Abstract Book

Understanding and predicting future fish distributions

Fish and habitat management

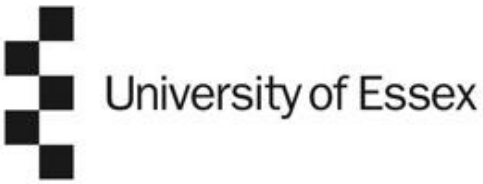
Protecting and restoring critical habitats

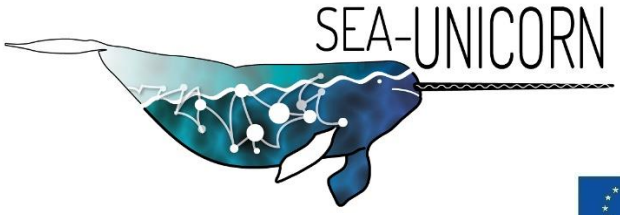
The role of fish in food webs

One Health

Fish movement and connectivity

Thank you to all the FSBI 2023 sponsors and supporters





This conference is partly sponsored by COST Action SEA-UNICORN (CA19107), supported by COST (European Cooperation in Science and Technology). COST is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.
https://www.sea-unicorn.com/ | https://www.cost.eu/

Thank you to all the FSBI 2023 Committees and Convenors

FSBI 2023 Convenors
Anna Sturrock (University of Essex)
Rui Vieira (Cefas)

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Rui Vieira
Audrey Darnaude
Susanne Tanner
Ben Ciotti
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Session convenors
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Molly Kressler
Naiara Rodríguez-Ezpeleta
Kirsty Richards
John Pinnegar
Ashley Townes
Audrey Darnaude
Edel Lheureux
Susanne Tanner
Matthew Hatfield
Rachel Johnson
Jonathan Ellis
Ben Ciotti
Paul Bangura

Additional support
Domino Joyce – FSBI liaison & FSBI2023 head of sponsorship
Chris Brodie – Website
Phil Lamb – Logo design
Will Perry – Publicity & Video - *Fishing for Exposure: tips on how to promote your research*
Michel Kaiser – Workshop lead - *How to Get Published*
Kirsty Bradley – Workshop lead - *Shine a light on your research using graphical abstracts*

And congratulations to the recipients of this year's Conference Awards: Matt Hatfield, Molly Kressler, Jonathan Ellis, Paul Bangura, Edel Lheureux, Ashley Townes, Kirsty Richards and Antonia Klöcker.

Table of Contents

Welcome to FSBI 2023!

Dear friends and colleagues,

Welcome to the FSBI 2023 Annual Symposium, co-convened by the University of Essex and the Centre for Environment, Fisheries and Aquaculture Science.

This year's symposium is hosted at the University of Essex, where *curiosity prevails, and where exploring new ways of thinking and pushing boundaries, isn't just encouraged, it's expected*. A very pertinent motto for this year's meeting where we hope to share and discuss the latest science on fish habitat ecology.

Understanding the factors driving fish behaviour, physiology and survival is increasingly important during this period of unprecedented global change, given their implications for fisheries stability and ecosystem health. To effectively use this information, we also need to build connectivity between natural and social scientists, industry, managers, and policymakers.

The themes of the 2023 FSBI Symposium are broad and inclusive, covering fish biogeography, habitat management and restoration, social-ecological connectivity, food web dynamics and One Health. The topics all have clear links to UN Sustainable Development Goals and the critical roles and services that fish provide.

On behalf of the Scientific and Local Organising Committees, we hope you enjoy the meeting and explore the 200-acre award-winning beautiful parkland - Wivenhoe Park and the historic city centre of Colchester – England's oldest recorded development.

Dr Anna Sturrock

Dr Rui Vieira

Message from the FSBI President

It is with considerable pleasure that I welcome you to the 2023 FSBI Symposium, this year organised jointly by the University of Essex and CEFAS (the Centre for Environment, Fisheries and Aquaculture Science). The organisers have put together a wonderful programme from the exceptional response to the call for papers from you, the delegates. An exciting week of science lies ahead. The work of staging the annual symposium is difficult to overestimate and so we all owe a debt of gratitude to all of the organisers of the logistics and the scientific programme for this year's meeting.

