFECTS OF PARENTAL ENVIRONMENTAL HISTORY

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Metabolic rates of early life history stages of marine fish are highly influenced by extrinsic factors. Still, the relationship between respiration rates and salinity as well as potential previous and parental adaptations to the environment, is largely unexplored. In the present study, we conducted experiments to investigate salinity effects on the routine metabolic rates (RMR) of Atlantic herring (*Clupea harengus*) larvae at three levels: low (6 psu), intermediate (16 psu) and high (35 psu). The larvae originated from parental fish of different genetic background and salinity adaptations to account for cross generation effects on metabolic rates. Closed respirometry carried out over 24 h generally confirmed near isometric respiration rates at all salinity regimes, with the rates were being 15.4% higher at 6 psu and 7.5% higher at 35 psu compared to 16 psu conditions. We found no significant effects of parental salinity regime on offspring metabolic rates. Our study demonstrates the ability of herring to cope with a wide range of environmental conditions, irrespective of parental environmental history and genetic origin. This phenotypic plasticity is considered to be one of the main contributing factors to the success of herring as a widely distributed fish species in the North Atlantic.

TUS7:3

**THE EFFECT OF BEHAVIOURALLY MEDIATED FISH VULNERABILITY ON EARLY-LIFE
PRODUCTION AND DISPERSAL.**

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The interest for the behavioural dimension of fisheries is growing due to the recent empirical evidence linking bold/active behavioural phenotypes and fish vulnerability. Because behaviour and life-history (growth, reproduction investment and maturation) theoretically co-vary within the eco-evolutionary context, behaviourally non-vulnerable individuals may be less productive and consequently contribute with less eggs at the population level. Here we have tested this hypothesis in *Serranus scriba*, a coastal temperate fish with a production of passive eggs. We first reproduced in laboratory conditions three groups' treatments: vulnerable, medium vulnerable and non-vulnerable biomass, with the same spawning stock biomass (SSB, individuals per population ~ 10) and duplicated. Vulnerability was individually assessed using extensive standardized protocols to measure the odds to be harvested. Fish groups were kept in different tanks under semi-natural conditions during the whole spawning season and the production of eggs was monitored every day. The temporal dynamics of eggs production, their harmonic or stochastic components, were compared across the three treatments. We have found that behaviourally mediated fish vulnerability may affect the dynamic of early-life production in our study case, and the expected impact at population level in the dispersal early-life is discussed considering the connectivity pattern of this species using a biophysical model eggs dispersal. Our findings may shed light on the links between fishing vulnerability and meta-population connectivity, which would provide new opportunities to apply new management policies based in scientific knowledge with important implications in fisheries conservation science.

WES12:4

**THE DEVELOPMENT OF THE CAUDAL SKELETAL ELEMENTS OF *Tetraodon cutcutia*
AND IMPLICATIONS ON ITS GENUS ASSOCIATION**

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Southeast Asian puffer fishes, especially those species formerly attributed to the genus *Tetraodon*, show a taxonomy in flux. Many species were described multiple times, leading to several synonyms. Additionally, the possible occurrence of multiple invasions of freshwater further complicates the evolutionary history and the taxonomic situation. In this study, we present a description of the development of the caudal skeleton of *Tetraodon cutcutia*. The caudal skeleton is a complex structure that is known to contain characters that are valuable for evolutionary studies. We also used a developmental series of *T. cutcutia* to include information about the ontogeny of the caudal skeleton. For this, eleven cleared and stained specimens from 2,6 mm NL to 28 mm SL were used. In the preflexion specimens hypural 1 was the first element to appear, and was followed by the parhypural, the neural and haemal appendages of the first preural center and the hypural 2. The flexion of the chorda and the single epural occurred in the 4,5 mm TL specimen. Unusual is the lack of the haemal arch portion of the parhypural, which *T. cutcutia* shares with puffers of the genus *Carinotetraodon*. In contrast, the parhypural in all other species of the genus *Tetraodon* we examined possesses a haemal arch. Based on our findings and a review of the molecular data, a closer relation between *T. cutcutia* and the genus *Carinotetraodon* than to other *Tetraodon* is suggested.

WES4:5

MATERNAL DIET MAY ALTER ENERGETIC AND STRUCTURAL COMPONENTS OF YOLK THAT SUPPORT OFFSPRING DEVELOPMENT IN RED DRUM (*Sciaenops ocellatus*)

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Lipids contained in the yolk provide energy and molecular building blocks that support embryonic and early posthatching development in fishes. Lipids deposited in oocytes come from three sources: (1) exogenous dietary sources; (2) mobilized body stores; and (3) biosynthesis in the ovary. Generally, neutral lipids are used by embryos as a source of energy, while polar lipids (phospholipids) are structural components of body tissues. Given the importance of the appropriate amounts of neutral and polar lipids to normal embryonic development, lipid class composition of eggs (within a species) should not vary substantially in response to changes in the maternal environment, such as diet. We experimentally manipulated the diet of two tanks of red drum (*Sciaenops ocellatus*) broodstock during their spawning period and measured the lipid class composition of the eggs they produced, using mass-spectrometry. We quantified five classes of polar lipids and five classes of neutral lipids on 27 samples of eggs spawned by red drum that were fed one of five different diets (shrimp, mackerel, sardine, squid, and beef liver). The proportions of neutral and polar lipids was relatively stable across diets (73%:27%). Principal components analysis revealed distinct differences in egg lipid class composition associated with adult diet. The first component (PC1, 36% of total variance) represented neutral lipids, particularly wax esters, which were highest in eggs from squid-fed adults. PC2 (20% total variance) represented polar lipids, particularly phosphatidic acid, which was highest in eggs from liver-fed adults. Wax esters were assumed to be biosynthesized by the adults, since they were lacking or in very small quantities in all diets. Beef liver had high levels of polar lipids, suggesting that the high levels of polar lipids (phosphatidic acid) in eggs from liver-fed adults were derived from dietary sources.

WES12:6

NO-KILL IN RESTOCKING PROGRAMS: ADVANCES IN NON LETHAL DETECTION OF FLUOROCHROMES IN MARKED JUVENILES, GLASS EEL CASE STUDY

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Restocking is one of the alternatives measures that have been widely used as a measure of remediation of ichthyologic biodiversity loss. To assess restocking efficiency, mass-marking provided the discrimination of restocked fish compared to wild fish. The use of fluorochromes recorded in the calcified structures such as otoliths has been used extensively to detect marked fish. However, reading mark on otolith requires the sacrifice of the fish. European eel recruitment collapsed down to 1% of 1980s levels. Within European eel management plan, restocked glass eel are marked with Alizarine Red S (ARS 150 ppm). The aim of our study was to implement a non-lethal ARS mark detection method using modern techniques of microscopy, imaging and fluorimetry. Batches of ARS marked and unmarked glass eels within a restocking protocol were collected before they were translocated. For marked and unmarked glass eels, ARS detection mark was assayed i) on glass eel fins with a binocular microscope, ii) on anesthetized glass eels using a fluorescence reflectance imager and iii) on a piece of caudal glass eel fins using fluorimeter. Among the three alternative methods tested, non-lethal ARS detection using fluorimeter appeared to be most efficient, the easiest method and the cheapest method. Overall, the present results provided a widely applicable, easy and non-lethal method to researchers and managers for detecting endangered marked fish.

WES4:2

MATERNAL EFFECTS ON EGG AND LARVAL SIZE OF EUROPEAN HAKE IN THE GALICIAN SHELF

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Maternal effects, environmental conditions and their interaction can influence size and condition of larvae, ultimately affecting their survival. This study aims to analyse maternal effects on European hake larval size from the Southern stock during the two main spawning peaks along the year (winter-spring and summer) in the Galician shelf (NW Spain). Actively spawning females (and their hydrated eggs) were sampled on a monthly basis from commercial fishing landings and larval samples were collected during two oceanographic surveys in March and June in 2017. Larval growth and morphometry were also analysed for each period. Results showed that spawning females were bigger and heavier during winter-spring period than in summer, but condition indices did not differ significantly between spawning periods. Eggs were significantly bigger in terms of diameter and dry weight (in association with female traits) in winter-spring than in summer, while egg oil droplets resulted smaller. However, standard length at hatch presented significant differences between periods, being 200 μm bigger in summer than in winter-spring even when the first increment of the otolith and larval growth rate were similar. Moreover, larvae from winter-spring period hatched shorter but wider while larvae from summer were larger and thinner. Then, results suggest that maternal effects are stronger and different in eggs than in larval stage. This study disagrees with the current unifying theory which suggests that larger eggs result in large larvae. In fact, size of European hake larvae may be more related with egg condition (determined by oil droplet size) than egg size. Differences among periods can be produced not only by maternal effects, it can also be an adaptation to environmental conditions of each period. Even that, this analysis should be integrated with environmental conditions to understand the complex process of larval recruitment.

THS8:4

**AGE, GROWTH AND DRIFT OF OVER-WINTERING LEMON SOLE, *Microstomus kitt*,
LARVAE IN THE NORTHERN NORTH SEA: BACKGROUND INFORMATION FOR
INVESTIGATING PROBABLE LOCATIONS OF SPAWNING AND NURSERY GROUNDS**

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Lemon sole, *Microstomus kitt*, is a commercially valuable flatfish species that occurs in shelf waters from the White Sea and Iceland in the north to the Bay of Biscay in the south. Spawning in the North Sea is generally assumed to peak between May and August with spawning being completed in October. Lemon sole larvae have been caught in regular sampling programmes in the northern North Sea from April through to February. In 2016, larvae were measured and sagittal otoliths removed and prepared for age determination, primary increments, using standard techniques. All otoliths were read using a light microscopy. The larvae caught in November and December ranged in nominal age from 4-45 days post-hatch which suggests spawning continuing into late October and November. The estimated hatching time and hence spawning time is in broad agreement with the historical data for this species in the northern North Sea. The drift modelling from the historical spawning grounds, using the age data of the larvae, suggests that all larvae originated from these spawning grounds, irrespective of when they were sampled. Forward projections of larval drift from the locations where the larvae were collected suggest that lemon sole at the size of potential settlement are widespread with no definitive nursery areas identified. However, there is a major need for further studies on directed swimming behaviour of larvae in the plankton and field studies capable of capturing juvenile lemon sole.

TUS6:1

FOOD WEB CONSTRAINTS ON LARVAL GROWTH IN SUBTROPICAL CORAL REEF AND PELAGIC FISHES

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Prey availability and predation pressure are thought to be key constraints on larval growth, especially in low-productivity, subtropical environments. Yet, understanding the effects of prey and predator distributions on larval fish populations has been challenging, given the dynamic biophysical drivers of plankton distributions and small scales of interactions. We integrated fine-scale net tows (10's m) with in situ imaging to explore predator-prey interactions influencing larval fish growth in the Straits of Florida. Otolith-derived recent growth was analyzed for three ecologically important fishes: two coral reef labrids (*Xyrichtys novacula* and *Thalassoma bifasciatum*) and one tuna (*Katsuwonus pelamis*), with differing growth rates (labrids 0.25 mm d^{-1} , *K. pelamis* 0.44 mm d^{-1}) and prey. We used generalized additive models to examine the relative importance of local prey and predator densities, as well as temperature, to recent larval growth. For *X. novacula* and *T. bifasciatum*, prey density (copepods; range 2-20 ind. m^{-3}) best explained variability in growth, with recent growth generally increasing with prey density. However, for *T. bifasciatum* fast growth also occurred in regions with the lowest prey densities but small, dense patches of prey. Successful foraging in those patches may elevate larval growth in these regions. For *K. pelamis*, fast growth occurred in regions with high prey ($>90 \text{ ind. m}^{-3}$) and predator ($>50 \text{ ind. m}^{-3}$) densities, indicating an additive effect of selective predation on slower growers and the growth benefit of highly abundant prey. This fast growing species is additionally constrained by temperature, as recent growth peaks at an intermediate temperature. Integration of these fine-scale sampling methods improves our understanding of the variable influence of prey and predators on larval growth, and consequently, larval survival.

WES4:1

**HOW BIG IS YOUR MOTHER? DETERMINING MATERNAL SIZE FROM STABLE ISOTOPES
OF INDIVIDUAL WILD CAUGHT LARVA**

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Overfishing and recruitment failures have altered the demographic structure of many fish populations. Especially, populations have experienced a decrease in the proportion of old, large individuals. Large females are highly fecund, but it has also been hypothesized that they may produce offspring of superior quality with higher survival probability than those from smaller females. All attempts to test this hypothesis have failed due to the inability to link individual offspring caught in the open sea to the size or age of the mother. Here, we provide a technique by which an individual wild caught larvae can be analysed to reveal the size of its mother. Our approach utilises the fact there are size related differences in diet of most fish species. These differences are reflected in the stable carbon and nitrogen isotope values of the predator and the isotopic diet signals are transferred to the offspring via the eggs. The isotopic signal is degraded in a predictable manner as the fish embryo and larvae develops. However, the original female isotopic signature, and therefore size, can be reconstructed using estimates of larval growth, turnover and diet isotopic values. We demonstrate this technique with wild caught larvae of Atlantic cod (*Gadus morhua*) larvae from Greenland and the Barents Sea, and present preliminary tests of larval survival in relation to mother size.

WES1:3

A COMMON TERMINOLOGY OF EARLY LIFE HISTORY STAGE OF FISH AND ITS DIRECT APPLICATION ON A MARINE FRAMEWORK DIRECTIVE NETWORK

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During the last few years, some studies have been lead in natural and artificial fish nurseries in French Med sea (Bouchoucha et al., 2016; Mercader et al., 2016, 2017; RESPIRE Network for France) in order to improve the knowledge on the functioning of these ecosystems and on the life cycle of fish. However, the recent analyses of the data collected ended in the decision to uniformize the terminology used, as well as the protocol of monitoring and the analyses methods. A meeting of different French experts in 2018 has resulted in a new definition of the different terms used, mainly based on visual criteria, adapted to the type of monitoring used. 5 stages have been defined : post-larvae, juvenile stage I, II, III, IV and adults. A definition of size classes for each step, and for the main species observed on the coast, has been established. Based on this work, the RESPIRE network (Marine Framework Strategy) adapted its protocol of monitoring and now, wants to better understand the quality of the settlement of juvenile of the North Western Mediterranean shoreline. In 2019, an important work will be led to define a typology of situation, based on a division of the coast consistent with the structuration of the fish community. Quality classes (reference thresholds) will be defined for each typology according to the repartition of the settlement data, based on reference areas and on the evaluation of the size-classes monitored. The aim of our presentation is to introduce the work on the stages definition and on the fish settlement typology with the first results of our reflection, as well as the difficulties that came across for this job.

WES1:4

**IMPORTANCE OF NURSERIES AREAS FOR EARLY LIFE STAGES OF FISH AT CENTRAL
COAST OF PORTUGAL**

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Most of marine fishes spawn offshore and the newly hatched larvae have to migrate into nursery areas. A successful recruitment to these areas is essential for their survival. Thus, the processes that affect its variability have been one of the major research items. Although estuaries are intensively studied, little is known about the adjacent coastal areas. This study aims to analyse and compare the importance of two nursery areas (estuary and coastal area) to the early life stages of fish. For this, larvae and juvenile fishes were sampled in the Mondego estuary and adjacent coastal zone over a year (2018-2019). The spatial and temporal pattern of the ichthyoplankton community was described and it was evaluated the influence of environmental factors for species distribution. Then, the recruitment pattern was evaluated through the comparison with the composition of juvenile fish. Results show a seasonal variation of larvae density in both systems. At the coastal area, *Sardina pilchardus* was the most abundant species peaking during autumn while at the estuary, the most abundant was *Pomatoschistus minutus* mainly during summer. Species as *Trachurus trachurus* and *Trisopterus luscus* seem to recruit at ocean while *Platichthys flesus* prefer estuarine areas. Seasonal variation seems to be related with temperature and species spawning processes. Patterns observed show a different use of nursery habitats by species reinforcing the need to integrate larval and juvenile stages to a better understand of the species and for management of fish stocks.

WES5:3

**THE DEATH OF SEBASTES: A GENERIC MODEL FOR THE EARLY LIFE OF
OVOVIVIPAROUS FISH**

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Natural mortality is an uncertainty in stock assessment as it is difficult to determine when clear predator-prey relationships are missing. Therefore, expert judgement is a common source for natural mortality rates, including the rate of 0.05 for beaked (*Sebastes mentella*) and golden redfish (*Sebastes norvegicus*) in the Barents and Norwegian Seas. A recent re-evaluation, using a range of estimators from the literature showed that most estimates were below 0.1, with the mode at 0.058. It also revealed outlying results up to 0.6 and that results based on unrelated taxa or different climate zones can be nonsensical. Whilst these estimates refer to the life cycle after recruitment, mortality in the early life stages is particularly high, variable and poorly studied. Rockfish (*Sebastes* sp.) are among the few commercially fished ovoviviparous taxa and the northeast Atlantic species share the traits of longevity and late maturation with many congeners and other deep-water species. Their reproductive strategy occupies a middle ground between r-selectors, such as the Gadidae, releasing millions of eggs, and K-selectors such as several shark species, giving birth to a few pups. Redfish release several tens of thousands well-developed larvae that have at least limited control on their depth and therefore the current they are in, can start feeding and evade predators. A potential disadvantage may be a shorter time window for the onset of successful feeding due to partial consumption of the yolk sac whilst still inside the ovaries. Here we present a generic trait based model, governed by body size, for the early life stages of ovoviviparous fish. The model is parameterized for the genus *Sebastes*, focusing on *Sebastes mentella* and provides estimates for natural mortality under different scenarios of predator- and prey-spectra. Results are compared with those for oviparous broadcast spawners and spatial variation in mortality is considered by examining data from plankton surveys.

WES4:4

TRANSFER OF FATTY ACIDS FROM MATERNAL DIET TO OFFSPRING IN A MARINE FISH

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Oviparous fishes produce eggs with a fixed amount of yolk, which is the only source of nutrients for embryos and for larvae until exogenous feeding begins sometime after hatching. Fatty acids in the eggs are critical for development and survival of embryos and larvae. Essential fatty acids (EFAs) cannot be synthesized by marine fishes in sufficient amount to meet their physiological demands and must be obtained from dietary sources. Therefore, the maternal diet is the sole source of EFAs for developing embryos and yolk-sac larvae. Recent studies of red drum (*Sciaenops ocellatus*), a batch-spawning marine fish, showed that variations in the amount of one EFA, arachidonic acid (ARA), in the maternal diet produced changes in the amount of ARA in the eggs. In particular, a quantitative examination of the transfer dynamics revealed that ARA concentrations in eggs responded to a diet shift within 2-16 days and the rate of change was proportional to the magnitude of change in the dietary intake. Here, we examined the diet-egg transfer dynamics of 27 essential and non-essential fatty acids in red drum. Twenty-three diet shift experiments were conducted on 11 tanks of broodstock. Each diet was maintained for at least 1 month during which spawned eggs were sampled. Fatty acid composition of eggs and dietary items was measured by gas chromatography. Lag correlations showed that at least seven fatty acids showed significant correlations between eggs and daily dietary intake, including three important EFAs (ARA, eicosapentaenoic acid and docosahexaenoic acid). This study demonstrates a close relationship between adult nutrition and embryonic nutrition, and reveals a mechanism by which maternal diet could affect the viability of early life stages. The variations in adult diet applied in these experiments simulate conditions that might occur naturally, such as migration of adults to spawning areas that have a different prey field or temporal variations in prey communities.

THS11:6

**IMPORTANCE OF GROWTH-DEPENDENT MORTALITY DURING THE JUVENILE STAGE IN
ATLANTIC MACKEREL OF THE GULF OF ST. LAWRENCE, CANADA**

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The Growth-Survival Paradigm (GSP) is based on a growing number of studies that have shown that year-class strength is driven by growth-dependent mortality during the pelagic larval stage. However, few of these studies have precisely identified the timing during ontogeny when the level of growth-dependent mortality drops and recruitment is set. Knowledge of this "endpoint" is however essential if we are to successfully integrate this type of early growth index into stock assessments. In a previous study looking into early life dynamics of Atlantic mackerel (*Scomber scombrus*) from the Gulf of St. Lawrence, Canada, we demonstrated that year-class strength is linked to interannual variability in growth-dependent mortality occurring within the first year of life. Based on the GSP, we speculated that the timing of severe growth-dependent mortality likely corresponded to the larval stage, i.e. the first 30 days of life. In the present study, we moved away from traditional ichthyoplankton or commercial fishing gear and instead relied on the northern gannet (*Morus bassanus*), one of the primary mackerel predators, to obtain a representative sample of the early juvenile stage for two (2015 and 2017) annual cohorts. For the years considered, significant differences in growth trajectories between YOY and 1-year-old individuals were observed, indicating the presence of growth-dependent mortality beyond the larval stage. A comparison between 2- and 3-months-old juveniles in 2017 also showed substantial selection for fast growing individuals within the early juvenile stage. The comparison between growth trajectories of 3-months-old and 1-year-old juveniles of the same cohort showed no significant difference, suggesting that the endpoint when recruitment is set corresponds to the age of 3 months. These results highlight the importance of considering early juvenile dynamics in this species and may facilitate the early detection of strong year classes for this stock.

TUS36

DO OTOLITHS RECORD PHYSIOLOGICAL STRESSES OF RESTOCKED YOUNG EELS?