The FSBI, together with hosting partners, runs a symposium every year. This is just one of the very many elements of activity that FSBI undertakes to support the fish biology and fisheries science community. If you are not a member of FSBI then please do think about supporting us and becoming a member (joining is easy through the FSBI website). For now, enjoy what I am sure will be an inspiring week of interesting new science.

Best wishes,

Professor Colin Adams

Hon. President FSBI

THE CITY OF COLCHESTER

As the oldest recorded town in Britain, Colchester has a rich history that dates back over 2000 years. During the rise of the Roman Empire, Colchester served as the first capital of Roman Britain leaving an extensive archaeological inventory. Evidence of Saxon settlement from the 5th to 8th centuries, followed by the Viking era during which Colchester was heavily settled by the Danes. Reminders of England's heritage can be spotted throughout the city centre, including the most complete Roman wall in the country and the iconic, coveted heritage site of Colchester Castle, the largest Norman Keep in Europe. The castle is also home to large collections of archaeological material, evidencing how much historical knowledge this modest city has to offer.

Colchester Castle, Dave Peck Photography

The outskirts of the centre bring character in a more naturalistic way. From the castle, you can follow the Wivenhoe Trail to the charming, riverside village of Wivenhoe. For those that way inclined, the end of the trail conveniently arises at various characteristic pubs along the River Colne waterfront. During the summer weekends, a small foot ferry runs across the water, providing access to the small town of Rowhedge. Just a short drive away, you can find several towns and villages (Manningtree, Dedham and Tiptree) boasting natural scenery and uninterrupted views of the estuaries.

Waterfront harbour in Wivenhoe, photo by Alice Malcolm-McKay

Colchester was recently appointed with city status at the Queen's Platinum Jubilee 2022. As part of this celebration, our very own Dr Michael Steinke from the School of Life Sciences, and Dr Boróka Bó from the School of Sociology, were invited to meet The King and Queen Consort to showcase aspects of the university's research.

HISTORY OF THE UNIVERSITY OF ESSEX

The University of Essex was founded in 1965 as one of seven “New Universities” founded in this decade. In its first year 122 students attended and, over the next five decades, close to 100,000 students from more than 140 countries have attended and graduated.

Essex, more so than the other New Universities, was set up specifically to stop Britain falling further behind, by specialising in the production of professional experts in advanced technology and management.

Sir Albert Sloman was the first vice chancellor of the university and wanted radical innovation to be at the heart of Essex's approach to research and education.

This is evidenced in the range of research happening at the university, from the pioneering work on poverty and inequality by Professor Peter Townsend, to the development of the world’s first publicly available computer language by Professor Tony Brooker and the fascinating marine biology research happening in the Life Sciences department.

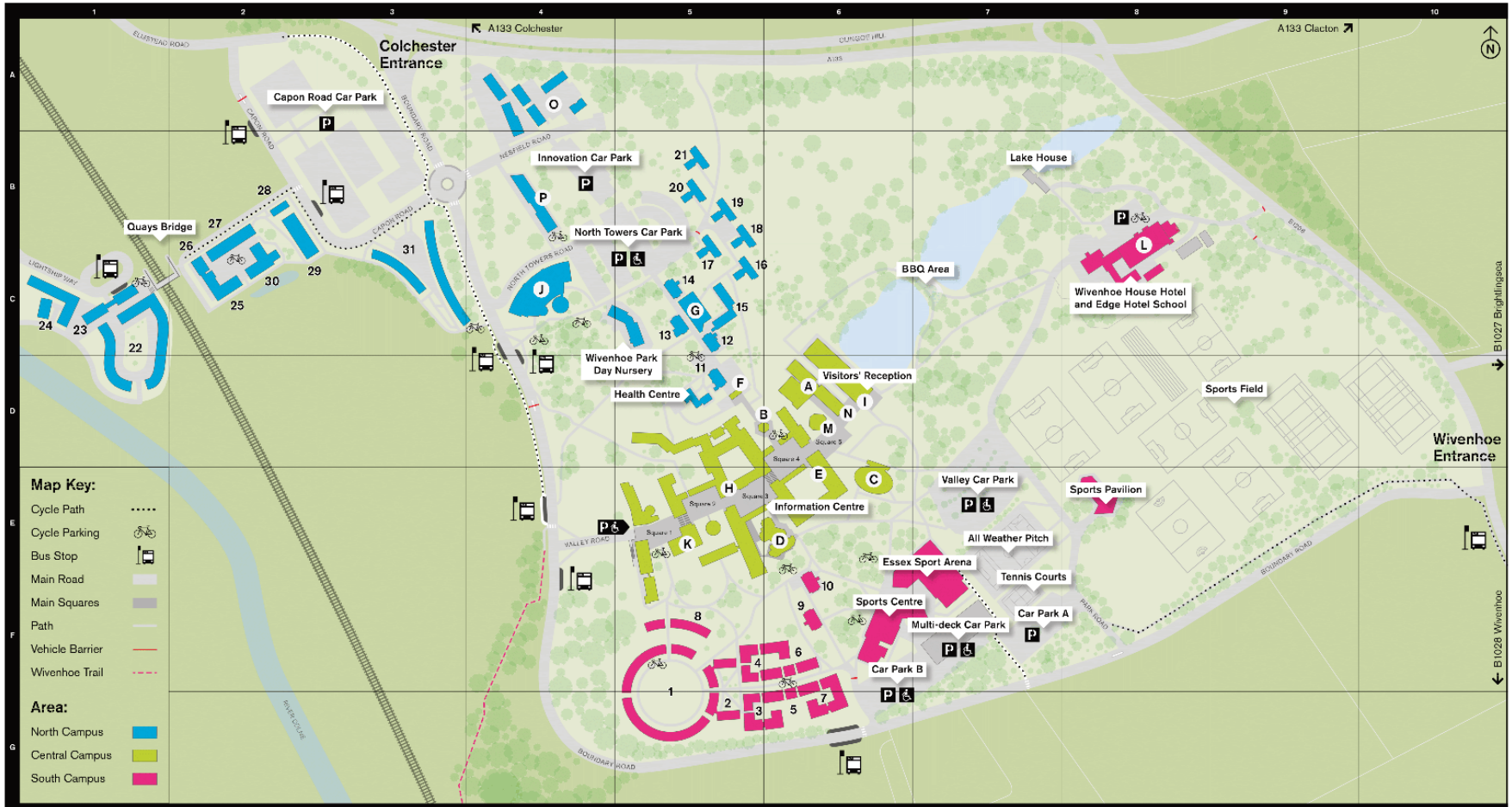
The architecture across the university was designed to link social and educational space to encourage a sense of community. ‘Brutalist’ buildings such as the Albert Sloman Library and The Hexagon, created by architect Kenneth Capon, have now become iconic. Capon said he didn’t want his designs to be 'shaggy and soft' so aimed to create 'something fierce to let them work within’.

Aerial view over campus where the ring of buildings on the left represents South Courts (our on site campus accommodation).

View across the lake to the Plaza in front of the Silberrad Student Centre where the Wednesday BBQ will be held

University of Essex

Colchester Campus Map



Our Learning Spaces
- **A** Albert Sloman Library (D6)
- **B** The Hex (D5)
- **C** Ivor Crewe Lecture Hall (E6)
- **D** Lecture Theatre Building (E6)
- **E** The Limehouse (E6)
- **F** The Tony Rich Teaching Centre (D5)
- **G** North Teaching Centre (E7)
- **H** The Orangery (E5)
- **I** Silberrad Student Centre (D6)
- **J** Essex Business School (C4)
- **K** STEM Building (E5)
- **L** Constable Building (C8)

Our Art Spaces
- **M** Art Exchange – Gallery (D6)
- **N** Lakeside Theatre (D6)

Our Knowledge Gateway
- **O** Parkside Office Village
- **P** Innovation Centre (B4)

Student Residences

South Courts (1–8)
- **1** Harwich (F5/G5)
- **2** Brightlingsea (G5)
- **3** Manningtree (G5/6)
- **4** Walton (F5/6)
- **5** Thaxted (G6)
- **6** Frinton (F6)
- **7** Rowhedge (F6/G6)
- **8** Alresford (F5)

South Towers (9–10)
- **9** Bertrand Russell (F6)
- **10** Eddington (E6/F6)