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Restocking measures of the endangered European eel (*Anguilla anguilla*) have been set up in Europe since 2011. Restocking operations are performed with glass eel post-larval stage during their upstream migration. Restocking protocols involve the collection of glass eel in estuaries, transport and marking of 30% of the glass eels with Alizarin red S before restocking. All these restocking operations such as transport, handling, osmotic and thermal shock are a potential source of physiological stress for glass eels. The objective of the present study was to investigate the inter-individual responses to stress in the structure of the otoliths of restocked fish. This was achieved using otolith and experimental science. The originality of the present study was to address restocking stress for early stages of European eels. An experimental setting was performed by rearing glass eels obtained from a restocking program during 9 months. A control group was obtained by collecting wild glass eels at the entrance of a freshwater habitat. Relying on microstructure analysis of the sagittae otoliths and biometric measures, we aimed at investigating inter-individual variabilities of glass eels during their larval and glass eel stage and verifying the presence of additional stress marks related to restocking. The present results would be useful for improving eel restocking protocols or interrogating the relevance of restocking eels programs as a measure of recovery of healthy eel populations.

TUS12:3

**THE DRASTIC ONTOGENETIC TRANSFORMATION OF THE TELESCOPE FISHES OF THE
GENUS GIGANTURA (AULOPIFORMES: GIGANTURIDAE)**

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The family Giganturidae comprises two species, *Gigantura indica* and *G. chuni*, which undergo one of the most drastic developmental transformations known among teleostean fishes. The transformation is so radical that in 1954, Tucker described an 8.4 mm giganturid larva as a different genus and species, *Rosaura rotunda* and placed it in a separate family, Rosauridae. The relationship between Rosaura and Gigantura remained undiscovered until the mid-1960's. Throughout ontogeny, the larvae change dramatically in their appearance. However, the metamorphosis happens in a short ontogenetic window, and the most striking challenge was to obtain enough larval specimens that are in critical stages. In addition to striking external changes in body shape and eye orientation, the jaws, gill arches, and pectoral girdle undergo radical reductions as well as topographic and structural changes. Here we present the initial stage of our study of the incredible developmental journey of Gigantura.

TUS7:1

IS CRITICAL SPEED OR IN SITU SPEED THE BEST MEASURE OF SWIMMING IN LARVAL FISHES?

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Larval marine perciform fishes have significant swimming abilities for much of their pelagic larval dispersal stage (PLD). This gives them the ability to directly influence their dispersal. However, there are several ways of measuring swimming ability, and in the context of dispersal, it is not clear which is the most appropriate. It is important to use the right swimming measure not only for modelling dispersal, but also for use in predicting both demographic and genetic connectivity. Recently, Nanninga & Manica (2018, MEPS, 589:1-12) concluded that for marine, demersal fishes "larval swimming capacities could serve as a powerful indicator of a species' long-distance dispersal potential", and were a better predictor than PLD. As their metric of swimming capacities, Nanninga & Manica used mean critical speed (U-crit), which is measured in a laboratory raceway by incrementally increasing flow until the larva cannot maintain position. The suitability of U-crit versus other swimming metrics, in particular *in situ* speed was examined here. Among-individual variability of swimming performance and ontogeny of swimming ability are important considerations. Data on swimming speed ontogeny from 10 species of 8 families show that U-crit and *in situ* speed were not well correlated. U-crit may be useful for comparing relative swim performance among species or ontogenetic stages if it is measured with the same sort of raceway. *In situ* speed is a more directly relevant measure of swimming performance in the context of dispersal.

WES1:2

JUVENILE RELEASE TO ENHANCE AND SUSTAIN FISH NATURAL POPULATIONS

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Biodiversity is declining, largely due to human activities. Habitat degradation, overexploitation, climate change, invasive species and pollution are recognized as the most influential. Many human activities in coastal areas, due to their strong economic influence, have led to an increasing urbanization of the coast. In Europe, and particularly in the Mediterranean shores, human activities have altered the coastline (e.g. harbors). A major consequence is habitat transformation and/or destruction, including the modification of the 3D habitat structure, recognized as a major threat to ecosystems and their functions. The consequence is the loss of its function for supporting associated marine organisms, notably the loss of potential areas for nurseries. A lack of suitable nursery habitat can restrict the recruitment of fishes and invertebrates, and increase juvenile risk of predation. One solution is the establishment of Marine Protected Areas (MPA). However, protecting large stretches of coastline is not always a feasible option. Alternative solutions of ecological restoration can be provided. The principle of post-larval capture and culture (PCC) considers that post-larvae result from natural breeding processes and have already undergone natural selection. As the PCC method occurs before post-larval settlement in nursery habitats, it provides a promisingly sustainable solution for protecting and recovering biodiversity. To mitigate further fishery and biodiversity declines, we propose to apply the PCC method to Mediterranean fisheries in the following process: (i) post-larvae captures with light traps, (ii) a rearing phase of post-larvae in aquariums to avoid high predation during settlement; (iii) subsequent release of reared juveniles. We present some preliminary results of external tag and visual recapture assessments, with 18 to 35% of recapture (UVC) after one month where natural survival between post-larvae and juveniles is typically less than 10%.

TUS3:2

MICROPLASTIC ABUNDANCE AND FREQUENCY OF INGESTION BY SARGASSUM-ASSOCIATED JUVENILE FISHES IN THE NORTHERN GULF OF MEXICO

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Microplastics are a growing concern in marine environments because they are durable, ubiquitous, and could be mistaken for food and ingested by small organisms. Microplastics are positively buoyant, and likely aggregate along convergence features on the ocean surface via atmospheric and oceanic processes (i.e. Langmuir circulation). Holopelagic Sargassum, a critical nursery habitat for many early life fish species, is often found in association with regions of convergence in the northern Gulf of Mexico. If microplastics are concentrated within Sargassum habitats, the risk of microplastic ingestion by early life fishes could be higher in Sargassum habitats relative to open water habitats. This could impact their health, survival, and recruitment to adult populations. To understand the impacts of microplastics in Sargassum communities, replicate neuston net samples were collected at the surface in the Gulf of Mexico from both Sargassum and open water habitats in July 2017. Microplastic abundance (mg m^{-2} of ocean surface) was compared between the two habitats, and stomach contents of juvenile fishes collected from Sargassum were examined for microplastics. Microplastic abundance was significantly higher in Sargassum habitats we sampled relative to open water habitats. Microplastics were identified in the stomach contents of many species. The microplastic frequency of occurrence (FO) in fish stomachs was taxon-specific, and ranged from 0-57%. Microplastics were found in the stomachs of several important fisheries species, including Mahi Mahi (FO=42.8%), Grey Triggerfish (FO=33.3%), and Amberjacks (FO=23.5%). Approximately 90.3% of the microplastics found in fish stomachs were small fibers. On-going research includes examining the impacts of microplastic ingestion on the gut microbiome of Sargassum-associated fishes. Results from this project may have implications for future fisheries-based management strategies for Sargassum and associated fishes in the Gulf of Mexico.

TUS3:8

**ANTHROPOGENIC INFLUENCES ON OTOLITH CALCIUM CARBONATE COMPOSITION
THROUGHOUT ONTOGENETIC DEVELOPMENT OF A FRESHWATER PRIMITIVE FISH
SPECIES**

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The effects of freshwater acidification in response to climate change are currently not well understood but are predicted to have consequences on the physiology and morphology of fishes, particularly at vulnerable early life history stages. Changes in temperature and pH are known to affect elemental incorporation rates into fish otoliths but little is known on how these environmental variables might influence otolith structure. Otoliths are calcified structures that form by the accumulation of biominerals deposited on a proteinaceous matrix in the inner ear of fish. Calcite, aragonite and vaterite are crystallized biomineral polymorphs of calcium carbonate (CaCO_3) and make up the primary composition of otoliths. Otoliths of primitive fishes, including sturgeons, were described as being composed entirely of vaterite. Recently, however, we demonstrated the otoliths of larval and juvenile Lake Sturgeon, *Acipenser fulvescens*, and White Sturgeon, *Acipenser transmontanus*, contained significant proportions of aragonite (43-98%). These findings were surprising given the ability to form aragonite in otoliths was previously thought to have first evolved in teleosts. It was unclear, however, if the observed proportional shift in CaCO_3 polymorphs was due to developmental changes or a physiological response to changes in environmental conditions. In this study we sought to quantify polymorph composition of otoliths via X-ray microdiffraction from larval and juvenile Lake Sturgeon when raised in varying temperature and pCO_2 conditions. Interestingly, pH had no effect on polymorph composition, however, fish raised in elevated temperatures had significantly different aragonite and vaterite proportions as well as inclusions of calcite crystals. These results indicate the ability to precipitate all three forms of CaCO_3 polymorphs is present in the earliest phylogenetic branch of actinopterygii countering long standing classifications of otolith composition among fish species.

WES4:6

FISH REPRODUCTIVE BEHAVIOUR: IMPAIRED BY GLOBAL CHANGES?

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Climate change and high levels of atmospheric CO₂ are changing our oceans. Through the increase of temperature and the decrease of pH, it is predicted that by the end of the century ecosystems and the species that inhabit them will be affected by these stressors. For a better understanding of the effects of these on species response, an experimental methodology combining stressors is the best approach. Here, we tested the effects of high CO₂ levels and temperature on the reproduction behaviour of a temperate marine fish, the two-spotted goby, *Gobiusculus flavescens*. This small pelagic fish, used as a model for temperate marine fish species, distributes from Norway to Portugal alongside the coast and is easily maintained and reproduced in captivity. The experiment had a full-factorial design, crossing two levels of pH (8.0 and 7.6) and two levels of temperature (present and 3°). Eight couples were exposed to each of the four treatments for a 3-month period. Reproductive output was analysed and parental investment assessed through several morphologic and behaviour analysis. Results suggest that both temperature and pH had an effect on reproductive output, although temperature seems to have a larger negative influence. Couples under higher temperatures produced less clutches and less eggs per clutch, than the ones under control conditions, however the size of the larvae at hatching didn't differ between treatments. On the other hand, males under low pH didn't seem to invest as much time on the defence of the nest. Although females in temperature and pH treatments invested greatly in reproduction, that didn't seem to translate in a higher reproductive output.

TUS9:1

**WHAT DOES SEX HAVE TO DO WITH IT? REPRODUCTIVE RESILIENCE AND
PRODUCTIVITY IN EXPLOITED MARINE FISHES**

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Perhaps the oldest question in fisheries science is how does spawning stock biomass (SSB) correlate with recruitment? Recent meta-analyses and estimates of effective breeding population sizes suggest the answer is, not very well. Yet the relationship of SSB to recruitment plays an important role in how we assess stock status and resilience. In this presentation, we outline the concept of Reproductive Resilience, defined as the capacity of a population to maintain the reproductive success needed to result in long-term population stability despite disturbances. A population's reproductive resilience is driven by the underlying traits in its spawner-recruit system, selected for over evolutionary time scales, and the ecological context within which it is operating. Traditionally, marine fish populations have been assumed to be relatively open and well mixed, with homogenous vital rates and stocks defined over large geographic scales. But this assumption is increasingly questioned, as technology provides new tools to assess spatial processes, movement ecology, and reproductive success. Most marine fish are pelagic spawners and use disparate habitat depending on life stage, with spawning site selection and diversity affecting later spatial components of the life cycle and the productivity and vulnerability of the stock to spatial disturbances, climate change, and fishing. Spotted seatrout, red drum, red snapper, gag grouper and red grouper are all highly fecund pelagic spawners but the spatial range of their life cycles differs, as does con-specific density at spawning sites, and spawning and nursery habitat. These traits, in turn, affect the resilience of these species to fishing and spatially-explicit stressors. In this presentation data from multiple studies on these species is integrated to demonstrate how reproductive resilience is species-specific and the importance of components, in addition to fecundity, typically not integrated into stock assessments.

TUS7:2

**LARVAL ORIENTATION BEHAVIOR BEGINS SHORTLY AFTER HATCHING AND MAY
CONTRIBUTE TO RESTRICTED DISPERSAL IN A CORAL REEF FISH**

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Most marine fishes disperse as tiny larvae that develop for several days to months in the upper water column before returning to settle in benthic habitats. Though once considered passive particles, it is now widely recognized that late-stage larvae can detect and orient their movements in relation to olfactory, visual, and auditory cues. These behaviors have the potential to influence the emergent pattern of larval dispersal, with important consequences for marine population dynamics and conservation. Yet, little is known about when larvae develop the ability to orient, or whether orientation varies with ecological context. Here, we present the results of a collaborative study to investigate the effects of ontogeny (Majoris) and ecological context (Foretich) on larval orientation behavior. We deployed lab-reared larvae of the neon goby *Elacatinus lori* offshore from their natal reef in a Drifting *In Situ* Chamber (DISC) designed to monitor and quantify larval orientation behavior. To investigate the ontogeny of orientation behavior, larvae were deployed every two days throughout development. We found that individual larvae oriented directionally at all ages. The proportion of larvae that oriented and the precision of their orientation did not improve with age. To investigate how orientation behavior varies with ecological context, larvae were deployed at multiple depths, distances from shore, and tidal phases within a narrow developmental window. We found that consistent orientation only occurred under specific ecological contexts. Taken together, our results suggest that neon goby larvae can orient from shortly after hatching, and may behave in ways which help to explain the relatively restricted pattern of dispersal for the species.

(Majoris and Foretich: Co-first Authors, Paris and Buston: Co-senior Authors).

TUS2:6

LABORATORY-BASED COMPARATIVE STUDIES OF THE EFFECTS OF ENVIRONMENTAL AND CLIMATE VARIABLES ON EARLY LIFE STAGES OF YELLOWFIN TUNA AND PACIFIC BLUEFIN TUNA IN PANAMA AND JAPAN

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The Inter-American Tropical Tuna Commission (IATTC) conducts research on the reproductive biology and early life history of yellowfin tuna (*Thunnus albacares*) at the Achotines Laboratory, Republic of Panama. Larvae hatched from eggs spawned at the Achotines Laboratory are routinely used in a variety of laboratory experiments designed to investigate the effects of key environmental and biological factors on pre-recruit survival. The Achotines Laboratory has also supported experimental investigations of the effects of climate change variables on early life stages of yellowfin tuna. In this presentation, experimental results from three major topics of yellowfin larval research will be discussed. These include studies of growth dynamics of larval and early-juvenile yellowfin, the effects of ocean acidification on larval yellowfin survival, and comparative studies of larval vital rates of yellowfin and Pacific bluefin conducted in Panama and Japan. Growth rates of larval yellowfin (3-16 mm SL) have been estimated in the laboratory and in situ. Growth rates have been estimated for all transformation and early-juvenile individuals reared in land-based tanks or a sea cage; the early-juveniles have ranged from 1.6-28.0 cm in length and up to 158 days after hatch. The effects of ocean acidification on larval yellowfin survival were investigated experimentally at the Achotines Laboratory. The comparative studies of larval yellowfin and Pacific bluefin tuna were conducted in Panama and Japan and included a comparison of larval growth and survival, vulnerability to starvation and timing of the onset of piscivory.

TUS2:11

**PHYSIOLOGICAL INDICATORS OF GROWTH: HOW GENOMICS CAN HELP US TO
BETTER UNDERSTAND CROSS x TRAIT IN COMMERCIAL FISHES?**

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An understanding of the physiology and mechanisms involved in the regulation of growth is essential in an aquaculture context to improve production. Understanding intra-population variability will improve the use of molecular markers in the development of selection programs. The main goal of this study was to deepen our understanding on regulators in which a selection ultimately acts. To do so, we used individuals issued from a breeding program launched in our facilities decades ago on brook trout *Salvelinus fontinalis* issued from a feral anadromous population. Thirteen selected and sixteen control families belonging to the fifth generation of this program were sampled (N = 4471 individuals including 2078 selected and 2398 controlled). At 1 of age, all the fish were weighed and measured. An analysis of the average weight of each family was done to determine the family performance in terms of growth. The four best and four worst performing families were chosen. Within each family, the eight individuals with the highest and the eight individuals with the lowest weights were sacrificed. The pituitary gland, brain, liver and white muscle were removed and placed in sterile tubes, frozen in liquid nitrogen, and stored at -80°C. In this tissue, we will evaluate the variability of the expression of some genes acting in the growth mechanism loop (brain: neuropeptide Y, somatostatin, and ghreline; pituitary: growth hormone GH and its receptor GHr; liver and muscle: GHr, IGF1 and IGF1r). The hypothesis tested is that gene expression levels of NPY, GH, GHr, IGF-1, IGF-1, IGF-1 r, somatostatin, and ghrelin will be higher in individuals from selected families thus enabling them to have greater growth potential. Finally, these results will be validated in relation to the weight-length data, calculating the Fulton condition factor (K) to determine the degree of well-being or robustness.

THS1:6

A MULTI-LIFE-STAGE APPROACH TO EXAMINE THE GEOGRAPHIC RANGE EXTENSION OF A MARINE FISH (SERRANIDAE: *Centropristis striata*) AROUND A BIOGEOGRAPHIC FAUNAL BREAK (CAPE COD, EAST COAST USA)

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It is believed that black sea bass (*Centropristis striata*) is extending its range northward, around Cape Cod, a known fauna break, and into a warming Gulf of Maine. Here, we examine the evidence from: 1) anecdotal reports, 2) spatial analysis (e.g., centroids of population distribution), and 3) a multi-life-stage approach, specifically plots of spawning females versus settled juveniles near Cape Cod. Anecdotal evidence - such as new state fishing records - is popular in the news but is still rather weak from a monitoring point of view, because historical records have reported this species in the Gulf of Maine since the 1930s. The use of spatial statistics has catalyzed attention that geographic shifts are occurring for a suite of species, but there are confounding factors, such as fishing effects or changing demographic rates that may cause the perception of shifts, rather than individual fish 'migrating' north en masse. Our use of multi-life-stage data examined the literature and data from two 40-year trawl surveys to confirm that black sea bass have spawned south of Cape Cod (Buzzards Bay and Nantucket Sound) since the 1880s, and that farther north (southern Gulf of Maine), spawning has likely occurred in the last 15 years. The northern distribution of settlement has increased about 1°N latitude over the recent four decades in association with warming sea temperatures in the southern Gulf of Maine. All three approaches have limitations in characterizing whether and how this northern expansion may be occurring, but each can be improved by considering survey designs and analytical details, for which we will list several recommendations. Black sea bass is likely a climate change 'winner,' where expansion at its northern range limit has been associated with increasing population size and fishery yields, so elucidating the mechanisms of this story is of broad interest.

THS8:2

DECIPHERING JUVENILE REALISED THERMAL NICHE OF LAKE TROUT BY SIMS HIGH-RESOLUTION OTOLITH $\delta^{18}\text{O}$ THERMOMETRY

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Water temperature selection in fishes is strongly regulated by physiology and behaviour. However, delineation of a species lifelong thermal niche, especially during early life stages, remains technically challenging. Lake trout (*Salvelinus namaycush*) survival and productivity are recognised as being tightly linked to thermal habitat. The factors guiding temperature selection during early life stages remain uncertain. In this study, we tested the significant factors controlling the realised thermal niche of juvenile lake trout from two small boreal lakes in southern Quebec. We used oxygen stable isotope ($\delta^{18}\text{O}$) thermometry of otolith calcium carbonates using single-ion mass spectrometry (SIMS). We investigated the thermal habitat of lake trout of known genotype. Ontogeny and genetics influenced temperature selection in both two Lake Trout populations. Young-of-the-year consistently used warmer, shallower habitats ($10.7 \pm 3^\circ\text{C}$, 7.5 m depth) before a juvenile transition to colder and deeper waters ($8.46 \pm 3.31^\circ\text{C}$). Stocked lake trout, exhibited a warmer and more variable thermal niche ($10.39 \pm 1.02^\circ\text{C}$). Their hybrid progeny also occupied a warmer thermal niche than local fish. This study demonstrated that high-resolution otolith $\delta^{18}\text{O}$ thermometry is a uniquely well-suited approach for unravelling the multiple factors that influence lifelong temperature selection in fish. Our results illustrate that the realised thermal niche is the result of a genetic-environment interaction and support fisheries management actions favouring the conservation of locally adapted behaviour.

TUS2:5

**LINKING SHORT-TERM PHYSIOLOGICAL MEASUREMENTS TO LONG-TERM CHANGES
IN POPULATION PRODUCTIVITY: THE THERMAL BIOLOGY OF ATLANTIC HERRING**

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Physiological measures can help identify thresholds in environmental factors causing changes in organismal-level performance. Relating these thresholds in a cause-and-effect manner, to long-term changes in the vital rates (e.g. growth, survival, reproduction) of field populations, can provide science advice needed to support conservation efforts. Here, we propose the use of thermal sensitivity of cardiac performance as a rapid screening tool to estimate temperature optima and upper tolerance limits in marine fish. Using Western Baltic Spring-Spawning herring as a case study, we identified the optimal and arrhythmia temperatures for cardiac function in larvae (16°C and 21°C, respectively). This optimal temperature was not significantly influenced by rearing temperature (7, 11 or 15°C). The number of days above this 16°C threshold during the herring spawning time (March-June) has significantly increased since 1992 in a major spawning ground for this population, especially during the last five years. The number of days >16°C was significantly related to the decreased annual production (recruitment index, 1992-2017). This finding suggest warming as partially responsible for the steady decline in annual productivity of this population over the past decade, and represent one of the first examples of the development and testing of a physiological-based ecological indicator for marine fish.

TUS3:3

TO FEED OR NOT TO FEED - THE CASE OF MICROPLASTIC UPTAKE IN JUVENILE SEABREAM

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An increase in the distribution and abundance of microplastic (MP) of terrestrial origin entering the marine environment has been observed over the past decades. As coastal ecosystems nowadays represent the gateway of MP pollution to the global ocean, it is hypothesized that early life stages (ELS) of commercially important fish species that rely on coastal habitats as nursery grounds face variable habitat quality and pollution levels, potentially influencing their survival and growth. According to the current scientific knowledge, direct ingestion as targeted food or mistaken prey items is the major pathway of MP uptake in fish. However, investigations on the effects of ingestion for ELS of fish are scarce, inconsistent and seldom incorporate both in-situ studies and laboratory experimental approaches. In this study the MP uptake by ELS of white seabream *Diplodus sargus* (Linnaeus, 1758) in a coastal lagoon system in Southern Portugal was assessed along with the spatial and temporal variability of MP pollution and habitat quality parameters. Findings from the stomach content analysis of wild-caught *D. sargus* were compared to the results of a laboratory MP feeding trial with the same species. In a novel approach, applying MP concentrations consistent with those found in the field, uptake preferences for natural prey items and either pristine or biofilm-coated blue polystyrene particles (size range 0.5 - 1 mm) were assessed. Initial results from the field and the experiments indicate that ELS of *D. sargus* take up artificial particles in low quantities. The experimental outcomes highlight the importance of performing MP feeding trials mimicking natural conditions in order to reliably evaluate the impact of MP on ELS. Moreover, it is suggested, that the potential implications of MP uptake on growth and condition of ELS need to be considered holistically, with the need to devote particular attention to species-specific feeding modes and intra-population variation.

THS11:3

**USING THE EARLY LIFE HISTORY STAGE IN THE DEVELOPMENT OF A CAPELIN
(*Mallotus villosus*) FORECAST MODEL**

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Forage fish are an important global fishery and occupy a key trophic position by linking plankton with larger marine species. Managing forage fish is problematic due to high spatial-temporal variation in biomass and strong responses to environmental variability. A variety of mechanisms have been proposed to explain variation in the biomass of the commercially fished Newfoundland capelin (*Mallotus villosus*) stock, including larval survival and timing of the retreat of sea ice (tice) via its effects on the spring bloom and adult feeding. These previous studies have focused on a single variable and none fully described the observed variation in capelin biomass in all years. Further, none of these approaches provided strong predictive power which is important for sustainable fisheries management. We analyzed a suite of models that explained capelin biomass from 2003-2017 and predicted capelin biomass through 2018-2019 using a Bayesian approach in a multimodel inference framework. The most parsimonious model included capelin larval abundance, tice, and capelin adult fall condition, and explained 68% of the variance in capelin biomass. The results are consistent with much of the literature that suggests forage fish are driven by bottom-up forces. This model allows us to produce in-season and 1 year forecasts of capelin biomass which is a valuable contribution to the management of this forage fish species.

WES3:9

**A FACTORIAL EVALUATION OF THE COMBINED EFFECTS OF ACIDIFICATION AND
HYPOXIA IN ATLANTIC SILVERSIDE OFFSPRING**

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Anthropogenic impacts are rapidly altering the physical conditions of marine systems. Under the combined effects of ocean acidification, warming, and eutrophication occurrences of coastal hypoxia and acidification are increasing in frequency and severity. Despite the recognition of this multi-stressor threat, the empirical evidence for combined effects of acidification and hypoxia on fish early-life stages is still scarce. This study reports on two factorial experiments that characterized the individual and combined effects of elevated pCO₂ and low dissolved oxygen (DO) in Atlantic silverside (*Menidia menidia*) embryos and early larvae. During both trials, offspring survival and growth consistently declined with DO level, but there were few additional effects of pCO₂. Mortality rates were high under hypoxic conditions but reduced survival was also detected under more modest DO reductions (~55% saturation). All low DO treatments resulted in significant sub-lethal effects that included smaller hatch sizes and slower post-hatch growth rates. Compared to the effect of low DO, effects of elevated pCO₂ were small and not significant for most traits. However, at 3 mg L⁻¹ DO a negative synergistic effect was detected where embryo survival under elevated pCO₂ (2,200 - 4,400 µatm) declined by ~30% relative to control pCO₂ levels (~400 µatm). These results demonstrate that *M. menidia* offspring are sensitive to DO levels well above operational hypoxia thresholds and conditions already seasonally prevalent in productive coastal habitats. Furthermore, the interactive effect on embryo survival suggests that acidified conditions increase the DO threshold for hypoxia-induced embryonic mortality.

TUS3:4

PHENOTYPE-DEPENDENT VARIATION IN MICROPLASTIC INGESTION RATES

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The ubiquitous occurrence and persistency of microplastics (MPs) in aquatic environments poses an increasing threat to marine organisms and ecosystems. Despite intensifying research efforts over the past years, however, we are still lacking a basic understanding of the biological effects of MP build-up on the world's oceans. This is true for even the most basic of questions, e.g.: To what extent do fish larvae actively ingest MP particles? While both field- and lab-based work has shown that fish larvae do ingest MPs, we know little about inter- and intra-specific ingestion rates. Here I show that inter-individual variation in MP ingestion in larval anemonefish is exceedingly high (ranging from 0 to 92% of the offered particles) even among closely related individuals. This variation was explained neither by size nor hunger-level, but may be driven to some extent by individual variation in behavioural traits (i.e. activity levels). Such non-random intra-specific variation in MP ingestion should be considered both in laboratory studies and assessments of potential population-level impacts.

THS1:5

SETTLEMENT VARIABILITY IN TIME AND SPACE: WHAT EUROPEAN PLAICE CAN TELL US.

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The term settlement in fish life history is not used in a uniform manner. In the case of flatfishes for instance, settlement involves the transition from a pelagic to a benthic mode of life, often occurring around the period of metamorphosis. On the other hand, in gadoids, the process is more protracted, involving a gradual shift from a primarily pelagic to a demersal mode of life. As such, quantitative studies on the settlement of fishes are difficult to execute well. Here we primarily draw on many studies on juvenile European plaice, *Pleuronectes platessa*, mainly from the Irish Sea to illustrate methods of studying settlement in fishes on to nursery grounds. We cover both the supply of settlers along with the processes involved in shaping the settlement patterns. We also, explore the use of theoretical models, field sampling for quantifying abundance and additional methods for determining the settlement patterns. We also explore the variability in settlement both over temporal scales (interannual) and over larger spatial scales.

THS8:1

**SESSION INTRODUCTION: ECOLOGICAL AND EVOLUTIONARY PROCESSES AFFECTING
FISH ELHS DISTRIBUTION AND SURVIVAL.**

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Fish can respond to environmental change in both plastic and (micro)adaptive ways. The ability and type of response will vary by species, populations, and stage. For example, species may quickly respond to environmental change by shifting their distribution in space (e.g. population distribution) or time (e.g. reproductive events). However, there are limits to these types of responses, imposed by the limiting requirements of different critical stages in a species' life history (e.g. early life history stages, ELHS). Combining eco- and evolutionary considerations in research can characterize potential responses to environmental change, and thereby identify vulnerable vs. resilient populations and species. Such pursuits can lead to more successful management strategies, as well as informing basic biological theory, particularly concerning trade-offs and ecosystem structuring. This session will explore how ecological and evolutionary processes on fish ELHS combine to characterize constraints and opportunities regarding a species' response to climate change. In this talk, we will introduce the session by presenting the eco-evolutionary research landscape regarding survival and distribution of fish ELHS and "setting the stage" for the contributed presentations to come.

THS11:7

**BRIDGE OVER TROUBLED WATER: ACHIEVING CONSERVATION AND FISHERIES
TARGETS IN A NETWORK OF MPAS AND OPEN ACCESS AREAS CONNECTED BY
LARVAL DRIFTERS.**

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Worldwide, coastal and marine ecosystems are being fragmented, subjected to biodiversity loss and to the over exploitation of many key marine resources as a result of multiple and cumulative human impacts. Addressing this global phenomenon requires effective implementation of sustainable marine resource management and the conservation of ecosystems. International panels like the Convention on Biological Diversity (CBD) have responded by requiring member countries to protect 10% of their coastal and marine areas by 2020. CBD targets should be ideally achieved through Marine Protected Area networks, understood as a collection of sites protected under variable restriction regimens that synergistically meet conservation objectives. To achieve this property, MPAs must be designed to allow for connectivity between spatially distinct areas so the network ensures population, genetic, community and/or ecosystem connectivity. Here, we use graph theory centrality measures to identify locations that should be protected in networks of MPAs connected by larval dispersion of early life stages of coastal species. MPA site selection is based on susceptible hydrodynamic, biological and ecological characteristics that contribute to marine population connectivity. Our results suggest that localities with higher productivity or larval recruitment do not always coincide with those that centrality measures, such as betweenness, highlight as the most important to maintain gene flow between sub-communities. Additionally, we highlight how individual biological features of organisms, such as vertical migration of larvae, and demographic processes associated with reproduction when interacting with hydrodynamic processes can modify larval connectivity between localities and the structure of the network of MPAs and OAAs.

WES5:5

ARE EPHYRAE OF *Pelagia noctiluca* IMPORTANT PREDATORS OF LARVAL TUNA?

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Large fishes such as bluefin tuna, *Thunnus thynnus*, and other related species, often migrate long distances to reproduce in relatively unproductive sites where the predatory pressure on eggs and larvae is thought to be low. However, such low predatory pressure remains largely unverified as the effect of planktonic predators such as gelatinous organisms has not been quantified. *Pelagia noctiluca* is the most abundant jellyfish in the Mediterranean Sea. Previous research has shown that fish larvae and eggs are important food sources of *P. noctiluca*, and that even early life stages like ephyrae can consume fish larvae. In fact, our preliminary observations revealed that densities of *P. noctiluca* ephyrae can reach up to 73 ephyrae m⁻³ in the Balearic waters during the tuna spawning season. Here we modeled the distribution and overlap of ephyrae and larval tuna in Balearic waters over six spawning seasons. Our field data shows that, although ephyrae densities rarely exceed 10 individuals m⁻³, larvae and ephyrae co-occur in over 46% of the sampled stations. These findings question current theories suggesting that predation pressure on early life stages of tuna in the Mediterranean spawning site is low due to a near-absent community of small filter-feeding fishes, and highlights a need to pursuing the hypothesis that ephyrae may exert important predatory pressure on early life stages of tuna.

TUS10:1

**RELEVANCE AND IMPLEMENTATION OF WAYFINDERS TO MODULATE DISPERSAL
KERNELS AND POP CONNECTIVITY IN BIOPHYSICAL MODELS**

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We have known for decades that the early life history (ELH) stages of fish are morphologically adapted for the reception of natural stimuli. But it is just in the recent years that we have seen an upsurge of interest in how these sensory capabilities influence their movement behavior, with studies documenting that they swim relatively fast, orient, and are sentient to olfactory, acoustic, visual, and magnetic cues. Fish larvae thus seem to have a tremendous capacity to actively influence their dispersal, potentially navigating their way to a place like home. Yet the dispersal consequences of the directional guidance from different cues has never been explored. More over, despite the fundamental role that the use of external compass can exert on larval dispersal and successful recruitment, orientation behavior is not typically considered in stochastic Lagrangian models developed for the study of their transport pathways and population connectivity. Here we develop new orientation modules for the open-source Connectivity Modeling System to quantify how swimming guided by sun compass, acoustic signal, and the Earth magnetic field, modulates dispersal kernels (DK) and connectivity networks for fish species with different pelagic larval durations (PLDs). We find that sun compass, combined with ontogenetic vertical migration, is most effective in decreasing dispersal distances and increasing settlement and self-recruitment. Surprisingly, PLD does not have a significant effect on the DK. This numerical study advances our understanding the "dispersive" ELH phase of fishes and of the critical role in structuring fish populations.

FROTH:4

**FATTY ACID PROFILE OF THE LIPID SAC OF POST LARVAL *Leptoclinus maculatus*
(STICHAEIDAE FAMILY) IN SVALBARD WATERS**

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A «lipid sac» is a physiological and biochemical adaptation of the Arctic demersal fish - the daubed shanny *Leptoclinus maculatus*. This is a unique provisional organ that accumulates a large amount of reserve lipids and maintains the buoyancy of pelagic postlarvae during its long-lasting (3-5 years) larval development. Individual fatty acids (FAs), their spectrum and indexes represent the nutritional needs and physiological condition of fish. This study focuses on the FA profile of storage (triacylglycerols (TAG) and membrane (phospholipids (PL)) lipids, collected from the "lipid sac" of post larval daubed shanny from Kongsfjord (Svalbard) during the polar night. FAs profile of lipid sac of the post larval was analyzed using the Equipment Sharing Centre KarRC RAS. TAG in the lipid sac of the pelagic L3 to L4 developmental stages were found to contain a high level of monounsaturated FA (70-74% of total FAs), among which 20:1n-9 (28%) and 22:1n-11 (27-29%) are trophic biomarkers of the zooplankton *Calanus* spp. Significant changes were observed in the FA profile of PL during the transition from the postlarval to the demersal stage, i.e., a decrease in the content of saturated FA (from 58 to 26% of total FAs) and an increase of monounsaturated FA (from 26 to 61%). Among polyunsaturated FA in the lipid sac the FA of n-3 family dominated; specifically, 22:6n-3 predominated in PL (<5%), and 18:4n-3 ($\leq 2.0\%$) - in TAG. The FA composition of storage and membrane lipids of the lipid sac shows postlarval dietary abilities and biochemical adaptation in the process of transition of pelagic postlarvae to demersal juvenile during the polar night in the Arctic. The research was made in the framework of the state assignment of the KarRC RAS No. 0221-2017-0050, by the RFBR No. 17-04-00466, and the Norwegian Research Council projects Timing of ecological processes in Spitsbergen fjords - SpitsEco (ES504895) and ArcticABC (No 244319).

WES5:1

DIVING INTO A PROBABILISTIC VIEW OF PREY-PREDATOR INTERACTIONS OF LARVAL FISH

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Feeding and mortality rates in larval fish are the outcome of the probabilities of encounter, attack and capture between prey and predator. The distribution of larval growth rates is the result of the physiological processes that turn ingested prey into tissue and any growth-selective processes that may result from predation. I used an extensive dataset of data collected from a sub-arctic ecosystem to reveal that the probability distribution of prey ingestion and larval mortality reflect similar underlying processes that are consistent with prey-predator interactions. Analyses of larval growth histories show similar probability distributions to those prey-predator driven interactions but with reduced variability in which the occurrence of extremes is considerably less likely than is apparent in ingestion rates. Age-dependent patterns of change in the variance-to-mean relationship of otolith growth increments indicate that the interaction between feeding/growth and mortality are complex and likely to vary depending on the abundance of both prey and predators.

TUS2:7

**PHYSICAL DRIVERS OF ABUNDANCE AND DISTRIBUTION OF JUVENILE FLATFISHES IN
SOUTHWEST ENGLAND**

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Commercially valuable flatfishes, such as plaice (*Pleuronectes platessa*), turbot (*Scophthalmus maximus*) and sole (*Solea solea*), rely on sandy beaches during their early life. The quality of these juvenile habitats can influence survival and growth of the juveniles, with knock-on effects on adult populations. Causes of variation in habitat quality are still largely unknown, however recent research suggests strong associations with the physical characteristics of the beaches themselves. This project aimed to determine the effects of wave climate, beach width, tidal range and sediment on juvenile flatfish communities across 17 beaches along the coastline of Southwest England. Sample beaches were selected to represent a wide range of physical properties in four discrete regions. Young of the year flatfish were collected from the surf zone during the months of May to September of 2018 using a 1.5 beam trawl. The trawl was pulled along for approximately 60 meters per tow. This was repeated six times per beach. For each beach the total number of flatfish were identified to species level and counted. In addition environmental data was collected on each occasion, including sediment samples and water parameters. Plaice and sole were more abundant at beaches on the Southern coast and inhabited more sheltered beaches with less wave action. They were also more abundant at beaches with lower average tidal range. In contrast, turbot were more prevalent on the North coast and on more exposed beaches with larger tidal ranges. This work has highlighted some potentially important factors involved in determining the distribution and abundance of these fish. It has also given us valuable new information regarding juvenile flatfish habitat in the Southwest of England as it is the first major survey of this kind that has been conducted in this area.

FRS8:7

**REDUCED PRODUCTIVITY OF A COMMERCIALY IMPORTANT FISH POPULATION: A
RESPONSE TO SHIFTING REGIONAL WINTER REGIMES**

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Shallow estuaries, bays and lagoons are hotspots of ocean productivity. In the temperate zones such systems often adjust rapidly to seasonal variations of atmospheric temperatures. Especially during springtime when biological reproduction processes begin, regional climate variability can be immense and uncovering biological response, such as fish recruitment, to changing temperature regimes, is a challenging task. Exemplarily for a response of coastal springtime productivity to regional climate drivers, we show how the annual timing of winter onset can significantly impact reproduction success of spring-spawning herring (*Clupea harengus*) in the western Baltic Sea. We show that a temperature threshold range of 3.5-4.5 °C triggers initial spawning. Based on this we applied model selection methods to a time series of seasonal sea surface temperatures and related the resulting best descriptor variables to annual reproduction success. The results reveal that a late seasonal winter onset contributed significantly to reduced larval production in a coastal nursery area and finally to a reduced abundance of juveniles in the entire distribution area. Using a combination of field research and modeling approach, we present a precedence for shifting regional winter regimes providing a present-day stressor to reproduction capacity of a central component of the coastal food web.

THS11:4

PELAGIC LARVAL GROWTH AND RECRUITMENT SUCCESS OF FLATFISH SPECIES IN THE MONDEGO ESTUARY

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Understanding the causes of variation in recruitment of marine fishes has been a central goal over the last century. The relationship between recruitment variability and larval growth and survival is poorly known for most species. In this study, we examined the effects of the variation in the early life characteristics (pelagic larval growth, pelagic larval duration, size-at-hatching and size-at-settlement) on post-settlement survival of flatfish species in the Mondego estuary over 5 years. Otolith analysis was used to back-calculate daily growth rates and other larval life history traits. Growth patterns during larval stage were investigated using forward-lag autocorrelation analysis. Results were related with the density of new recruits of flatfish species in the Mondego estuary during the 2011-2015 period. Growth revealed to be a good predictor for fish recruitment while interannual changes in the growth patterns seems to be related with the feeding success during early larval stage. This study highlights the larval life traits as tool for predict recruitment, thus its importance for the management of resources.

WES5:6

**OCCURRENCE OF ICHTHYOPLANKTON IN AUTUMN HERRING DIETS OF EASTERN
NEWFOUNDLAND**

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Capelin is the keystone forage fish in the Northwest Atlantic ecosystem where it is a conduit of energy from lower to higher trophic levels. The capelin population collapsed in the early 1990s with minimal recovery in the subsequent three decades. Atlantic herring, an inshore forage fish in the region, is a known predator of the early life stages of fishes. In the Barents Sea, herring predation is a major driver of capelin recruitment dynamics. Atlantic herring diet in eastern Newfoundland has not been assessed since the 1940s. The objective of this study is to describe the diet of herring in autumn, a period of potential temporal and spatial overlap with capelin larvae, by pairing stomach content and stable isotope analyses. Adult herring were sampled weekly from August to November of 2017 and 2018 in Trinity Bay, Newfoundland. Stomach contents were identified to the lowest possible taxonomic level. Muscle samples were analyzed for stable isotopes and the results compared with signatures from neighboring bays, collected between 2012 and 2017. Preliminary results from the 2017 stomach samples (n=340) indicated that the most frequently consumed prey items included copepods (primarily *Temora* spp.), decapod larvae, cladocerans, and the early life stages of fishes (eggs, larvae and juveniles). Of the fish larvae found in the stomachs, the majority were identified as capelin while loose otoliths were primarily from gadids. We anticipate that the results from 2018 will generally reflect similar prey composition as 2017 but possibly with a smaller contribution of larval capelin due to low larval numbers observed in the fall ichthyoplankton surveys. As 2018 data becomes available, we will compare the results between years and neighboring bays, as well as distinguish the long-term contribution of pelagic and benthic prey to herring diets.

TUS12:1

**SPECIES COMPOSITION AND DIVERSITY OF FISH LARVAE IN SRI LANKAN WATERS
FROM A COMBINED MORPHOLOGICAL AND DNA BARCODING APPROACH**

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Species composition and diversity of larval fish in Sri Lankan waters were studied using Multinet Mammoth (1 m²) net samples (300 µm) during June-July 2018. Even though the information of early history of fishes is vital in fisheries management, Sri Lankan waters have been poorly described and no comprehensive studies have been previously conducted. The total of 1106 fish larvae collected has been assigned to more than 50 families based on their morphometric and meristic characteristics. Fish family composition and diversity varied among the regions. The North East region was predominated by pelagic and mesopelagic fish families, i.e. Engraulidae, Nomeidae and Bregmacerotidae. The Central East region was mainly dominated by pelagic families, i.e. Engraulidae, Scombridae and Carangidae. South East and South West regions were dominated by demersal families such as Lutjanidae, Bothidae and Tetraodontidae. Furthermore, in the Southern and North West regions were mainly dominated by mesopelagic fishes, among myctophids were the most abundant larvae. Further validation of larval families as well as identification of some of the individuals to species level was carried out using DNA barcoding, which has been proven to be a powerful tool for studying biodiversity of fish larvae. The results from the combined methods so far indicate not only a high species diversity, but also gaps in the databases when searching for DNA sequences in Sri Lankan fish. Therefore, the remaining fish larvae collected by Multinet samples will be sequenced to be assigned to higher taxonomic levels. This increased knowledge on species composition and diversity of larval fish is useful for sustainable management of fish resources and marine environment.