North Towers (11–14)
- **11** Rayleigh (D5)
- **12** Keynes (C5)
- **13** Tawney (C5)
- **14** William Morris (C5)

15 Wolfson Court (C5)

The Houses (16–21)
- **16** Anne Knight (C5)
- **17** Swaynes (C5)
- **18** Issac Rebow (B5)
- **19** Richard Woods (B5)
- **20** Thomas Hopper (B5)
- **21** Josephine Butler (B5)

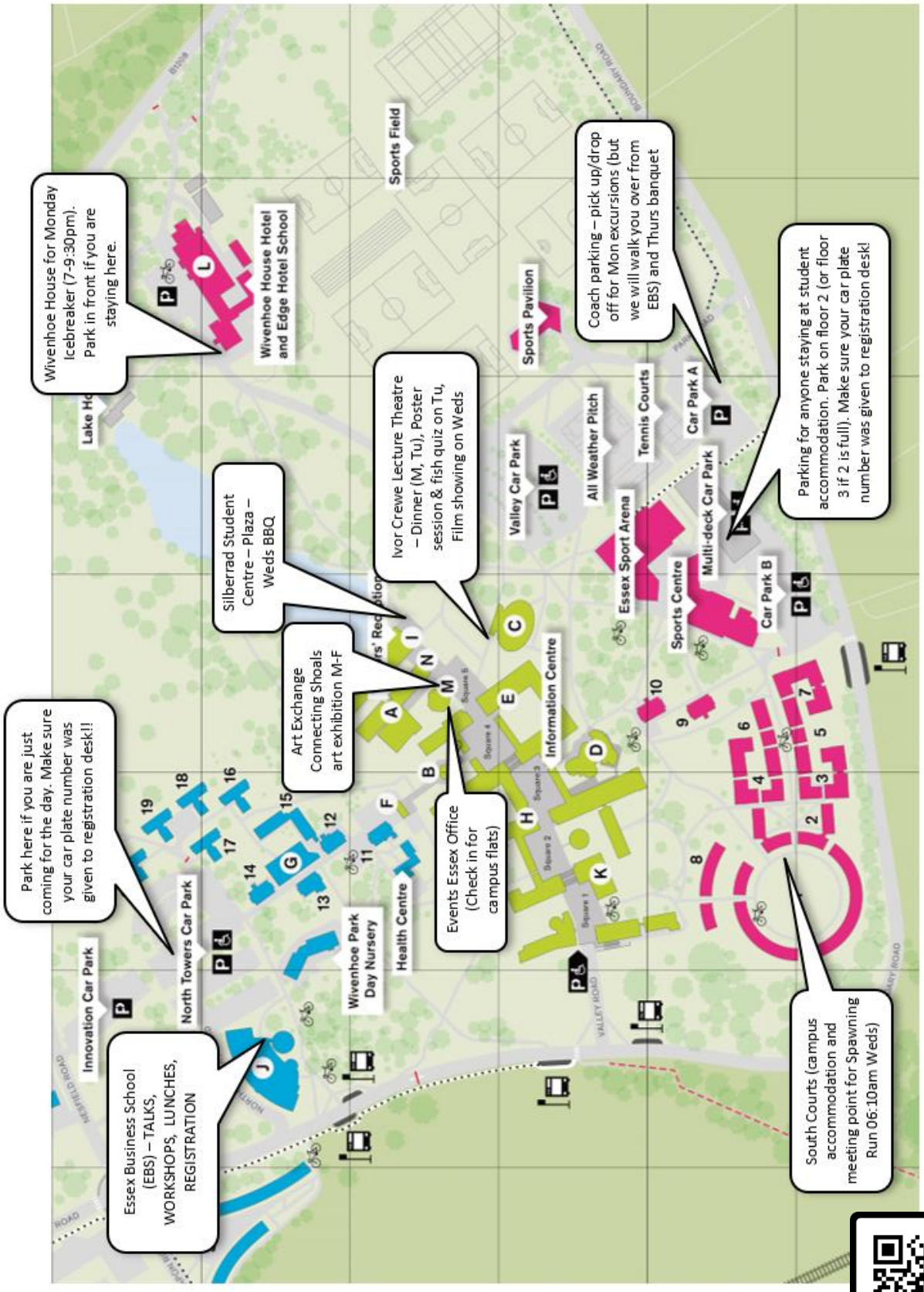
University Quays (22–24)
- **22** Sainty Quay (C1/D1)
- **23** Hawkins Quay (C1)
- **24** Matthews Quay (C1)