TUS3:1

FISH LARVAE AND MICROPLASTICS IN AN URBAN ESTUARY: TEMPORAL AND SPATIAL PATTERNS OF THE RATIO FISH LARVAE : MICROPLASTICS

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Several marine species use estuaries as nursery grounds, profiting from the high food availability and sheltering to maximizing the survival of early life stages. The initial stages of fishes are highly vulnerable to natural environmental conditions, with an increasing vulnerability to several anthropogenic pressures, as overfishing, environmental stress, and pollution. Microplastics (MPs), i.e. plastics < 5mm, are emergent contaminants and their increasing amount in the aquatic environments has raised major concerns about their impact in planktonic communities. MPs can pose several risks to fish larvae, including physical or chemical injuries derived from MPs ingestion, and ecological effects impacting the overall community. The present work aimed to investigate the dynamics of the ratio between fish larvae and MPs in an urban estuary (Douro estuary, NW Portugal). Monthly sampling surveys were performed from December 2016 to December 2017, in nine sampling stations along the horizontal salinity gradient of the estuary, with a 500 µm mesh-size planktonic net. Samples were sorted, and fish larvae identified to the highest taxonomic level possible. MPs were quantified using the NOAA protocol adapted for estuarine waters. Gobiidae, Clupeidae and Soleidae were the most abundant families and the Douro estuarine larval fish assemblages was highly dominated by few but abundant taxa, as the common goby, *Pomatoschistus microps*. A total of 2.152 MPs particles was collected, with a mean abundance of 17.06 MPs 100 m⁻³, surpassing the mean abundance of fish larvae 11.66 fish larvae 100 m⁻³. In fact, results showed a concerning overall ratio of 1.0 fish larvae : 1.5 MPs. Although the peak larval fish abundance did not coincide with peaks of MPs in time or space, such results highlight the need to further our understanding on the biological and ecological effects of MPs pollution in early life stages of fishes.

WES3:16

**RESEARCH ACTIVITIES AT THE INTER-AMERICAN TROPICAL TUNA COMMISSION
ACHOTINES LABORATORY**

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The Inter-American Tropical Tuna Commission (IATTC) conducts research on all life stages of tropical tuna, both in the lab and in situ, at the Achotines Laboratory, Republic of Panama. Achotines Laboratory is the only research facility in the world with captive broodstock tuna that have been spawning on a near daily basis for more than two decades. Yellowfin tuna (*Thunnus albacares*) collected from local coastal waters at 1 year of age and held in a 1,300 m³ in-ground concrete tank are reared to reproductive size in 6-9 months. Yellowfin tuna eggs, larvae and juveniles resulting from those spawns are used for a variety of studies. Wild-caught late-juvenile and adult tuna are also maintained in captivity for research purposes. In addition to research carried out by IATTC scientists, visiting scientists from other institutions and entities around the world travel to Achotines Laboratory to utilize the extensive research facilities. Recent partners include Kindai University, the International Seafood Sustainability Foundation, AZTI Tecnalia, Texas A&M University, the University of Miami, and the Tokyo University of Marine Science and Technology. A review of recent joint research projects will be presented as will preliminary results from some of these activities.

WES3:15

**INFLUENCE OF SEAGRASS HABITAT STRUCTURE ON THE GROWTH OF JUVENILE
ANNULAR SEABREAM**

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With increasing anthropogenic activity, there is concern about overall habitat loss via fragmentation and what effects this may have on local biotas relying on seagrasses. In this study, otolith microstructure techniques were used to determine individual growth rates of recently settled (year-0) annular seabream, *Diplodus annularis*, in areas with different seagrass cover and complexity (shoot density and canopy height) in Mallorca. The annular seabream is a resident of *Posidonia oceanica* meadows and is a primary component of the recreational fishery throughout the Balearic Islands. Variation in seascape composition can affect access to food resources and/or predators, possibly influencing post-settlement growth and mortality, and subsequently adult population structure. Fish that experience decreased predation risk or higher access to food may have faster growth rates or are in better condition. Here, we compare the size (otolith radius) at settlement and juvenile growth (mean otolith increment width) during days 0 - 20 post settlement in juvenile *D. annularis* individuals (5 - 6 cm TL) in areas with different seagrass complexity in Palma Bay, Mallorca. We hypothesize that growth rate among surviving juveniles will be higher in seagrass beds with higher habitat complexity. Understanding how the surrounding seascape affects individual-based measures of habitat quality, like condition or growth, may provide useful information regarding optimal fish habitat.

TUS10:3

**ESTIMATES OF FOOD LIMITATION EXPERIENCED BY PELAGIC FISH LARVAE IN THE
GULF OF MEXICO**

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In the ocean, mortality is known to largely dictate the fate of larval fish. Starvation is considered to be a dominant contributor to pelagic larval mortality in oligotrophic spawning regions where zooplankton biomass is low and highly variable. Particularly, starvation is thought to widely occur during the critical period when larvae switch to exogenous feeding exclusively. Estimates of starvation provide a way to evaluate environmental impacts, such as a warming ocean, on larval fish given that zooplankton and the underlying lower trophic level are intimately connected to local hydrodynamic conditions. Estimates of starvation also have the potential to greatly improve our ability to predict fluctuations in larval survival and recruitment. In order to evaluate larval fish susceptibility to starvation we configured a coupled physical-biogeochemical ocean model of the Gulf of Mexico and developed a methodology to quantify food limitation based on model zooplankton abundance and larval metabolic requirement estimates. Model zooplankton abundances are validated against, and agree well with, an extensive multi-decadal zooplankton database in the Gulf of Mexico. Based on model zooplankton fields we find that food limitation rarely occurs on the inner shelf, however, in the oligotrophic Gulf of Mexico the model resolves the full spectrum of food deplete and replete conditions. Coupling to an individual-based lagrangian fish model enables investigation of explicit starvation-driven mortality throughout the pelagic larval duration. Ocean modeling tools such as the ones used in this study have the potential to help better resolve the stock-recruitment relationship in fishery assessment models. Further ocean modeling studies that examine zooplankton and the resulting prey fields for larval fish are invaluable for predicting impacts of future environmental perturbations on larval survival and subsequently global pelagic fish stocks.

WES3:13

OCEAN ACIDIFICATION AFFECTS SURVIVAL OF HERRING LARVAE VIA FOOD WEB ALTERATION

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Future changes of the ocean, such as warming, acidification and anoxia were shown to directly affect a wide range of marine organisms. Since marine organisms interact in complex communities, each direct effect may in turn influence other species indirectly via the food web. The combined direct and indirect effects of ocean acidification were assessed in two mesocosm studies, where pelagic communities up to fish larvae were enclosed for several weeks and manipulated with CO₂ concentrations projected within the next hundred years. The first mesocosm study was performed in the Gullmarsfjord, Sweden from January to June 2013, while the second study took place from May to July 2015 in the Raunefjorden, Norway. In the first study, an enhancement of primary production in the ocean acidification treatment was mirrored by an increase in zooplankton abundance, which served as prey organisms for the herring larvae. After six weeks, herring larvae survival was significantly higher in the elevated CO₂ mesocosms (~760 µatm pCO₂) compared to the ambient CO₂ mesocosms. The second mesocosm experiment with CO₂ levels of ~2200 µatm pCO₂ confirmed the higher herring larvae survival at elevated CO₂, although overall survival rates were much lower than in the previous study. This time, however, no obvious CO₂-induced enhancement of primary and secondary production was observed. Possible explanations for the higher herring larvae survival under elevated CO₂ in this experiment could be lower competition and predation by gelatinous zooplankton. Results of herring larval survival from both studies will be discussed in the context of food web effects of ocean acidification and will be used as "food for thought" to highlight knowledge gaps regarding species interactions in ocean acidification research.

FRS8:6

DENSITY- AND SIZE-DEPENDENT MORTALITY IN FISH EARLY LIFE STAGES

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The importance of survival and growth early in life for population dynamics depends on the degrees of density- and size-dependence in survival at later life stages. Quantifying density- and size-dependent mortality at different stages is therefore important to understand and potentially predict the recruitment to the population. We apply a statistical state-space modelling approach to analyse time-series of abundance and mean body size of early life stages of fish. The focus was to identify the importance of abundance and body size for growth and survival from one life stage to the next, and to quantify how the dynamics propagate through the stages to influence recruitment. We thus identify both relevant stages and mechanisms (i.e. density- and size-dependence in survival and growth) linking recruitment variability to early life dynamics. The analysis was conducted on six economically and ecologically important fish populations representing four species from four sub-arctic marine ecosystems. Our results underscore the importance of size for survival early in life. The comparative analysis suggests that size-dependent mortality and density-dependent growth frequently occur at a transition from pelagic to demersal habitats, which may be linked to competition for relatively low-predator feeding space. The generality of this hypothesis warrants testing in future research.

TUS9:2

**3-DIMENSIONAL ADVECTION, DIFFUSION, AND MORTALITY OF EGGS AND LARVAE
DISPERSING FROM A NASSAU GROUPEL (*Epinephelus striatus*) SPAWNING
AGGREGATION OBSERVED WITH A NOVEL PLANKTON IMAGING SYSTEM**

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Fisheries biologists' quest to disentangle the roles of fishing from the environment often centers on understanding recruitment, as it largely determines fluctuation in adult abundance. Recruitment variability is driven by physical-biological processes that mediate the survival and dispersal of egg and larval stages. In addition, the degree of self-recruitment and population connectivity via larval dispersal is important to the population dynamics and spatial management of fish with limited adult movement, e.g. tropical reef fish. For all of these reasons, understanding the fate of eggs and larvae is a critical part of efforts to characterize population processes. Satellite-tracked drifter releases and physical-biological models are frequently applied to study dispersal, but their assumptions often go untested without direct field data of egg and larvae distributions. In this study, we demonstrated the ability of a novel in situ plankton imaging system to observe the 3D positions of individual eggs and larvae around drogued drifters. The egg and larvae images were of sufficient resolution to clearly distinguish development stages. We then used these fine-scale spatiotemporal data to statistically fit parameters of a 3-dimensional diffusion-mortality model for two cohorts of Nassau Grouper eggs as they dispersed following spawning in 2017. Finally, we used our estimates of diffusivity and mortality to predict the spread of eggs and larvae around previous years' drifter tracks in order to evaluate the possibility of self-recruitment. Our results confirm that drogued drifters track eggs at least until hatching (23-26 hours), and suggest self-recruitment as a possible mechanistic explanation for the strong 2011 year class of Nassau Grouper on Little Cayman.

WES3:14

**HUMAN IMPACTS ON SHALLOW-WATER FISH NURSERIES IN SOUTH AFRICA:
CHANGING PARADIGMS AND POLICY**

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Coastal fish nurseries are vital to the survival of early life history stages of fishes on the temperate coast of South Africa. Contemporary research has shown that nursery use is complex and many habitats are understudied. Ocean spawned fishes use a plethora of nurseries that often transcend traditional intra-disciplinary boundaries. Marine spawned fishes enter coastal areas where they have the ability to utilise a variety of niche types, often able to vary habitat use within species to reduce competition. Fish movement extends into rivers, where an abundance of larval insect prey have been identified in early stage marine fish diet. However, the larval and juvenile stages of marine and estuarine fishes that are using the coastal nursery mosaic are impacted on by a range of threats transcending traditional habitat boundaries such as reductions in freshwater supply to rivers and estuaries, pollution, barriers to migration for marine fishes in rivers, introduction of freshwater invasive species that collectively impact on the survival of fishes using multiple nursery areas. Overfishing, intricately coupled with impoverishment and the lack of resource use enforcement in nursery areas compounds the survival to adulthood. Intrinsic bias in scientific surveys and literature have created a setback in understanding coastal linkages which is exemplified by the critical shortage of legislation covering nursery mosaics from oceans to estuaries and rivers.

TUS2:10

**IMPLICATIONS OF A TIDALLY MODULATED RIVER PLUME ON FINE-SCALE LARVAL FISH
TROPHIC INTERACTIONS**

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Tidally-controlled river plumes form distinct frontal boundaries that can change the spatial distributions of zooplankton. By altering spatial overlap between zooplankton taxa, these frontal boundaries have the potential to influence trophic interactions at the base of marine food-webs. Because many traditional sampling techniques cannot resolve fine-scale zooplankton distributions and spatial overlap, the physical effects of tidally-controlled river plumes, such as the Columbia River Plume (CRP), on larval fish trophic interactions remain poorly understood. Here, we use the In situ Ichthyoplankton Imaging System (ISIIS), to examine changes in the fine-scale horizontal and vertical distribution of larval fishes and their zooplankton prey and predators over a CRP ebb and flood tide series. Two ~26-km cross-plume transects were sampled in June 2016, each capturing plume, frontal, and oceanic water masses from the surface to ~50m depth. Temperature, salinity, fluorescence, and oxygen values varied greatly ranging from 7.57 to 16.44 °C, 16.2 to 35.61, 0.03 to 0.8 volts, and 1.67 to 7.83 mL L⁻¹, respectively. In total, 161 plankton groups were identified including multiple larval fish taxa and prominent prey (e.g., copepods) and potential predators (e.g., gelatinous zooplankton and chaetognaths). We observed distinct spatial distributions of zooplankton taxa in the flood and ebb tides with all taxa occurring more frequently below the fresher plume waters. Larval fish showed a particularly marked transition with no fish present in salinities <30. These findings suggest that larval fish, their prey, and their predators may be vertically compressed on short time scales in this region which may result in altered trophic interactions over the duration of a flood ebb tide series.

THS1:7

**PERCH LARVAE (*Perca fluviatilis* L.) DISTRIBUTION AS A SPAWNING SITES INDICATION
IN THE SZCZECIN LAGOON, BALTIC SEA**

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The Szczecin Lagoon, divided into the Great Lagoon (the Polish part) and the Small Lagoon (the German part) by a narrowness, constitutes a significant part of the Odra River estuary area (Baltic Sea). It is a highly productive and efficient reservoir, despite its polutrophic status and significant pollution. Its coastal areas are the spawning ground and the nursery areas for many fish species. However, so far, there is little hydrobiological and ichthyological data on coastal areas used by fish for reproduction. There are some works describing the location of the spawning grounds of pikeperch of the Szczecin Lagoon, but they relates to various periods of the last century, and there is no publication on perch. The aim of this study was to determine the location of spawning grounds of perch in the Polish part of the Szczecin Lagoon, based on the distribution of early stages of fish, with reference to local environmental conditions. The ichthyoplankton surveys in 2013-14 and 2017-18 was conducted at stations around the central basin of the Szczecin Lagoon at 2 - 4,5 m deep. Perch larvae at the earliest stage of development, were caught at most of surveyed sites but their abundance differed during years. The collected material allowed to determine the places used by perch for reproduction.

TUS12:2

**A CONCEPTUAL FRAMEWORK FOR EARLY LIFE STAGES OF FISHES TO STUDY
HETEROCHRONIES AND STAGE TERMINOLOGY**

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Consistency of biological concepts and the associated vocabulary is not just about naming species (i.e. segments of a genealogical process). It is also about naming parts (or attributes) and life stages (i.e. segments of an ontogenetic process). Ontogenetic stages have been diversely defined for teleosteans in the course of the history of biology, ichthyology and aquaculture. When comparing among species, robustness of those stages have not yet been tested facing missing data and possible developmental heterochronies. A new and simple conceptual framework is proposed to measure heterochronies among species and evaluate their impact on terminology. The method can also be used to assess robustness of terminologies (facing missing data) and ensure consistency of life stages across species, and/or to produce nested sets of positively defined stages. The outcomes are both fundamental in comparative anatomy and developmental biology, and applied, in fisheries and aquaculture. This new framework is applied to a few freshwater fish species displaying divergent life history traits to illustrate its potential.

WES12:5

SKELETAL DEVELOPMENT OF *Mugil cephalus* (MUGILIFORMES)

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The skeletal development of mugiliforms is poorly studied, despite them being a worldwide distributed taxon, which was in the focus of several studies: the ecology of several species as well as the general larval development were previously studied and are well known. The development of the skeleton, however, was overlooked for a long time. With new approaches to artificial rearing of mugilids, the necessary larvae for such a study are now available. Based on developmental stages of *Mugil cephalus*, we examined the development of the skeleton. In a first step we focused on selected skeletal complexes, i.e. caudal fin, dorsal fins, pectoral and pelvic girdle. These complexes were chosen in the context of traditional morphological and recent molecular phylogenetic hypotheses which largely disagree in the position of mugilids. The (recently erected) taxon Ovalentaria now comprises different taxa formerly widely separated throughout the percomorphs. Within the Ovalentaria Mugiliformes have no well-supported position and many other taxa are candidates for being their possible sister-group. Our approach was to collect data from the osteological development of mugiliforms and related taxa to provide more information to this issue and to test existing hypotheses. The development of the dorsal fins could play a key role as similar adult conditions are present in mugiliforms and atheriniforms, a taxon formerly closely associated with the Mugiliformes (based on other morphological data/characters). Another focal character complex is the pelvic girdle ? here mugilids show a more general percomorph condition much different from atheriniforms. First results look promising and will help understand the evolution and phylogeny of the Mugiliformes.

TUS3:6

EXPLORING FACTORS THAT HAVE SUPPRESSED RECENT RECRUITMENT LEVELS IN NORWEGIAN SPRING SPAWNED HERRING. ARE THE CLUES IN THE FIELD STUDIES?

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The Norwegian spring-spawning herring (NSSH, *Clupea harengus*) has been experiencing vast fluctuations in spawning stock biomass (SSB). While reaching 16 million tonnes in the 1940s, this stock declined to only a few thousand tonnes, partly because of low recruitment success, but particularly due to severe overfishing in the 1960s, including on young individuals. Recovery was facilitated by restrictions on the fishery and an exceptionally successful recruitment of the 1983-year class. The stock is currently classified as at full reproductive potential with an SSB of around 4 million tonnes, but the lack of a large recruiting year class since 2004, which is as of yet unexplained, is partially responsible for the recent stock decline. Here, we examine larval and postlarval NSSH survey data between 1981 and 2016, along with associated climate fluctuations, with the intention of gaining a better understanding of recruitment dynamics. A constant warm state of the Norwegian Sea since 2002 corresponds to low NSSH recruitment years indicating similar dynamics of other small pelagic fish stocks. Due to the prolonged warm state in the Norwegian Sea associated with increasing ocean temperatures give rise to the apprehension that the NSSH stock may suffer on a long term. The principle focus of this work is to detect abiotic and biotic explanatory factors likely underlying the apparent reduction in survival of early life history stages and the lack of any strong year classes since 2004.

TUS10:4

DISTINCT OTOLITH MICROCHEMISTRY SIGNATURES OF LARVAL CAPELIN (*Mallotus villosus*) FROM NEWFOUNDLAND AND NUNAVUT

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A major breakthrough in the ability to discriminate among larval populations of varied natal origin was the discovery of daily sequestering of elements in the three pairs of fish otoliths. The chemical composition of ambient water primarily influences otolith chemistry in larval fish; however, maternal contributions, and environmental gradients (e.g., temperature, salinity) can confound our ability to identify the natal origin of larvae. These confounding factors suggest that larval otolith chemistry would be more successful at distinguishing individuals from populations that are more geographically separated where concentrations of ambient trace elements are more likely to differ. The goal of this study was to determine if otolith microchemistry could be used to distinguish the natal region of larval capelin (*Mallotus villosus*), amongst spawning regions on the east (Trinity Bay: 2018) and northeast (Notre Dame Bay: 2014, 2015) coast of Newfoundland as well as Pangnirtung Fjord in Cumberland Sound, Nunavut (2015). A field-rearing experiment was conducted, whereby eggs were reared in canisters at their natal spawning sites within each region. Once hatched, larvae were collected and sagittal otoliths removed. Trace element concentrations were determined using Laser Ablation Inductively Coupled Plasma-Mass Spectrometry (LA ICP-MS) and concentrations of both essential (Mg, Mn, Zn) and nonessential trace elements (Sr, Ba) were quantified. Otolith concentrations of Ba and Mg were significantly higher in larvae from Newfoundland relative to Nunavut, but Sr and Zn were significantly lower. These differences resulted in differing chemical signatures among larvae raised in the three regions. Characterizing region-specific otolith chemical signatures that reflect natal origins of capelin larvae is the first step in determining region-specific productivity, habitat use and connectivity between source and sink populations.

FROTH:5

SAMPLING THE EARLY LIFE HISTORY STAGES OF FISHES

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Over time many different gears have been developed for sampling early life history stages of fish. These gears have been developed for sampling a specific life stage, i.e. eggs, newly hatched larvae or fully developed larvae. The development of the gears has also been dependent on the circumstances sampling could be conducted, i.e. size of the vessel, speed of sampling, summer versus winter or day versus night sampling. Over time, the gears have also been used for collecting early life stages for which they were not originally designed to sample. The question arises whether the gears currently used for collection of data, which is used as the basis for management decisions, are efficient in catching the desired life stage. In this presentation, catchability of different gears is tested against each other and for the different early life stages. For North Sea herring different surveys use different gears to provide information on a number of different early life history stages. These data are compiled into indices for the assessment and ultimately the management of the stock and spawning components. Over time the gears have also changed for various reasons. One fundamental question is whether these long-time series indices are actually representative of the life history stage they have been developed for. Can the management of the stock be improved if the catchability of the different gears would be taken into account? This presentation will provide information on performance and catchability of relatively slow- and high-speed sampling gears.

FROTH:1

WE GOT IT, SO WE ARE DOING IT: COMPARATIVE ANALYSIS OF THE EARLY LIFE STAGES OF FRESHWATER FISHES BASED ON THE STOREFISH DATABASE

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Climate change is impacting freshwater fishes that are essential to ecosystem function and food security, but have limited options for temperature regulation or dispersal. Understanding, predicting, and mitigating climate change impacts on freshwater fishes requires knowledge of how vulnerable life stages such as eggs and larvae respond to temperature, and how these responses vary among populations and species. Such information is available for 80 European fishes through the STOREFISH (STrategies of REproduction of FISH) database (est. 2005), and has been used to publish research into reproductive strategies and potential climate change impacts. However, an equivalent database does not exist for North American freshwater fishes. In this context, we received a two-year (2018-2020) grant from the Thomas Jefferson Fund to expand STOREFISH by ~100 freshwater species (~20 from Europe and ~80 from North America). We are particularly interested in the 14 early life history traits in STOREFISH that are most relevant to this project, and will then re-visit the comparative analyses that have been conducted on European species to identify similarities and differences in thermal biology and expected climate change impacts. We will present the results of our efforts so far, including joint seminar courses at our respective institutions, research visits, an overview of the work that has been conducted by our students, and - if we have time between the abstract deadline and the conference - some preliminary analyses.

FROTH:2

**COMMUNITY ASSEMBLAGE STRUCTURE AND VERTICAL DISTRIBUTION PATTERNS OF
DEEP-PELAGIC ICHTHYOPLANKTON IN THE NORTHERN GULF OF MEXICO**

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The early life stages of deep-pelagic fishes play a critical role in pelagic food webs and oceanic carbon cycling, yet little is known about the composition and distributions of larval fishes in the northern Gulf of Mexico (nGOM) beyond the epipelagic (< 200 m). The deep-pelagic plankton cruises conducted during the Natural Resource Damage Assessment following the Deepwater Horizon oil spill provide an unprecedented opportunity to study mesopelagic ichthyoplankton dynamics in the nGOM. These data will improve our understanding of baseline conditions in the deep-pelagic, which will be invaluable for anticipating the effects of future environmental perturbations. Here, we describe the community composition and vertical distribution patterns of mesopelagic ichthyoplankton in the nGOM from six deep-pelagic plankton cruises conducted in 2010 and 2011, sampling 48 stations with depth-discrete net tows (> 1,000 m). We examined seasonal and spatial patterns in abundance and assemblage structure, and assessed the environmental drivers of horizontal and vertical larval distribution. Myctophidae, Gonostomatidae, Sternoptychidae, and Phosichthyidae accounted for 97% of the total larvae > 200 m. Larval fish assemblages in the nGOM varied by season and depth, and most differentiation among mesopelagic populations was attributed to the dominant taxa. Mesopelagic fish larvae were abundant in the epipelagic during both day and night, and do not appear to display the extensive diel vertical migration behavior characteristic of later life stages. These analyses aim to fill key gaps in knowledge about the distributions of deep-pelagic larval fish in the nGOM and the biophysical drivers that structure them. Our results will be incorporated into a data-driven vertically resolved ecosystem model for the nGOM, which will help to elucidate the role of deep-pelagic functional groups in the transfer of energy from mesopelagic to epipelagic food webs, which support numerous fisheries.

TUS3:7

EXPOSURE TO HARMFUL ALGAL BLOOMS IMPAIRS PREY RECOGNITION AND FORAGING SUCCESS IN A LARVAL FRESHWATER FISH

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Cyanobacteria are prevalent blue-green algae that have adverse impacts on both human health and the environment. At least 8 classes of toxins produced by cyanobacteria have been identified with the potential to affect organismal physiology and function. Of these, β -N-methylamino-l-alanine (BMAA) and its isomer 2,4-diaminobutyric acid (DABA) are potent neurotoxic metabolites of interest because they are a risk factor for neurodegenerative diseases in humans. However, sensorimotor integration is also critical to the successful survival and reproduction of resident aquatic organisms, and these neurodegenerative cyanotoxins have the potential to modify the expression of simple and complex behaviors within individuals and the outcomes of interactions between individuals in aquatic environments. One way that this can happen is through changes that compromise an organism's ability to correctly perceive, process and respond to relevant biotic stimuli (e.g., predators, prey, or mates). In this study, we examined the effects of DABA on the foraging behavior of a larval fish (*Promelas pimephales*). We exposed larvae to a range of environmentally-relevant concentrations of DABA for 21 days. We then tested larvae in prey-capture assays to assess the effect of neural disruption on the outcomes of predator-prey interactions and recorded individual prey strikes using a high-speed camera to assess changes in both the cognitive and motor aspects of hunting behavior. Compared with nonexposed fish, exposure to DABA was associated with reduced foraging success and changes in the ability of larvae to recognize prey. These data improve our understanding of how aquatic contaminants affect stimulus-response pathways through their effects on brain function and suggest that even subtle contaminant-induced shifts in perception, processing, or response can have marked effects on fitness.

WES12:7

**THE LATERAL LINE SYSTEM OF LARVAL TELEOSTS: NEW PERSPECTIVES ON
STRUCTURAL AND FUNCTIONAL DIVERSITY**

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The sensory systems of larval teleosts follow ontogenetic trajectories that are punctuated by shifts that may be linked to changing sensory demands associated with life history transitions. The neuromast sensory organs of the lateral line system of larval fishes have been shown to be sensitive to unidirectional and low frequency water flows arising from prey and predators, and are thus critical for survival. They initially form early during the larval period and increase in number, typically forming lines on the head and trunk. At the end of the larval period a subset of these neuromasts becomes enclosed in bony lateral line canals (in a conserved subset of dermatocranial bones and in the lateral line scales) and become functionally distinct from those remaining on the skin. Thus, two neuromast populations in larval fishes have different fates and need to be recognized - presumptive canal neuromasts (those that will become enclosed in the lateral line canals), and superficial neuromasts (those that will remain on the skin throughout life). We have shown that in several taxa (e.g., zebrafish, salmonids, cichlids, gobies, etc.) these two neuromast populations may be distinguished by: 1) the rates at which they increase in number, 2) their size, shape, and directional polarity of apical sensory hair cells, and 3) the spatial arrangement of neuromasts within and among lines. Recognition of these two receptor organ populations provides a new perspective for the examination of structural and functional diversity in the lateral line system of the early life history stages of fishes. Funded by NSF Grant #1459224 to JFW.

TUS3:5

**ICHTHYOPLANKTON ASSEMBLAGES IN THE MAINSTEM OF THE YANGTZE RIVER:
THREATS AND CONSERVATION IMPLEMENT**

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Ichthyoplankton assemblages were investigated in the upper mainstem, middle and lower reaches, and the estuary of the Yangtze River, respectively. Ninety-two species were collected in the upper mainstem. Lowest number of species and density and latest occurrence of peak abundance at Yibin (30 km downstream the dam cascade) reflected intensive negative impacts of hypolimnetic discharge from the dam cascade. Highest density at Mudong (in the tail of TGR and 500 km downstream the dam cascade) indicated important nursery function of the tail water. Highest number of species and endemic species at Zhuyang suggested that the river section up and down there should be set as conservation priority. Fifty-four species were collected in the middle reaches. Larvae in the river section closer to the Three Gorges Dam (TGD) were lower in abundance, delayed in occurrence, declined in feeding intensity and growth rate, and had a narrower temporal niche width and higher temporal niche overlaps than those further from the dam. Association of the longitudinal gradients of the assemblages with environmental variables (e.g., water temperature and transparency) indicated intensive negative impacts of dam release in the river section near the TGD, which were diminished with the distance to dam increased. Fifty-six species were identified in the lower reaches. Larval abundance was highest at Anqing (downstream of the mouth of the Poyang Lake) among all the sampling sections in middle and lower reaches, suggesting critical function of the connectivity of Poyang Lake to the Yangtze River. With the river section up and down the mouth of the Poyang Lake, together with the lake-river connectivity system, should be considered as a priority for conservation. Forty-nine species were collected at the estuary, and number of species and density were higher in the near-shore areas than in the mid-stream ones, indicated important nursery function and conservation value of the near-shore habitats.

POSTER SESSION

COMPARING THE INFLUENCE OF THE THERMOCLINE STRUCTURE IN THE VERTICAL DISTRIBUTION OF LARVAL FISH COMMUNITIES ASSOCIATED TO ATLANTIC BLUEFIN TUNA IN THE GULF OF MEXICO AND WESTERN MEDITERRANEAN SEA

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The Mediterranean Sea (MED) and the Gulf of Mexico (GOM) are two main spawning areas for Atlantic Bluefin Tuna (BFT, *Thunnus thynnus*) and other large pelagic fish. Both areas are characterized by warm temperatures (30°C in summer), strong mesoscale activity and oligotrophic conditions. In contrast, they show a very different thermocline structure: very shallow in the MED (~20m depth) and deeper in the GOM (~100m depth). Little is known on the effect of the thermocline structure and intensity on the vertical distribution of the larval fish community (LFC). Temperatures are expected to increase due to climate change, consequently resulting in changes in the stratification structures. Therefore, comparing LFC distribution between the two areas can help to understand how similar species use the water column in relation to the thermocline structure and the environment associated. In 2012, two cruises were conducted during the tuna spawning period in the MED and the GOM to sample fish larvae and oceanographic data using vertical resolution sampling devices (Mocness net). Mean larval abundances in the GOM were higher than those in the MED (629,4 vs 47,5 larvae 1000 m⁻³). BFT larvae represented 23.3% of the total abundance in the MED and 2.3% in the GOM. Generalized Additive Models revealed the structure of the thermocline was as the main variable influencing the distribution of the tuna species and the LFC in the MED whereas in the GOM different variables were necessary to explain LFC's vertical distribution due to the heterogeneity of the environment across stations. Although thermocline distribution was deeper in the GOM, sensitive taxa to temperature (e.g. Scombridae) were strictly inhabiting surface waters in both scenarios, revealing a stronger dependence on other variables, such as light, rather than of temperatures. The current higher temperatures in the GOM scenario will help to understand potential consequences of future warmer scenarios for the MED summer LFC.

PS11:10

IS WINTER MORTALITY OF YOUNG-OF-THE-YEAR STRIPED BASS IN THE ST. LAWRENCE ESTUARY SIZE-SELECTIVE?

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Successful renewal of natural fish populations depends on a variety of factors, which often drive a cohort through outstanding mortality rates during early life stages. The juvenile stage is frequently overlooked by fish population studies, especially in its earliest, but it turns out to be an important and complex bottleneck to recruitment. In the northernmost, recently reintroduced (after extirpation in the 1960s) population of striped bass (*Morone saxatilis*) in the St. Lawrence Estuary (Quebec, Canada), first winter of life for the young-of-the-year (YOY) juveniles seems to play a major role in determining the year-class strength. Spawned in May, the YOY striped bass reach the end of their first growing season (September) with a particularly broad size range (20 to 160 mm), what makes us believe that winter mortality may act selectively against smaller individuals, as happens with other striped bass populations. In this study, we intend to evaluate winter mortality selectivity by characterizing the survivors, i.e. the 1-year juveniles that have survived through winter, in comparison with the whole population before winter. The characterization will be based on growth trajectories and back-calculated lengths obtained from otolith microstructure. This analysis will allow an investigation into other important questions: is faster growth always favorable for this population? From which point do the YOY juveniles begin to grow in such distinguished rates? By confirming a winter mechanism of size selectivity and estimating a minimum length for survival, the annual recruitment index of St. Lawrence Estuary striped bass can be refined, by taking into account not only the YOY abundance, but also its size distribution at the end of the first growing season.

PS7:33

**RELEVANCE OF STRUCTURAL ENVIRONMENTAL ENRICHMENT ON ELHS BEHAVIOUR
EXPERIMENTS**

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Structural environmental enrichment (EE), that is, a deliberate addition of physical complexity to the rearing environment, is recently considered as a highly recommended tool to guarantee or improve the welfare of laboratory or captive fish. Structural EE allows the animals a greater control over their environment and experiencing new situations, approaching the species-specific behaviours in wild life. Its objective is to improve the psychological and physiological wellbeing of animals in captivity, providing new sensorial and motor stimulation in order to help meet their behavioural and psychological needs, and increase the behavioural options of the animals, while reducing the frequency of abnormal behaviours. We demonstrated on seabream (*Sparus aurata*) juveniles that adding structural EE in experimental rearing environments of early life history stages (ELHS) leads to different effects: i) aggressiveness among individuals and fish interactions with the net-pen were reduced; ii) conditions of pectoral and caudal fins were improved; iii) modifications on the use of space, given that fish reared with EE increased the use of the inner areas of the experimental cage; and iv) no effects were observed on fish body condition and growth parameters. These results highlight the relevance of cage/tank/aquarium characteristics where fish experiments are performed, and suggest the use of structural EE on ELHS experimentation to improve fish welfare and reduce the behavioural effects of bare environments.

AN APPROACH TO THE DIET COMPOSITION OF MYCTOPHID LARVAE UNDER THE LEEUWIN CURRENT INFLUENCE (WESTERN AUSTRALIA): FEEDING INCIDENCE ASSOCIATED TO FUNCTIONAL MORPHOLOGY

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Mesopelagic fish of the eastern Indian Ocean are represented by a high number of myctophid species. The horizontal distribution patterns of their larvae have been previously studied; however research on larval feeding habits is non-existent. The main goal of this study is the description of the diet for the most abundant myctophid larvae off Western Australia: *Benthosema suborbitale*; *B. fibulatum*; *B. pterotum*, *Lampadena luminosa*, *Hygophum hygomii*, *Lampanyctus alatus*, *Myctophum asperum*, *M. obtusirostre*, *M. selenops*, and *Diaphus* spp. "deep" and "slender" morphotypes. The study region is an oligotrophic area under the influence of the Leeuwin Current for part of the year, such as in the period of study, autumn 2007. Myctophid larvae were diurnal feeders, and only a few postflexion individuals prey at dawn or night-time. Feeding incidence was higher in postflexion than earlier stages, and in larvae with saccular guts than in those with straight guts. The highest feeding incidence was found in *L. luminosa* and *Diaphus* spp. "deep-morphotype", and the lowest in *H. hygomii*. Larvae were zooplankton feeders, with nauplii and copepodites being the most important groups in their diet. In general, the species with straight guts fed mainly on nauplii and those with saccular guts had a wider variety of prey categories. Some species such as *B. pterotum* and *M. obtusirostre* fed also over larval-stage euphausiids and on small amphipods. Presence of soft prey such as larvaceans was also observed in the guts of *Diaphus* "slender morphotype". The wide prey size spectrum observed in larvae of many species indicated that they are generalist for most of their larval life e.g., *M. obtusirostre*, others such as *L. alatus* and *Diaphus* spp., preferred larger prey items, disregarding the small ones as they growth. Comparisons with larval feeding patterns of similar species from other ecosystems were discussed on the light of the environmental features of the region.

PS12:11

**APPLICATION OF HIGH-THROUGHPUT SNPs GENOTYPING FOR ASSESSING THE
ORIGIN OF *Engraulis encrasicolus* EGGS**

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We describe the analysis of SNP markers in anchovy (*E. encrasicolus*) egg samples to detect their origin at spatial small-scale (200 Km) by assigning genotypes to adult stocks. The novelty of this work is the application of a high-throughput rapid method for genotyping each single anchovy egg, in a single execution, using a set of 96 genome-wide single nucleotide polymorphism (SNPs) in a dynamic array system by microfluidic technology. The characterization of wide and small-scale population connectivity patterns of fish migratory species is one of the key challenges for a reliable conservation and management of the stocks. The existence of two genetically ecotypes in *E. encrasicolus* was already identified based on SNPs polymorphism in the Atlantic and in the Mediterranean Sea, detecting that habitat type (offshore vs. coastal) is the most important component of genetic differentiation among populations of anchovy. In this work, anchovy eggs genotypes from distinct sampling site in the Central Mediterranean area were assigned to adult populations, showing a very high posterior probability of assignment with a score ranging from 85.1% to 100%. Considering each individual egg, lower values of assignment were observed. Nevertheless, only two localities in which adult anchovies were sampled represented donor populations for the coastal egg genotypes. Although some degree of mixing among the hauls could exist, the assignment of egg groups to adult populations led to distinguish the contributions of distinct ecotypes to new wild generations. The high rate of eggs dispersion caused by marine currents and the different degrees of local retention could explain the genetic heterogeneity observed in the adult populations, where eggs from neighbouring spawning sites tend to mix. The results highlight a new useful tool for evolutionary questions, breed recognition, assignment and connectivity assessment of individual eggs in studies of anchovy population and stock dynamics.

PS8:37

**OVERLAPPING OF NURSERY AREAS OF TWO SMALL PELAGIC FISH IN MIDDLE
EASTERN ADRIATIC SEA**

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Sardine (*Sardine pilchardus*) and anchovy (*Engraulis encrasicolus*) are commercially the most important fish resources that are known as fast-growing and short-lived species. They are characterized by marked fluctuations in their respective stock sizes due to their high dependence on highly variable, environmentally driven, annual recruitment pulse. Within this study abundance and distribution of their early life stages were observed and compared taking also into account few environmental parameters. Namely, during 2017 two ichthyoplankton surveys (July, November) were carried out in the same area of middle eastern Adriatic. On each station, standard vertical plankton tows were made using a WP2 sampler (mouth opening 0.255 m²; mesh size 0.200 mm), sea surface temperature and salinity were taken by the multiparameter probe. After ichthyoplankton analysis, the remaining of ichthyoplankton sample was filtered onto preweighed glass-fiber filters (Whatman GFC) and dried for two weeks before weighing, which was then used as a proxy for food availability. The abundance of anchovy eggs and larvae varied between 8 - 140 eggs m⁻² and 4 - 136 larvae m⁻², while the abundance of sardine eggs and larvae coming from the same area ranged between 4 - 240 egg m⁻² and 4 - 56 larvae m⁻². Analysis of early life stages distribution pointed out that both species were the most abundant on the station which depth range between 60- 80 m. Furthermore, eggs and larvae of both species were accompanied by each other and their early life stages preferred area of slightly lower sea surface temperature (lower from the season range), which in this area proved to be an area of upwelling. Nevertheless, even though these two species are opportunistic regarding the spawning season as sardine is spawning during the colder and anchovy during the warmer part of the year they seemed to prefer quite a same area for nursing.

PS6:28

**FEEDING PATTERNS OF TRANSFORMING AND JUVENILE MYCTOPHIDS THAT REACH
THE NEUSTONIC LAYERS**

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Lanternfish of the family Myctophidae are one of the most abundant fish in the open ocean. Adult myctophids have a wide vertical distribution through the water column; with conspicuous differences in their day and night location, feeding at night in the epipelagic zone and being more dispersed in the mesopelagic region during the day. Contrasting, larval stages are restricted to the upper 200 m, both day and night, performing restricted vertical displacements. Transforming stages show a less defined diel vertical and feeding pattern, while juveniles behave like adults. In this study we analysed the trophic ecology of transforming and juvenile stages of a particular group of myctophids known for reaching the neustonic layers in their adult night migration: *Myctophum affine*, *M. asperum*, *M. nitidulum* and *Gonichthys cocco*. Neuston samples were collected across the tropical and equatorial Atlantic, in 12 stations sampled day and night. Transforming and juvenile stages occurred at night in the neuston, where they fed, and were absent from this layer during the day. The highest prey ingestion was observed for individuals collected mainly between 1-4 am. The incidence of feeding in the stages of transformation (60%) was lower than in the juveniles (66-100%). The number of prey ingested and their sizes did not show any increasing trend between stages, but there was great variability among individuals. Diet of the four species was mainly composed by a variety of genus of copepods, generally dominated by *Oncaea* spp species. For *M. asperum* there was almost no other type of prey in the stomachs. The high carbon content of preys like hyperiids made that the total carbon content per stomach was higher when these prey occur in the diet, such as in juveniles of *M. nitidulum*.

PS2:14

LARVAL ECOLOGY OF NORTHERN SAND LANCE IN WEST GREENLAND

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Sand lance (Family *Ammodytidae*) is one of the most important forage species of boreal marine ecosystems, where it is consumed as the main prey by numerous marine mammals, seabirds and demersal fishes. Despite playing a key role in shaping the dynamics of these ecosystems and their fisheries, the abundance as well as population structure and dynamics of sand lance remain poorly described, which impedes the development of ecosystem-based management strategies. This lack of knowledge of sand lance ecology is mainly attributable to a short life cycle, winter reproduction and unique burrowing behaviour that makes it invulnerable to conventional fishing gear. The juveniles and adults are strongly associated with sandy habitats, while larvae are pelagic and can be found for a protracted period in the surface layer of the water column. In Godthåbsfjord (West Greenland), northern sand lance (*Ammodytes dubius*) larvae are known to occur from January to July. During this extended hatching and larval growth season, individual larvae are exposed to substantial variations of temperature, salinity, current and zooplankton prey abundance, with potential effects on survival rate. Variations in environmental conditions are usually reflected on the individual growth trajectory, which can in turn impact survival rate. In most situations, larvae characterized by faster growth are generally characterized by lower cumulative predation mortality due to shorter larval stage duration. The main objective of this study is to quantify variability in individual growth trajectory of larval sand lance throughout the hatching and early larval growth season. Larvae were sampled on a weekly basis from January to July 2018 in Godthåbsfjord. Sagittal otoliths have been extracted and are currently being analysed for the determination of age and otolith daily growth. This study will provide the first assessment of variability in survival potential within a larval sand lance cohort.

PS1:6

**SPATIO-TEMPORAL PATTERNS OF LARVAL FISH SETTLEMENT IN THE NORTHWESTERN
MEDITERRANEAN SEA**

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To identify the spatial and temporal patterns of larval fish supply to coastal habitats in the NW Mediterranean Sea, 13 sites were monitored throughout the French Mediterranean coast using light-traps, from July 2012 to December 2015. A total of 27,800 coastal fish larvae belonging to 72 species were caught over 1073 sampling nights. Three species assemblages were detected in late spring-early summer, summer, and winter, with high consistency among years at each site. Catches Per Unit Effort (CPUE) were most often very low (median CPUE=0), with rare high catches events. Statistical analyses of CPUE were therefore conducted with quantile regressions, focusing on low (q25), medium (q50), high (q75), and extraordinary catches (q90). Most variations in CPUE among years, topographic basins and species were statistically significant for high and very high catches only. The year-to-year variability followed the climatic variability in the NW Mediterranean basin, while at year scale, CPUE displayed strong seasonality, with a major peak in early summer accounting for most of the larval supply and a weaker peak in autumn. An influence of the lunar cycle was detected for all catch levels, with higher CPUE around the new moon and significant temporal autocorrelations at a lag of about 28 days. Spatial patterns were also detected, with, among others: a strong influence of the Rhône river's triggering a lower and later larval supply in western sites compared to eastern sites, a lower species richness at sand-dominated sites compared to rock-dominated ones, and higher diversity and abundance at sites located within or close to a marine protected. These results confirm the high variability of larval supply at all temporal scales and the foremost influence of the moon, already observed in tropical environments, also apply to Mediterranean fish assemblages, and indicate that larval fish supply is a solid candidate for monitoring the state of the NW Mediterranean ecosystems.

PS6:29

WHO'S EATING WHOSE PROGENY? CANNIBALISM AND INTRAGUILD PREDATION OF SMALL PELAGIC FISH OFF WESTERN IBERIA.

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The incidence of cannibalism and intraguild predation was assessed for three small pelagic fish species abundant off western Iberian waters; sardine *Sardina pilchardus*, anchovy *Engraulis encrasicolus* and chub mackerel *Scomber colias*. Fish were collected during spring acoustic surveys for two contrasting years; one when sardines were the most abundant small pelagic fish species in the area, and the other after an outburst of the biomass of anchovy to maximum historical levels, concomitant with a decrease in sardine biomass. All fish species included fish eggs in the diet. Sardines were the main predator of fish eggs, including those of sardine and anchovy, followed by chub mackerel. The consumption of anchovy eggs by sardine was related to the biomass of anchovy in the area, and significantly higher than the cannibalism by anchovies on their own eggs. Chub mackerel was the main predator of fish eggs following sardines, particularly ingesting those of sardine. Impact of these trophic relationships on the dynamics of small pelagic fish is discussed, and estimates of cannibalism and intraguild predation on total egg mortality for Western Iberia are presented.

PS1:7

DIFFERENCES IN DAILY GROWTH RATES BETWEEN TWO ECOTYPES OF COEXISTING JUVENILE ATLANTIC COD (*Gadus morhua*) INCREASE DURING SETTLING.

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Co-existence of sympatric populations of a fish species is a common phenomenon. In the fjords of southern Norway, two ecotypes of Atlantic cod (*Gadus morhua*) co-exist during their juvenile life stage. Cod of the North Sea ecotype are on average 2 cm larger than the Fjord ecotype at the end of their first growing season in September suggesting either differences in spawning time or differences in growth during the larval and early juvenile phase. We analysed daily otolith increments of 145 cod sampled in 2000, 2003, 2008 and 2015 at two locations, and estimated individual hatching times and daily growth rates. A hydrodynamic model provided daily water temperatures for the two locations during the larval and juvenile phase. There was no significant difference in hatching time between the two ecotypes, locations or years. Population specific models (GAMM) of the effect of temperature and fish length on growth rates were evaluated. The North Sea ecotype was found to grow significantly faster than the Fjord ecotype population. Growth differences were small and non-significant until the juveniles reached ca 50 mm and disappeared again in juveniles larger than 100 mm. This size range corresponds to the size during which the cod settle to the bottom. Competition for resources, such as food and shelter, increase during this phase and we hypothesize that cod of the North Sea ecotype has a competitive advantage over the Fjord ecotype that enable them to grow faster during settling.

PS8:38

**THE ICTHYOPLANKTON DIVERSITY IN THE UPPER WATER LAYERS OF THE EASTERN
MEDITERRANEAN**

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Marine ichthyoplankton is mainly found in the upper layers of the water column, down to 200 m depth. This study aims to identify and characterize the diversity of fish eggs and larvae in the neuston layer of the eastern Mediterranean Sea in order to provide new insights into patterns of dispersal in multi-species communities, particularly due to the continuous invasion of Indo-Pacific species. Ichthyoplankton samplings have been conducted above and beyond the continental shelf, using horizontal hauls of Manta net with 300 μ l mesh that is used to sample the very top surface layer of the water. In order to identify the species, I use molecular taxonomy techniques and amplify the mtDNA COI gene, commonly refers to as the 'Barcoding gene'. In our present preliminary results, we found a high prevalence of eggs and larvae of invasive species (70%). In addition, some of the invasive species have been found beyond the continental shelf, far from their permanent habitat (10-30 km), thus demonstrating their high dispersal abilities. The knowledge obtained by this research is unique to the eastern Mediterranean, yet crucial for understanding the population dynamics of fish stocks in both time and space, and the functioning of marine ecosystems.

PS4:22

**GENETIC SIMILARITIES BETWEEN ATLANTIC BLUEFIN TUNA (*Thunnus thynnus*)
LARVAE SPAWNED IN THE NW-MEDITERRANEAN AND IN THE GULF OF MEXICO**

Carolina Johnstone, Estrella Malca, Jose Maria Quintanilla, Trika Gerard, David Lindo-Atichati, Diego Lozano-Peral, Amaya Uriarte, Jose Maria Rodríguez, Francisco Alemany, John Lamkin, Alberto García, Montse Pérez, Raul Laiz-Carrion

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Atlantic bluefin tuna (ABFT, *Thunnus thynnus*) larval ecology research in the last decades has increased with ecosystem-based fisheries management. Two well established spawning areas of this heavily exploited species, segregated into Western and Eastern stocks for management purposes, are the oligotrophic open waters in the Gulf of Mexico (GOM) and the Mediterranean Sea (MED). The definition of the genetic structure of ABFT is complicated due to its high migratory capacity, and the use of larval samples for population genetics has been extremely limited. In 2014 ABFT larvae were collected from GOM and MED spawning areas, respectively, for genetic structure analyses. Genomic DNA was extracted to genotype eight microsatellite loci (Ttho-1, Ttho-4, Ttho-7, Tth-34, Tth16-2, Tth 1-31, Tth 157, and Tth 208) in 43 (GOM) and 50 (MED) larvae. Genetic diversity estimators based on allele frequencies support lack of population structuring within ABFT larvae collected in spawning areas of Eastern and Western ABFT stocks, with close to zero values for genetic diversity estimators after pairwise comparisons. Locus Tth208 was the most polymorphic and locus Tth 16-2 was significantly deviated from Hardy-Weinberg equilibrium. Analysis of genotyped individuals resulted in higher kinship probabilities associated to larvae collected in GOM spawning grounds in 2014. Results are discussed in the context of hydrographic information from both GOM and MED spawning grounds. A genetically homogeneous population with no significant genetic structuring is hereby assessed based exclusively on larvae of known natal origin. The definition of the genetic structure of ABFT populations is essential, not only in terms of fisheries management, but also considering the potential impact of climate change on ABFT. This study has been sponsored by projects ECOLATUN CTM2015-68473-R (MINECO/FEDER), NASA grant NNX11AP76G, TUNAGEN and BLUEFIN.

PS12:12

**THE FISHES OF THE SOUTHERN OCEAN EDITION II: A FOCUS ON THE DIVERSITY OF
ANTARCTIC LARVAL FISHES**

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The scientific guide 'The Fishes of the Southern Ocean', edited by Gon and Heemstra and published in 1990, is the most comprehensive identification guide of Southern Ocean ichthyofauna. After nearly three decades, a second edition is in the making to update the knowledge accumulated since 1990, and highlight remaining unknowns in the field. In contrast to the first addition, there will be a chapter dedicated to reviewing major early life history trends of Southern Ocean fishes and various identification guides. Although the chapter will provide information on all families present in the Southern Ocean, the focal point is families of the dominant suborder, Notothenioidei. This poster will highlight material from the chapter, including an historical overview of the studies of the early life history of Antarctic fishes, common traits with images of larvae for most of the families, and information on biogeography. It is important to understand Antarctic early life history stages and document diversity, as rapid climate change and krill fisheries continue to alter the region.

PS6:30

ATLANTIC BLUEFIN AND BULLET TUNA LARVAE TROPHIC NICHE SEGREGATION IN THE SHELF/SLOPE AREA OF THE SPANISH COAST (NW MEDITERRANEAN)

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The trophic ecology of Atlantic bluefin tuna, *Thunnus thynnus* (ABFT) and bullet tuna, *Auxis rochei* (BT) larvae were studied by analyzing both bulk nitrogen and carbon stable isotopes. Larvae were collected during the MEDIAS acoustic survey on July 2011 by means of Bongo plankton tows using 90 cm squared mouth equipped with 1mm mesh during night time. Twenty three stations along the shelf/slope waters of the Mediterranean coasts of Spain (from Cape La Nao to the Gulf of Vera, south of Cape Palos) were selected and divided in three categories based on presence of only ABFT (C1), only BT (C2) or presence of both ABFT BT (C3). No significant differences were observed in both temperature (T) and salinity (S) at 5 m and 100 m depth, with wider T and S ranges in C2 stations. A total of 203 larvae were analyzed: 102 ABFT and 101 BT within the same size range from 4 to 12.5 mm SL for both species. Differences in the BFT larvae showed significantly lower DW in relation to SL than the BT, implying species-specific differences in larval growth or condition patterns within the same feeding scenario. BT showed higher trophic position (TP) and isotopic niche width than ABFT in both presence or absence of ABFT scenarios, suggesting a greater trophic plasticity for BT, which can move to waters preferred by ABFT. No overlap between isotopic niche has been detected even sharing spatial distribution. This trophic niche segregation is interpreted as a successful ecological strategy allowing coexistence of both species within the same spatial distribution without sharing food resources. This inter-specific study of apex species will provide a better understanding to the comparative trophic ecology of ABFT larvae, with direct implications on larval growth and survival and consequent recruitment processes with repercussion in management strategies. This study has been financed by ECOLATUN PROJECT CTM2015-68473-R (MINECO/FEDER) and IEO.

PS4:23

COMPARATIVE ATLANTIC BLUEFIN TUNA MATERNAL ISOTOPIC NICHE ESTIMATED FROM LARVAL ISOTOPIC SIGNATURES FROM THE GULF OF MEXICO AND BALEARIC SEA

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Atlantic bluefin tuna (ABFT, *Thunnus thynnus* Linnaeus, 1758) is a large migratory oceanic top predator which spawns mainly in the NW Mediterranean Sea (MED) and the Gulf of Mexico (GOM). An Eastern and a Western separate stocks are differentiated for fisheries assessment and management, although they share common feeding grounds. Stable isotope analysis (SIA) has become a useful tool to diet and the trophic interactions of marine ecosystems. An isotopic maternal transmission model for ABFT was used to estimate maternal isotopic values from isotopic values of preflexion larvae reared under controlled conditions. Maternal isotopic widths were estimated using SIBER package (Stable isotope Bayesian ellipses in R) from 65 and 54 wild preflexion larvae from MED and GOM respectively. Standard Ellipses Area (SEA_c) and niche overlap from the GOM and MED are discussed based on: contrasting spawning scenarios with different isotopic baselines, migration from common feeding grounds, variable arrival times to the spawning ground and age contribution to nitrogen isotope variability. The current study provides evidence that stable isotope ratios during early ontogeny can be used to infer isotopic information from breeders and can open new methodology to evaluate the maternal trophic characteristics that influence larval survival, growth and condition with a direct effect on recruitment. This study has been funded by projects ECOLATUN CTM2015-68473-R (MINECO/FEDER), BLUEFIN TUNA, and NOAA-SFSC. A.U. was the recipient of an FPI-IEO 2011/03 pre-doctoral fellowship (IEO).

PS3:18

ICHTHYOPLANKTON COMMUNITY STRUCTURE IN BOKA KOTORSKA BAY (SOUTHERN ADRIATIC SEA)

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The state of biodiversity reflects the degree of stability and persistence of ecosystems, especially in cases of significant direct or indirect anthropogenic impacts on marine environment. Analyses of early life stages of fishes at three locations in the area of marina Porto Montenegro were analyzed during spring and summer of 2016, 2017 and 2018 by monthly dynamics (March-August). Historical data indicates that part of the investigated area is one of the main spawning areas of pelagic fish species, especially for *Engraulis encrasicolus*, *Diplodus annularis*, *Diplodus puntazzo*, *Diplodus sargus* and *Coris julis* (MERKER and VUJOŠEVIĆ, 1972; MANDIĆ et al., 2014). The aim of this work is to compare the diversity of species with historical data, especially after the formation of the exclusive marina and to estimate possible impact on the distribution and species composition. Investigation shows dominance of anchovy (*E. encrasicolus*), sand steenbras (*Lithognathus mormyrus*), brown comber (*Serranus hepatus*) and annular sea bream (*D. annularis*). Total ichthyoplankton abundance was lowest during 2017 when total abundance was in range from 4-24 eggs/larvae per m² of sea surface, while during 2016 and 2018 total abundance was in range from 4-67 and 4-86 eggs/larvae per m² of sea surface, respectively. Differences in ichthyoplankton abundances between the 3 years were revealed by multivariate analyses (MDS and SIMPER) and ANOVA analyses. The analysis of the basic physical parameters of sea water did not show significant deviations throughout the research period. It can be concluded that the anthropogenic impact most likely caused the changes that led to the change in composition of dominant species between years and the negligible spawning of anchovy in 2017. Results pointed out the necessity of introducing of more intense management and protection measures of pelagic fish species in the area of Boka Kotorska Bay.

PS7:35

**PERSONALITY TRAITS VARIATION IN JUVENILE WILD AND ARTIFICIALLY-REARED
POPULATIONS OF GILT-HEAD SEA BREAM *Sparus aurata***

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Personality traits are defined as among-individual differences in five major axes of behaviour; boldness, aggressiveness, exploration, sociability and activity, that are consistent on time and ecological context. Recently, it has been shown that repeatable behavioural variation may play an important role in many ecological and evolutionary processes of fish populations, particularly on early-life stages. Personality variation provides protection to populations over time and plays an important role in the proper functioning of ecosystems. Even so, there is limited bibliography about personality traits in early life-stages marine species, and there are few studies about how behavioural traits are the result of genetic factors and environmental conditions. In addition, there is no standardized methodology to quantify the axes of behaviour in the laboratory for many marine species. In this work we have developed a new methodology to study the five major axes of behaviour through automatic tracking in juvenile marine fish in laboratory conditions. We have used the system to quantify the five axes of personality in two lines of juvenile individuals (wild animals and animals raised in captivity) of gilt-head sea bream *Sparus aurata*. Both our novel system to measure personality, but also our hypothesis-testing comparing wild and artificially-reared fish populations will contribute to disentangle the proximate mechanisms of marine fish personality and their ecological and evolutionary consequences.

PS12:13

**DETERMINING SPAWNING IN THE NORTH SEA USING VISUAL AND MOLECULAR
TAXONOMIC METHODS**

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The traditional spatial distribution and spawning time of species at different trophic levels have changed during the last decades in response to global warming. However, there is still limited knowledge about these changes. Increased knowledge of fish reproductive strategies is mandatory to optimize the planning of seismic surveys to reduce its potential negative effects on reproduction and development of early life stages. This study investigates the current spawning times of fish eggs and larvae for the major North Sea fish stocks using two different methods. Samples were collected weekly using a WP2 net with a mesh size of 500 µm at three locations in the central and northern North Sea. Eggs and larvae were analyzed in parallel following molecular barcoding and visual taxonomic methodology. In total, 2973 individuals were investigated, approximately half using barcoding and the other half using visual taxonomic approach. While visual identification of eggs to species was hampered was difficult for identifying eggs due to overlap between the taxa, more than 90% of the eggs were identified at species level using the molecular approach. Furthermore, the visual approach identified 90% of the larvae to species level, while 98.5% were identified using the molecular method. Both techniques showed similar distribution patterns, Dab (*L. limanda*) was the most abundant species at the southernmost location, the Norway pout (*T. esmarkii*) at the northernmost sampling site, while the Mackerel (*S. scombrus*) dominated at the central location. The small variation in the spawning times between both methods is most likely due to the different number of individuals analyzed. Even though the molecular taxonomic approach showed better identification results to species level, it did not allow staging of the eggs, which was only possible using the visual method.

PS6:31

FEEDING ECOLOGY OF BLUE WHITING (*Micromesistius poutassou*) LARVAE IN THE NORTHWESTERN MEDITERRANEAN SEA

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Blue whiting, *Micromesistius poutassou*, is a gadoid widely distributed in the North-Atlantic Ocean and Mediterranean Sea. The Mediterranean population is considered isolated from the Atlantic Ocean, and in the northern Catalan coast (NW Mediterranean Sea) it is a species of high commercial interest. In this area, fluctuations in the abundance of blue whiting have been related to interannual variations in winter hydrodynamics. These, in turn, lead to fluctuations in primary production that, may then determine changes the survival of early life stages. For this reason, understanding food web interactions during the larval stage is pivotal to predict the success of recruitment to adult fish populations. In order to approach this subject, we studied the trophic ecology of blue whiting larvae by combining stomach content and stable isotopic analyses, in the Catalan coast, during two consecutive winters of contrasted environmental conditions. The specific aims were: (1) to analyse the diet composition of blue whiting larvae; (2) to assess the likely interannual differences in diet in relation to winter conditions and (3) to examine the trophic structure and relationships among blue whiting larvae and the biomass-dominant plankton items. The stomach content of blue whiting larvae (2-34 mm SL), collected day and night, was analysed and prey were measured and identified to the lowest taxon possible. Prey carbon content was estimated from size data using taxon-specific allometric equations. The stable isotope analyses were conducted in blue whiting larvae at different ages (preflexion, flexion and postflexion stages), in fractionated plankton samples, and in the most abundant planktonic groups.

PS6:32

**THE FEEDING HABITS AND TROPHODYNAMICS OF LARVAL AND JUVENILE FISHES IN
THE KUROSHIO OFF JAPAN**

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We examined the feeding habits and trophodynamics of larval and juvenile fishes to understand how diverse fish populations are sustained in the "oligotrophic" Kuroshio ecosystem off the coast of Japan. Fish were sampled using frame trawls, then we analyzed the gut contents of 462 individual fish larvae and juveniles. The fish taxa were classified into eight groups and six outliers in the cluster analysis. Four of the groups consumed mainly calanoid (*Paracalanus* spp. and *Clausoclanus* spp.) or poecilostomatoid copepods (*Oncaea* spp. and *Corycaeus* spp.), and two of the groups preyed mainly on ostracods or appendicularians. The maximum values for frequency of occurrence (%FO) of prey items matched well with the numerically dominant prey items (%N) in each cluster group. Furthermore, prey selection by larval and juvenile fishes was determined not only by prey size but also by the prey taxa availability. Because non-metric multidimensional scaling (nMDS) result revealed that temporal and spatial variation in the diets of the dominant fish taxa was not likely to occur, prey selection may be robust and inherent in nature among these taxa of larval and juvenile fishes. In addition to ordinary trophic pathways (grazing and microbial food chains), we propose an alternative trophic pathway (tunicate food chain) linking the primary producers with fish larvae and juveniles via tunicate plankton. These results indicate that several prey and trophic pathways support the feeding and growth of a taxonomic array of larval and juvenile fishes in the Kuroshio ecosystem.

PS2:15

CHANGES IN VERTICAL LOCATION IN THE WATER COLUMN OF MESO- AND BATHYPELAGIC SPECIES THROUGH DEVELOPMENT: BEHAVIOUR VS HYDROGRAPHY

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The species composition, distribution and abundance of meso- and bathypelagic species from oceanic waters of the NE Atlantic have been analysed to investigate the modifications in vertical distribution patterns from larvae to adult stages. Plankton and micronekton samples from surface to 1800 m depth, were taken in May 2018 in 8 stations placed in a transect from 20°N to 55°N. The transect crossed intense productivity, thermal and salinity gradients, from the North Atlantic Subtropical Gyral Province (NASGP) to the north Atlantic Arctic Province (NAAP). Hydrographical boundaries were evident in the species composition and abundance, with lower diversity in the northernmost station in the NAAP. Larvae and transforming stages of myctophiforms and stomiiforms dominated all over the region. Although the Brunt-Väisälä frequency indicates higher water column stability in the NASGP stations than in the north, vertical distributions were similar along the region. Myctophid larvae were always concentrated in the first 100 m, irrespective of the time of the day. Their transforming stages occurred from surface to 1200 m at night (with no clear migration), and from 400-700 during the day. Stomiiform larvae appeared in the upper 200 m, while transforming showed a wide distribution from surface to 1000 m both day and night. The distribution of the gonostomatid *Cyctothone* (7 species) is an interesting case of study with larvae always in the upper 100 m, and non-migrating juvenile and adults located in the mesopelagic zone (even reaching the bathypelagic layers in the case of *C. microdon*). As in previous investigations, it was globally observed that the deepening in the water column is an ontogenetic process related with development that starts when ventral groups of photophores become formed. The wider vertical distribution of this transition stages compared to both larva and adult indicates that they have not developed yet the vertical displacement characteristic of adult stages.

PS10:9

**LARVAL DISPERSAL PATTERNS IN THE DUSKY GROUPER (*Epinephelus marginatus*,
LOWE 1834) BETWEEN MARINE PROTECTED AREAS ALONG THE SOUTHEASTERN
IBERIAN COAST**

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The knowledge of the factors that determine the distribution of marine organisms is crucial to improve current management strategies, given the serious threats that affect marine biodiversity. In the present study, an individual-based biophysical model is developed for the dusky grouper (*Epinephelus marginatus*, Lowe 1834) in order to evaluate the self-sustainability, larval supply and connectivity among a set of marine protected areas (MPAs) located along the southeastern Iberian peninsula, in the Western Mediterranean Sea. We analyzed the present and future functioning of the network of MPAs present in this region in the light of the biological attributes of the species and the oceanographic processes predominant in the area. The results suggest that connectivity of larvae follows well-established patterns influenced by the configuration of the coast and its oceanographic features, although with a slight spatio-temporal variability between spawning seasons. We highlight the weaknesses and strengths of the present MPA network and provide some tips that could improve its performance in the future.

PS1:8

**SETTLEMENT PATTERNS OF GROUNDFINCHES IN PROTECTED AND FISHED NEARSHORE
WATERS ALONG THE NORTHERN CALIFORNIA CURRENT SYSTEM**

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Settlement of early pelagic stages is a necessary step in the replenishment of adult populations of benthic marine species. However, understanding spatial and temporal patterns of settlement remain largely unknown for most harvested species along the northern California Current System (CCS). To quantify such patterns, we monitored settlement of five fish taxa to two regions of the Oregon coast (233 km apart) from late spring to early fall, 2012–2016. The five-year time series revealed that settlement within and across seasons was episodic, variable, and taxon-specific, with cabezon (*Scorpaenichthys marmoratus*) exhibiting the most uniform settlement, and splitnose (*Sebastes diploproa*) and redbanded (*S. babcocki*) rockfishes exhibiting the most episodic settlement. Fish settlement tended to be correlated with short events of upwelling relaxation for all but the largest taxa. Size-at-settlement tracked taxon-specific temporal patterns of arrival but was unrelated to water temperature. Spatial patterns of settlement revealed few consistent differences between central and southern Oregon sites. Within-region differences in fish settlement between small marine reserves and nearby fished areas was region- and taxon-specific, highlighting the fact that size and habitat heterogeneity should be considered in the design of marine reserves. Such quantification of spatial and temporal variation in fish settlement along the Oregon coast is important to fully understand population dynamics, inform fishery management targets, and design effective spatial management strategies.

SUN-COMPASS ORIENTATION IN MEDITERRANEAN FISH LARVAE

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Mortality is very high during the pelagic larval phase of fishes but the factors that determine recruitment success remain unclear and hard to predict. Because of their bipartite life history, larvae of coastal species have to head back to the shore at the end of their pelagic episode, to settle. These settlement-stage larvae are known to display strong sensory and motile abilities, but most work has been focused on tropical, insular environments and on the influence of coast-related cues on orientation. In this study we quantified the in situ orientation behavior of settlement-stage larvae in a temperate region, with a continuous coast and a dominant along-shore current, and inspected both coast-dependent and independent cues. We tested six species: one Pomacentridae, *Chromis chromis*, and five Sparidae, *Boops boops*, *Diplodus annularis*, *Oblada melanura*, *Spicara smaris* and *Spondylisoma cantharus*. Over 85% of larvae were highly capable of keeping a bearing, which is comparable to the orientation abilities of tropical species. Sun-related cues influenced the precision of bearing-keeping at individual level. Three species, out of the four tested in sufficient numbers, oriented significantly relative to the sun position. These are the first in situ observations demonstrating the use of a sun compass for orientation by wild-caught settlement-stage larvae. This mechanism has potential for large-scale orientation of fish larvae globally.

PS4:24

EFFECT OF BREEDERS DIET ON PARENTAL INHERITAGE IN SEAHORSES (*Hippocampus guttulatus*): AN EXPERIMENTAL APPROACH ASSESSED WITH STABLE ISOTOPE ANALYSIS

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Seahorses (Genus *Hippocampus*; Family Syngnathidae) are vulnerable ovoviviparous fishes, and males incubate the eggs received from females. The parental inheritance to the newborn juveniles was assessed in the long-snouted European seahorse *Hippocampus guttulatus* by means of stable isotope ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) profiles. For that, three homogeneous (size, weight) groups of adult seahorses (reared or wild collected) were fed on different diets during the whole breeding season (5.5 months; 20 March 2017 - 5 Oct 2017): Unenriched adult Artemia (Diet A), unenriched adult Artemia and frozen *Neomysis* sp. (Diet AM) and frozen *Neomysis* sp. (Diet M). Isotopic values of diets A, AM and M were -20.8, -21.6 and -22.4 ‰ for $\delta^{13}\text{C}$ and 7.7, 9.9 and 12.1 ‰ for $\delta^{15}\text{N}$, respectively. Samples of breeder's dorsal fin were taken at the onset and at the end of the breeding season and compared with samples of newborn juveniles. Isotopic profiles in fins at the end of the breeding season were significantly different among treatments A, AM and M (-14.4, -16.8 and -18.5 ‰ for $\delta^{13}\text{C}$ and 10.6, 13.5 and 14.7 ‰ for $\delta^{15}\text{N}$) and positively correlated with those in the corresponding diets. Also, isotopic values in newborn batches reflected the breeder diets. Isotopic patterns of change for $\delta^{13}\text{C}$ in batches of newborn did not show any regular trend along the breeding season, However, $\delta^{15}\text{N}$ values showed a continuous change towards $\delta^{15}\text{N}$ equilibrium values, which were presumptively reached after about 180 days from the onset of the breeding season. Equilibrium values in newborn would range from -18.3 to -15.0 ‰ for $\delta^{13}\text{C}$ and from 11.6 to 15.1 ‰ for $\delta^{15}\text{N}$. This is the first study on parental heritage regarding stable isotopes in seahorses. The results achieved highlights (1) the low isotopic turnover rates in adult seahorses, and (2) the importance of an adequate availability of a high quality diet long before the start of the breeding season. This study was financed by Proyecto Hippoeco (MINECO, Spain; CGL2015-68110-R

PS4:25

INHERITANCE OF STABLE ISOTOPES IN SEAHORSES (HIPPOCAMPUS REIDI): EFFECT OF PARENTAL DIET PRECEDING BREEDING SEASON

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In seahorses, (Genus *Hippocampus*; Family Syngnathidae) females deposit mature eggs into the brood pouch of the males. Embryos development occurs inside the pouch, lasting 2-4 weeks, depending on the species. Seahorse females are batch spawners with repeated brooding of males within a breeding season. The effect of breeder's diet preceding breeding season on stable isotopes ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) inheritance was assayed in *Hippocampus reidi*. Three homogeneous (size, weight) groups (0M, 2.5M and 5.5M) of adult seahorses were maintained for 5.5 months (Period 1) preceding the breeding season (April-September 2018) (Period 2). The breeders were fed on a mixture (1:1) of unenriched adult *Artemia* and frozen Mysidaceans *Neomysis* sp. (Diet AM) except for the whole and first half of period 1 in treatments 0M and 2M, respectively, when the diet consisted of unenriched adult *Artemia* (Diet A). Samples of breeder's dorsal fin were analyzed for isotopic profiles at the onset of periods 1, and compared with those from newborn. Isotope values of diets A and AM were -20.2 and -22.9 ‰ for $\delta^{13}\text{C}$ and 7.7 and 10.9 ‰ for $\delta^{15}\text{N}$, respectively. At the onset of period 2, isotopic values in breeders from groups 2.5M and 5.5M (-21.9 and -22.1 ‰ for $\delta^{13}\text{C}$ and 17.0 and 17.6 ‰ for $\delta^{15}\text{N}$) were similar and significantly different from those in group 0M (-18.6 ‰ for $\delta^{13}\text{C}$ and 18.6 ‰ for $\delta^{15}\text{N}$, respectively). Also, isotopic values in newborn batches reflected the breeder diets and progressively reached isotopic equilibrium values for both $\delta^{13}\text{C}$ $\delta^{15}\text{N}$. Equilibrium isotopic values were presumptively reached after about 140-150 days from the onset of the breeding season. Equilibrium isotopic estimates in newborn would range from -22.7 to -21.4 ‰ for $\delta^{13}\text{C}$ and from 14.4 to 14.7 ‰ for $\delta^{15}\text{N}$. The low isotopic turnover rates achieved in our study demonstrate for the first time the long time effect of the diet preceding the breeding season. This study was financed by Proyecto Hippoeco (MINECO, Spain; CGL2015-68110-R).

PS4:26

SPATIAL COMPARISON OF MATERNAL ISOTOPIC SIGNATURE INFLUENCE ON EARLY LARVAL GROWTH RATES OF BLUEFIN TUNA

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Atlantic bluefin tuna (ABFT), *Thunnus thynnus* (Linnaeus, 1758), is an oceanic migratory top predator considered a key species in the pelagic ecosystems with two well established spawning areas in oligotrophic open waters, the Gulf of Mexico (GOM) and the Balearic Sea (MED). Early life stages are a critical period when fish larvae suffer maximum mortality rates. Survival during this period is crucial for future recruitment success in which larval growth has a determinant role. Stable isotopes analysis (SIA) has proven useful to study the early life trophodynamics related and infer their ecological importance. Daily growth, otolith biometrics and isotopic signature of nitrogen ($\delta^{15}\text{N}$) of ABFT preflexion larvae of each spawning ecosystem [GOM (n=54) & MED (n=65)] were compared in order to evaluate the maternal isotopic effect during early larval growth. We found significant inter-population differences with higher growth rates and bigger otoliths with wider increments associated with lower values of $\delta^{15}\text{N}$ in GOM. An optimum growth and a less efficient growth groups were split using residual analysis for each population. The two groups had a direct relationship between growth potential and isotopic signatures of $\delta^{15}\text{N}$ at early larval stages at each spawning area. These results point to the importance of the maternal isotopic signatures observed in faster larval growth associated to lower $\delta^{15}\text{N}$. Faster growth during the early life stages can improve overall larval survival and may represent a key maternal legacy for this species. During preflexion stages, isotopic signature of maternal transmission predominates whereby lower values of $\delta^{15}\text{N}$ are discussed with trophic condition of breeders during the oogenesis process and age contribution to isotopic variability of spawners. This study has been financed by projects ECOLATUN CTM2015-68473-R (MINECO/FEDER), NASA grant NNX11AP76G and BLUEFIN.

PS8:39

**SPATIAL DISTRIBUTION OF THE LARVAL FISH COMMUNITY IN THE NW IBERIAN
UPWELLING SYSTEM, IN SUMMER**

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In this study we analyze the spatial distribution of fish larvae in the NW Iberian upwelling system in summer. A total of 69 stations arranged in fifteen transects perpendicular to the coastline, including the shelf and slope regions, were sampled. Stratified oblique ichthyoplankton samples were collected at 5 depth strata with a MultiNet. Micro- and mesozooplankton samples were also collected and CTD casts performed. Fish larvae were sorted from the multinet samples and identified to the lowest possible taxonomic level. A total of 2189 larvae belonging to 65 taxa (56 species, 6 genus and 3 families) were identified. The hydrographic situation during the cruise showed the presence of a mesoscale eddy in the area during the whole period of study. Also upwelling events were taking place, but they were not strong enough to break down the water column stratification, except in the inner shelf. Sea surface temperature and salinity showed an inshore-offshore decreasing gradient. The deep fluorescence maximum was located around 30-50 m depth. The maximum larval fish abundance was recorded in the eddy region. The larval fish community was not spatially structured and only 3 species showed significant diel vertical migration. The environmental variables involved in species distribution were geostrophic velocity, fluorescence, surface temperature and bottom depth. For its part, the variables significant in explaining variance in larval fish abundance were salinity, dynamic height and bottom depth.

PS2:16

COMPARATIVE STUDY OF THE LARVAL SURVIVAL OF TWO CLUPEOID SPECIES IN THE NORTHWESTERN MEDITERRANEAN BASED ON A BOX-BALANCE MODEL

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Sardinella aurita and *Engraulis encrasicolus* are two co-occurring clupeoid species whose spawning season takes place in summer in the NW Mediterranean, their eggs and larvae coexist in the plankton during this period. The summer is characterised by a stratified water column and low primary production at surface, where the only nutrient supply comes from runoff water. Spawning of both species is associated to these productive areas, and larval growth and survival would depend on hydrodynamic structures dominated by the Northern Current. The current flows over the continental slope and significant mesoscale features such as meanders and eddies are being developed along the current path. These structures may act as areas of accumulation, offering suitable conditions for larval survival, or as offshore exporting mechanisms. Three oceanographic cruises, consisting of basic oceanographic parameters measures and ichthyoplankton sampling, were performed in summer (July 2003, July 2004 and June 2003) along the Catalan coast. Larval growth rates of both species, studied by analysing their sagittal otoliths, were established as $0.604 \text{ mm day}^{-1}$ for *E. encrasicolus* and $0.775 \text{ mm day}^{-1}$ for *S. aurita*. With these values the age of sampled individuals and larval abundances at age were obtained. Then, global larval mortalities for each survey were estimated by log-linear regression of the abundances at age. *S. aurita* presented a much higher daily mortality rate (46%) than *E. encrasicolus* (28%). For a given area, the model compares the actual age distributions with that which would be obtained if the population were in a steady state, assuming the mortality rates within the age range used for the regression are constant for each species and survey. This balance model allows to estimate the larval inputs and outputs in the area, thus assessing how the hydrodynamic structures influence the survival of *E. encrasicolus* and *S. aurita* larvae.

PS8:40

**WHAT FACTORS DETERMINE THE SPATIO-TEMPORAL DISTRIBUTION OF *Coris julis*
AND *Thalassoma pavo* LARVAE IN THE NORTHWESTERN MEDITERRANEAN SEA?**

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In the last years, the distribution of *Thalassoma pavo*, a warm water species, has been expanded northwards in the western Mediterranean Sea in relation to sea warming. In this area, it cohabits with the cold water, ecologically similar, species *Coris julis*. Both species have similar body size, habitat preferences and feeding, living in shallow rocky habitats and Posidonia beds. As both species reproduce in spring/summer their planktonic eggs and larvae coexist and may interact in some way during that period. Here we analyze the spatial and temporal distribution of *C. julis* and *T. pavo* larvae in the Catalan coast (NW Mediterranean) to characterize their main spawning areas identifying the environmental factors that shape the spatial structures of larvae of both species. Six oceanographic surveys were conducted in summer of two decades (July 2003, September 2003, June 2004, July 2004, June 2011 and July 2012) along the Catalan continental shelf. Basic oceanographic parameters were measured, and ichthyoplankton samplings were performed using Bongo, neuston, and MOCNESS nets. Larvae of both species were collected in surveys conducted in June and July, being absent in September. In all surveys, *C. julis* was significantly more abundant than *T. pavo*, though the abundance of both species did not show significant differences among surveys, months and years. Larvae of both species had a shallow distribution, between surface and 50 m depth. The spatial distribution of *C. julis* larvae showed a wide distribution all over the shelf, while *T. pavo* larvae had a more coastal and scattered distribution, being more abundant in the northern part of the area.

POTH:1

**THE SOUTHERN BAY OF BISCAY: A SPAWNING GROUND FOR *Thunnus thynnus* AND
Sarda sarda?**

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The Atlantic *Thunnus thynnus* is a large pelagic species that in spring migrates long distances from the foraging grounds in the North Atlantic to the spawning grounds, traditionally considered to be the Gulf of Mexico (GOM) and the Mediterranean Sea (MED). However, tagging studies show that not all sexually mature fishes migrate into either spawning grounds. This may be because *T. thynnus* do not spawn every year or because other spawning grounds exist elsewhere. For the western Atlantic, unequivocal evidence of *T. thynnus* spawning outside the GOM has been presented. In this study, I show evidence that the eastern Atlantic *T. thynnus* also reproduces outside the MED. Using opportunistic ichthyoplankton samplings, 9 *T. thynnus* larvae, ranging in size 3.6 to 7.1 mm standard length (SL), were collected during July 2010 and 2015, in the Southern of Biscay of Biscay (SBB), at sea surface temperatures ranging from 20.2 to 22.2 °C. As for *Sarda sarda*, this is a medium-sized tuna species that distributes along the western and eastern (between Northway and South Africa) Atlantic coasts and the MED. In the eastern, spawning grounds for this species are located in the neritic regions of the tropical and subtropical Atlantic, where it reproduces from December to June and the MED, where it reproduces between May and July. However, 5 larvae of this species, ranging in size between 4.8 and 7.6 mm SL, were collected in July 2012, July 2015 and August 2008, at sea surface temperatures ranging 18.4 to 22.2 °C, in the SBB. Although, this region seems no to be an important spawning ground for *S. sarda*, since this species reproduces in the neritic region, sampled monthly since 2001 and its larvae have been occasionally found in the ichthyoplankton samples. In the case *T. thynnus* the importance of the SBB as spawning ground should be evaluated, since larvae of this species appeared in 33.3% of the stations sampled during July, in the slope-oceanic region, where this species reproduces

POTH:2

**COMMUNITY STRUCTURE OF ICHTHYOPLANKTON IN THE NE ATLANTIC IN SPRING,
UNDER CONTRASTING HYDROGRAPHIC CONDITIONS**

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The ichthyoplankton community composition and structure in the Atlantic region off the NW Iberian peninsula (AR), and in the southern Bay of Biscay (SBB), in spring 2010 were analysed. The inter-sampling and the inter-region environmental variability provided the opportunity to observe how larval fish species adjust their distribution to relatively rapid changing hydrographic conditions. The 294 samples, collected from 2 cruises, yielded 95333 fish eggs and 40915 fish larvae, belonging to 104 taxa, in 39 families. *Scomber scombrus* eggs were the most abundant, while *Sardine pilchardus* dominated the larval fish population. The SBB showed a more abundant and diverse ichthyoplankton community than the AR, although in both regions the larval fish population was structured into a shelf and off-shelf larval fish assemblages (LFAs). Inter-sampling variability, related to downwelling/upwelling regimes, was observed in the cross-shelf distribution of the LFAs in the SBB. However, in the AR LFAs maintained their distribution regardless of the hydrographic situation. This suggests that LFAs distributions are good indicators of downwelling and weak coastal upwelling regimes, but not of relatively strong or strong coastal upwelling. Although depth was identified by multivariate analyses as the most important variable in explaining larval fish species distribution, a shelf-break front in the SBB and the surface offshore (onshore) flows associated to coastal downwelling (upwelling) in the AR seem to have been key in defining and maintaining LFAs boundaries

PS8:41

SURVIVAL OF ATLANTIC BLUEFIN TUNA (*Thunnus thynnus*) LARVAE HATCHED AT DIFFERENT PH AND SALINITY CONDITIONS

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In this study, we assessed the effect of pH and salinity as independent factors on larval survival (LS) of Atlantic bluefin tuna (ABFT -*Thunnus thynnus*) together with their Na⁺/K⁺-ATPase and V-type H⁺-ATPase activities. Fertilized eggs of ABFT were obtained on 25 June 2016 from a spontaneous spawning of broodstock in the farming facilities at El Gorguel (Cartagena, SE Spain) of Caladeros del Mediterráneo Company. The fertilized eggs were transferred to facilities of the Spanish Institute of Oceanography (IEO) in Mazarrón (SE Spain). In a first experiment, eggs (n = 150 per treatment, in 3 replicates) were exposed to sea water salinity (SW: 38 ppt) and four pH treatments until hatch was completed (44 hours at 23 °C): 8.0 (control), 7.7 (near future), 7.5 (far future) and 7.3 (lower). In a second experiment eggs (n = 150 per treatment, in 3 replicates) were exposed to eleven salinities treatments and constant pH 8.0 (control) until hatch was completed (44 hours at 23 °C): 27, 30, 33, 36, 37, 38 (control), 39, 40, 43, 46 and 49 ppt. No significant differences in LS were observed with pH treatment, but lower H⁺-ATPase activity was detected at control environmental pH (pH 8.0). A "U-shaped" relationship was observed between hatching salinity and both Na⁺/K⁺-ATPase and H⁺-ATPase activities in whole larvae hatched, increasing both activities in groups exposed to extreme salinities. However, LS showed an inverse "U shape" curve respect to environmental salinity with higher values at intermediate salinities and lower LS at extreme salinities. These results suggest higher survival rates with lower active pumps activities. Survival results are discussed in terms of osmoregulatory cost adapting to a pH and salinity predicted for the near future scenarios. This work was funding by the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 678193.

POTH:3

**CHARACTERIZATION OF THE LARVAL HABITAT OF TUNA SPECIES IN THE CENTRAL
MEDITERRANEAN SEA**

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Atlantic bluefin tuna and other tuna species reproduce in the Mediterranean Sea every summer. Despite the Central Mediterranean Sea, in particular the strait of Sicily, is one important spawning site for many tuna species, little is known on the relationship between the environmental variables and their larval spatial distribution. Using historical larval collections and in-situ sampled environmental variables we modelled the relationship between the presence-absence and the abundance of tuna species and the oceanographic scenario in the Central Med. Previously, we conducted a comparison between the two plankton nets used for sampling, Bongo 40 and Bongo 90 to compare their catchability in relation to the targeted species. The results suggest most tuna larvae were located in the easternmost area in the south of Capo Passero characterized by specific hydrodynamic conditions compared to the surrounding areas. This study suggests more research in the Central Mediterranean tuna spawning grounds is needed to understand its role compared to other areas in the Mediterranean Sea.

PS8:42

MORPHOMETRIC AND BIOCHEMICAL ANALYSIS HIGHLIGHTING DIFFERENT EUROPEAN ANCHOVY LARVAL SUBPOPULATIONS IN THE SICILIAN AND MALTESE SHELVES.

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The European anchovy (*Engraulis encrasicolus* Linnaeus, 1758) is an important fishing resource in the Strait of Sicily that supports a high recruitment success variability. The presence of two spawning areas for this species, the drifting of the larvae along the currents and the different oceanographic conditions within the region suggest the presence of different larvae subpopulations. Morphometric and biochemical approaches (including amino acid composition, carbohydrate, lipid and protein content), have been used to analyse the differences among larvae collected in the Sicilian Channel during 2009. Unusually, larvae appear in great abundance offshore although there is also a big number of larvae in the South East Shelf of Sicily and Maltese Archipelago. The amino acid composition discriminates 2 larval groups closely related to the spawning regions: Adventure Bank and the shelf between the South of Sicily and Malta. In addition, there are morphometric and growth differences between recently hatched larvae in these 2 regions, reinforcing the hypothesis of two larval subpopulations and suggesting differences in the parental reproduction effort within the Strait of Sicily that should be studied. Between South of Sicily and Malta regions there are growth and biochemical composition differences since larvae from the Maltese coast present higher protein content and a bigger growth rate than those from the South of Sicily, pointing out Malta as an area with a better nutritional condition environment. However, no differences in growth rate have been observed between Adventure Bank area and the Maltese shelf so a diverse nutritional condition cannot be suggested between these two areas despite Maltese larvae present a higher protein content. The analysis of carbohydrate, lipid and protein content from other years (2005 and 2008) reveal there is an important interannual variability in the organic content indicating that results cannot be extrapolated to all time series.

PS2:17

**ROLE OF UNSTABLE WINTER DYNAMICS SHAPING THE FISH LARVAL DISTRIBUTION IN
THE NORTHWESTERN MEDITERRANEAN**

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Winter conditions in the NW Mediterranean cause instability of the water column and non geostrophic dynamics, such as vertical mixing and convection, are significant. These events contribute to renew nutrients at the photic zone thus providing conditions for phytoplankton blooms at shallow shelves. Interestingly, besides the high productivity in winter, only few fish species reproduce (~20 %): those characteristic of relatively cold water of north Atlantic biogeographic affinity. This study aims to elucidate how the winter hydrodynamics off the Catalan coast determine the spawning strategies of *Micromesistius poutassou* and *Sardina pilchardus* in February 2017 and 2018. In 2017, a surface strip of low salinity, due to heavy rain, was found in a wide area along the northern coastal area. Besides this situation played against vertical mixing, these surface waters were rich in nutrients. By contrast, 2018 was dry thus with higher surface salinity and lower vertical stability involving subduction and cascading events. In both years, the shelf-slope front was evident through the epipelagic layers. The spawning and larval distribution of *S. pilchardus* were associated with the coastal productive waters. The spawning of *M. poutassou* took place along the upper slope and even over the shelf, also at the submarine canyons, but offshore limited by the front. Larger larvae were mainly found over the highly productive shelf. The larval vertical distribution of both species showed high variability, not only related with the daily cycle or developmental stage, but also with the vertical instability. The well known hydrodynamic structures, such as anticyclonic eddies that use to retain larvae during the stratified season, become less important in winter. In that case, the shelf-slope front appears to be a key factor retaining *M. poutassou* larvae avoiding their offshore dispersion, even though the species is commonly considered as oceanic.

COMPOSITION AND DISTRIBUTION OF MESOPELAGIC FISH LARVAE OFF THE WEST COAST OF THE BAJA CALIFORNIA PENINSULA DURING CLIMATE ANOMALIES IN SUMMER 2014

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During 2013 to 2016, a series of climatic events developed in the northern hemisphere of the Pacific Ocean that affected the dynamics of the California Current System (SCC). The oceanic region off the western coast of the Baja California Peninsula (WCBCP) was affected in 2015-2016 by one of the most intense El Niño events recorded (comparable with those of 1982-1983 and 1997-1998), which was preceded by the warm water mass that originated in the Gulf of Alaska in 2013, and by a short-lived El Niño event in 2014. This work provides evidence of the influence of environmental variables on the distribution of fish larvae associations of the WCBCP during the summers of 2014 and 2015. The cruise was conducted along the Peninsula of Baja California following a series of transects perpendicular to the coastline and extending to the boundary of the Exclusive Economic Zone of the Mexican Pacific, covering 5173 nautical miles. Conductivity, temperature and depth data were collected through CTD casts in addition to dissolved oxygen data. Fish larvae were sampled using a Bongo net in oblique hauls from 200 m depth to surface. Due to the amplitude of the sampling area and the presence/influence of the different environmental variables, it was possible to determinate 3 zones with different characteristics (Northern zone, transition zone and southern zone). Fish larvae with meso and bathypelagic distribution (Stomiiformes: *V. lucetia*) dominated on the Myctophiformes (*T. mexicanus*, *D. laternatus* and *C. towsendi*), both in the northern zone and in the transition zone. In the zone south, after the Stomiiformes dominated epipelagic larvae (Perciformes: *C. punctipinnis*, *P. multifasciatus* and *E. gracilis*). The distribution and composition showed affinity with tropical-subtropical or warm-temperate waters because of the anomalous warming during the period of study at the surface waters of the Northwest Pacific (The Blob) and by a short El Niño event during 2014.

PS3:19

JELLIES BEG TO DISAGREE: ENHANCING FISH PRODUCTION VIA ARTIFICIAL UPWELLING?

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Artificial upwelling aims to enhance oceanic CO₂ sequestration and fish production. The upwelling of nutrient-rich deep water into oligotrophic surface waters may induce a shift from a more complex, multilevel pelagic food web to a simpler one, leading to increased energy transfer to higher trophic levels and thus higher fisheries yield. This process could, however, be levered out by the gelatinous shunt. Due to their fast generation times and efficient feeding behavior, gelatinous organisms such as tunicates can indirectly compete with fish larvae by displacing copepodite grazers, an important food source for the latter. Other taxa, notably jellyfish, directly interact with fish larvae and juveniles through competition for common prey and predation. Consequently, they could form a dead end in the food chain and outweigh artificial upwelling's bottom up control on the community. To explore artificial upwelling effects in an oligotrophic pelagic food web, 9 large scale pelagic mesocosms were deployed off Gando Bay (Gran Canaria) for 5 weeks from November to December 2018. Four different mixing regimes of increasing intensity (8, 15, 28 and 49% of total mesocosm volume exchanged with 350-meter-depth water) were established in two parallel set-ups: on one hand, through a single mixing event at the start of the experiment, and on the other via smaller deep-water introductions every four days throughout the course of the experiment. Preliminary data on shifts in jellyfish abundance in relation to the abundances of ciliates and dinoflagellates, common prey to both these organisms and fish larvae, will be presented. Top-down control on these microzooplankton groups will be discussed within the frame of artificial upwelling and fish-jellyfish interactions.

PS8:44

THERE'S A NEW KID IN TOWN: LIONFISH INVASION OF THE PLANKTON

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Within the last several decades, the Indo-Pacific lionfish, *Pterois volitans/miles* (Scopaenidae) has invaded and become established in the western Atlantic Ocean, the Caribbean Sea, and Gulf of Mexico, causing well-documented critical changes to coral reef ecosystems throughout the region. While numerous efforts are underway to understand the effects of and control this invasion, most of these efforts are focused on the adult life stage. Dispersal by the pelagic stage has likely been the main contributor to the rapid population expansion throughout the region, yet there are very few documented cases of larvae being collected anywhere in the invaded region where adult lionfish are abundant. We compared ichthyoplankton collected using identical sampling gear from the Straits of Florida (SOF) in 2007-8 (early lionfish population expansion) to those collected in 2014-15 (during the ongoing expansion), providing the opportunity to test for a temporal change in the ichthyoplankton. Despite a substantially greater sampling effort in 2007-8 (total of 938,126 m³ of water sampled compared to approximately 144,013 m³, ~15% sampled in 2014-15), we collected no lionfish larvae in 2007-8, whereas in 2014-15, 76 larvae were collected. The overall mean density in 2014-15 of 0.4-0.7 lionfish larvae 1000m⁻³ is comparable to a number of common reef fish families and is likely beginning to have an ecological impact on plankton constituents. As the invasion continues, additional studies of the ecological role of lionfish larvae in the plankton are warranted.

PS3:20

FISHERY OF THE TRANSPARENT GOBY, *Aphia minuta*, AND ASSOCIATED SPECIES ON THE FISHING GROUND OFF BALEARIC ISLANDS (WESTERN MEDITERRANEAN): A SUCCESSFUL CO-MANAGEMENT

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A traditional fishery that has come down in the last decades has been focused on the delicate transparent goby or 'jonquillo' with an important culinary value in Spain. This small fish is exploited by local and small-scale fisheries in western Mediterranean. Schools of a mixture of gobies are located by the echo-sounder during winter season in shallow waters. Fishery is aimed to the transparent goby (*Aphia minuta*) during his adult phase which spend mostly time of his life in water column while preying on plankton. In the Balearic Islands, it is traditional to use a small purse seine known as 'jonquillera' for transparent goby (*A. minuta*) and Ferrer's or crystal gobies 'cabotí' (*Pseudoaphya ferreri* and *Crystallogobius linearis*) and 'artet' that is aimed at picarel 'gerret' (*Spicara smaris*). Since 2009 the daily catch had to be limited by vessel to 30 kg for *A. minuta* or 50 kg for a mixture (*A. minuta*, *P. ferreri* and *C. linearis*). The Balearic Government Plan (2016-2019) considers that it is a highly localized and selective fishery, carried out by a small number of vessels (37 licenses), and without any effect on protected habitats. Environmental factors condition the abundance of *A. minuta*, who leave the surface when shallow water is heated. The results in total kg for this February have been 60 % more for gobies' mixture and 84 % more than for *A. minuta* in 2018. At the end of the sixth campaign (2019) of this co-management Plan of the implementation for the local fisheries, catches declared are kept above the previously published minimum criteria, which translates into an apparent recovery success of the fishery. Failure to reach the annual minimum quotas, based on historical records, would suppose the temporal closing of this traditional fishery, as a tool for its sustainable exploitation.

PS3:21

INCIDENCE OF THE MICROPLASTIC FIBRES IN THE DIET OF BLUEFIN TUNA POST-FLEXION LARVAE IN THE NW MEDITERRANEAN SEA

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Atlantic bluefin tuna (ABFT) (*Thunnus thynnus*, L., 1758) is a migrating large predator that spawns in the Mediterranean Sea and the Gulf of Mexico. Heavy exploitation rates of ABFT during the nineties propitiated larval trophic ecology research that highlight the importance of the transition from planktivorous to piscivorous diet. At presently microplastics (<5mm) are widely recognised as an important planktonic ecosystem pollutant potentially ingested by animals of every level of the marine food web. A large ptoportion of the microplastics present in the marine ecosystems are microplastics fibres that have been recently found in the stomach content of ABFT piscivorous larvae. To analyze the incidence of microplastics in ABFT post-flexion piscivorous larvae we microscopically examined stomach content of 34 post-flexion larvae with size range between 7-10mm SL (mean 7.99 ± 0.70 mm) collected during the Bluefin 2017 ichthyoplankton survey carried out in the Balearic Sea (W Mediterranean) from June 27 to July 12, coinciding with the peak of the ABFT spawning season. All fibres observed were counted, measured and characterized by colour. The results showed 94% of larvae were piscivorous and 38% had at least one microplastic fibres in their stomach. A total of 36 fibres were counted and more than 80% of fibres were blue colour. Whether these plastic contaminants were passively or actively ingested, they may affect the condition of larvae. The presence of microplastic fibres in fish larvae undoubtedly raises concern because its impact on the survival of ABFT larvae still remains uncertain and is open to scientific experimentation. This study has been financed by ECOLATUN project CTM2015-68473-R (MINECO) and the Bluefin Tuna Project.

POTH:5

**SPATIAL AND SEASONAL DIFFERENCES IN THE VERTICAL DISTRIBUTION OF
CEPHALOPOD PARALARVAE IN THE WESTERN MEDITERRANEAN**

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Cephalopods, as most fish species, pass through a planktonic early life stage that has been rarely studied worldwide. They are similar in shape to the adults, therefore they are called paralarvae. In this study, we describe for the first time the vertical distribution and abundance of cephalopod paralarvae in the western Mediterranean Sea, an area characterized by high mesoscale activity. Mesozooplankton sampling overall the water column was carried out using depth-stratified sampling devices during the non-stratified season in autumn 2009 and in summer 2010 when a strong thermocline was formed. A total of 170 paralarvae was collected, from which eight taxa were identified to the species level, one to genera and seven to family. Paralarvae were more abundant in summer than autumn. In the water column, paralarvae were mostly captured between 200 and 500 m, although there are taxa that are found throughout the whole water column like *Heteroteuthis dispar* and *Histioteuthidae*. The most abundant taxa were the family *Ommastrephidae*, accounting for 37.06% of the paralarvae, followed by far by *Heteroteuthis dispar* (17.02%) and *Loliginidae* (11.18%). The vertical distribution and temporal dynamics of paralarvae is discussed regarding their contribution to the identification of potential ecological interactions with fish larvae such as competition or predation.

**ADRIATIC ANCHOVY EARLY LIFE STAGES DISTRIBUTION OBSERVED IN THE LIGHT OF
SOME ENVIRONMENTAL PARAMETERS**

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During the MEDITS survey carried out in July 2018 along the eastern Adriatic Sea (Croatia) ichthyoplankton samples were collected for anchovy (*Engraulis encrasicolus*, Linnaeus 1758) early life stages determination. Standard vertical plankton tows were made on 63 stations using a WP2 sampler (mouth opening, 0.255 m²; mesh size, 0.200 mm). On each station sea surface temperature and salinity were measured using a multiparameter probe. In order to determine food availability for the anchovy, after the sorting, counting and removing anchovy eggs and larvae from the ichthyoplankton samples the remaining of ichthyoplankton sample was filtered onto preweighed glass-fibre filters (Whatman GFC) and dried for two weeks before weighing. Obtained weight was used as a proxy for food availability. In ichthyoplankton samples abundance of anchovy eggs and larvae abundance varied from 4 to 228 eggs m⁻² (geometrical mean±CL:34.56±17.12 eggs m⁻²) and 4 larvae/m² to 60 larvae m⁻² (geometrical mean±CL:10.58±12.80 larvae m⁻²), respectively. In general, abundances of anchovy early life stages were correlated with collected environmental parameters and there were no statistically significant correlations (p<0.05). This was more or less expected since this species has a protracted spawning season, which entails high tolerance of sea temperatures and salinity values (Betulla Morello & Arneri, 2009; a peak of spawning occurs between 18°C and 28°C, anchovy eggs were found within salinities from 9.1 to 38.7). Despite the lack of statistically significant correlations, it seems that eggs and larvae accompanied each other and that they preferred the areas of somewhat lower temperature and salinity but more abundant with food prey items. This coincided with the fact that a higher abundance of anchovy early life stages within this study were found in the upwelling areas defined for this part of Adriatic.

WHY AND HOW TO PROMOTE AQUAPONICS IN JUNIOR HIGH SCHOOL?

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Aquaponics, which combines the rearing of aquatic animals in recirculating aquaculture system with the culture of plants without soil (hydroponics), is a perfect mode of production to illustrate numerous scientific fields, develop new skills and more importantly promote new vocations. The aim of this project, which started in mid-2018, is to install small facilities in junior high schools for students aged between 11 to 14 years old. Three aquaponics systems are already running: two in metropolitan France (Dombasle-sur-Meurthe and Commercy) and one in Saint-Pierre and Miquelon (SPM); I was born there. This project involves tens of people, including politics, directors, teachers, and students. Fundings were provided by high schools, a private pet shop and the Territorial Council of SPM. New collaborations are planned for next years between high schools already involved in the project as well as with new ones in both Miquelon and Magdalen Islands (Canada). Several reports for both journals and TV shows were realized. In conclusion, this project illustrates how teacher-researchers at the university may help stimulating new teaching programs and more generally science in high schools, and hopefully promoting vocations, and hence new economic activities, particularly in remote areas.

CHAT WITH NEPTUNE: UNDRRESSING THE FORMAL LANGUAGE OF SCIENTIFIC TEXT, DISCUSSING GENDER BIAS IN ACADEMY AND PROMOTING LIFE AS A MARINE SCIENTIST

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Successful scientific communication and societal interaction is fundamental to the effective use of scientific knowledge. In Brazil, the challenge of disseminating knowledge to the public is aggravated by social inequalities and ongoing environmental problems. A useful strategy to increase the reach of scientific information is through informal social media websites, like blogs. The blog Chat with Neptune was created in April 2015, and since then, has weekly publications in Portuguese and monthly in English. The blog's objective is to develop a virtual communication channel that aims to disseminate findings in marine science by raising awareness and promoting debates of science-related topics among non-experts. The blog is divided into five sections: Marine Science, Women in Science, Scientist Life, Opportunities and Events, and Uncomplicating Neptune (definition of some important terms in oceanography). A total of 230 posts have been published, of which 36 are in English. Other than the maintaining publications in the blog, the team promotes the popularization of science and gender bias discussions outside the virtual environment, through workshops, meetings and other activities.

webpage: <https://www.batepapocomnetuno.com/in-english>

MEZCAL ARTIST-AT-SEA PROGRAM

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Through calm and rough weather, artists-at-sea fully engage in research while spending focused time on board creating art from freshly collected samples and experiences of the research activities. This *Artist-at-Sea* program is a funded component of our NSF project MEZCAL (MEso-Zooplankton food webs in the northern CALifornia current). We have worked with a local art center (Sitka Center for Art and Ecology) to broadly advertise and select professional artists to join our research team on three major research cruises. The formal application process has attracted much attention in the art community and resulted in the selection of three talented and enthusiastic professionals, with a fourth to come. Social media communications about the program posted while offshore have enhanced public awareness of the science and art being conducted at sea. After each cruise, the artists are invited to extend their residency for several weeks at the Sitka Center to have post-cruise time to assimilate their experiences into their art. Following the residency, the artists continue to work on their final products as well as organize their individual outreach activities, further extending the overall outreach component of the project. Once the fourth and final cruise is completed, an exhibit of the products of all four artists will be displayed at local marine science centers and will tour Oregon's metropolitan areas and underserved coastal communities. The fusion of art and science is not a new endeavor but increasing investment in this kind of collaboration enhances both the scientific process and broadens cultural understanding of science.

ENGAGEMENT WITH HARVESTERS IN NEWFOUNDLAND AND LABRADOR

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Since the 1500s, Newfoundland and Labrador, Canada has had a rich, vibrant cultural and economic connection with fishing. An important component of my job as a Research Scientist at the federal department of Fisheries and Oceans Canada is to engage with and explain our scientific research to harvesters. This involves having fleet representatives at the table during stock assessments, presenting science results at advisory meetings, participating in media interviews, and working with harvesters on research projects. Harvesters want to contribute traditional ecological knowledge (TEK) and data to the stock assessment process to influence decision making. However, there is no framework for including qualitative TEK in the stock assessment process. Research projects involving both harvesters and scientists that produce quantitative data is a promising avenue of collaboration. Current collaborative projects in the Newfoundland region are a sentinel inshore Atlantic cod survey, post-season crab surveys, and Atlantic herring gill net surveys. A new research project on using scientific echo sounders on fishing vessels to obtain data on capelin spawning stock biomass is in the consultation phase. Collaborations like these incorporate leadership of scientists with harvester's knowledge and skills to produce data that is directly applicable to the stock assessment process.

PLANKTON PORTAL: A CITIZEN SCIENCE PROGRAM TO ENGAGE THE PUBLIC IN ICHTHYOPLANKTON

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As large and complex data sets become more common in biological oceanography, the demands for processing and visualizing these data are increasing precipitously. *Plankton Portal* is a successful web-based citizen science and outreach program that aims to engage a wide audience to help classify *in situ* images of plankton collected by the *In situ* Ichthyoplankton Imaging System (ISIIS). The goals of Plankton Portal are twofold: (1) stimulate interest in plankton under the idea that “no plankton = no life in the ocean” and (2) use citizen scientists to help QA/QC complex biological oceanographic data sets. We have developed modules and field guides to aid in zooplankton identification that are used by citizen scientists to classify ISIIS images. We also maintain an active blog to communicate with users. To date, a total of 10,207 volunteers have made 1,248,398 classifications of 430,479 uploaded images. Current images are from the Mediterranean Sea and the Southern California Bight; shortly new data from the northern California Current will be added, exposing our volunteers to varying oceanographic regions. The Plankton Portal project has provided a strong link between citizen scientists and researchers, leading to informed discussions of the findings and research implications of the data under study.

BUILDING TRUST WITH INDIGENOUS COMMUNITIES: LESSONS LEARNED FROM THE ALASKA FISHERIES SCIENCE CENTER

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One stakeholder group that is extremely difficult to build relationships with, not just for scientific dissemination but also scientific planning and implementation, are indigenous communities. In Alaska, indigenous communities live in remote locations that often lack a robust technology infrastructure, making such communities difficult to reach both in person and digitally. These communities also rely on marine activities, like fishing and whaling, for subsistence as they have for generations and are often weary of scientific activities occurring outside of their communities. Over the years, communicators and scientists at the Alaska Fisheries Science Center have learned that communication is the key to engaging and building positive relationships with indigenous communities. However, communication must be consistent to respect cultural traditions and to successfully build channels for bilateral communication and needs to happen before, during, and after scientific activities. For this talk, I will share the strategy and tools we, as federal scientists at the Alaska Fisheries Science Center, have found most successful to engage members of indigenous communities in Alaska, particularly those living in the Arctic. The communication strategy discussed here can be implemented at different scales, depending on the magnitude of the scientific activity, to build trust with indigenous communities around the globe.

OUTREACH AND INFORMAL EDUCATION THROUGH ONE-ON-FEW SHARING WITH SCIENCE-TRAJECTORY STUDENTS

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We have developed an internship discussion program at our laboratory designed to give younger students a leg up on advancing their education and career path in the marine sciences. The program is called the Sandy Hook Internship Program (SHIP) and is based on the premise that you, the mentor, have walked in the students' shoes. Through humility and sharing, you may provide students with a headlamp to illuminate the road that lies ahead in graduate school and beyond. Critical features of our discussion program include 1) awareness of the possible, 2) pivot points in career paths, 3) networking, and 4) career ladders vs career horizons. More pragmatic items are also discussed including 1) making the first contact with an adviser/employer, 2) resumes to match the position, 3) preparing presentations, and 4) writing proposals and manuscripts. In addition, outside speakers provide seminars during the SHIP season. Following their presentations, guest speakers respond to normal questions and answers, and then are asked to be prepared to answer any reasonable professional questions from the students. Past students have found SHIP to be an invaluable vessel.

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