The Meadows (25–30)
- **25** Cole (C2)
- **26** Arber (C2)
- **27** Godwin (B2/C2)
- **28** Elton (B2)
- **29** Tansley (B2/C2)
- **30** Conway (C2)

31 The Copse (C3)

Disabled Visitors
For information on access and parking arrangements, please contact Visitors' Reception: +44 (0)1206 874321

KEY LOCATIONS



Also use google maps (www.tinyurl.com/FSBI2023)
or the 'Find Your Way' app (https://findyourway.essex.ac.uk/)

SCAN ME

KEY INFORMATION

TRAVEL INFORMATION

All travel info is provided on our conference webpage: https://fsbi.org.uk/symposium-2023/

PARKING

- If you are staying in campus accommodation, use the multi-storey Visitor Car Park B on Level 2 (if full, use 3). Use postcode CO7 9HT in your sat nav.
- If you are staying in Wivenhoe House, use the car park in front of the hotel.
- If you are not staying overnight, use the North Towers car park (postcode CO4 3SQ). This car park is located next to the Essex Business School.

Do not pay for parking. But do ensure your plate number has been recorded by Events Essex when you register to avoid getting a ticket.

CAMPUS SECURITY

You can find the Security and Safety Centre on Square 3 where they provide 24-hour, face-to-face and phone support for students, staff and visitors including security, reporting urgent out-of-hours faults, dealing with lockouts out of reception opening hours, first aid, lost property, issuing of keys out of reception opening hours.

Contact number: +44 (0) 1206 872125

IN AN EMERGENCY, ring **2222** from a campus emergency phone or Studentcom, or **+44 1206 872222** from a mobile phone. Do not ring 999. Patrol Officers, who are trained first aiders, are available 24 hours. They will assess the situation and arrange attendance of emergency services where required.

ACCOMMODATION & CHECK IN/CHECK OUT TIMES

Wivenhoe House Hotel check in is from 15:00, check out by 11:00.

University campus accommodation check in is from 14:00, check out by 09:30 [Acccommodation in South Courts - Manningtree Court or Rowhedge Court].

Any questions - call Events Essex Summer Reception on +447825 608085.

To check in go to the Events Essex Office (see campus map), which is open 08:00-21:30, 7 days a week. You will be given a key fob and a meal card that you can use to get your breakfast in the mornings.

REGISTRATION

Conference registration will be in the Essex Business School (EBS) foyer.

Opening hours:

- Monday and Tuesday **8:30 - 17:30**
- Wednesday - Friday **8:30 - 9:00 and during break times**

We will provide a room near the desk for you to leave luggage in as required.

CATERING

To reduce our impact and promote good sustainability practice, please remember to bring your own water bottles and travel coffee mugs each day.

Breakfast for people using campus accommodation will be held from Tuesday to Friday at **07:00 – 09:00 am** in the Canteen (Square 3), Buffalo joes and Fusion (both Square 4). We strongly suggest you go for breakfast at 7:00am to beat the queue of other conferences/ language schools that are happening at the same time. Coffee/tea will be served in the EBS foyer at 08:30-09:00 each day.

Coffee and refreshments will also be provided in the morning and afternoon each day. Please see programme below for a full breakdown of the week schedule.

Lunch will be provided in the EBS foyer at various times between 12:00 and 14:00 (see programme below) on Tues to Thurs. On Friday lunch will be provided in the Lakeview Room of the Silberrad Student Centre (see campus map).

Dinner will be held in the Ivor Crewe Lecture Theatre on Monday and Tuesday, and on the Plaza outside the Silberrad Student Centre on Wednesday.

The Banquet dinner will be held on Thursday in Prested Hall. Coaches will depart from Car Park A (see map) at 17:45 sharp**.** Return coaches will depart from Prested Hall at 23:15, with an earlier bus around 22:00 (or once reasonably full).

The banquet will include the FSBI 2023 Medal Awards and a Banquet Speech by Chris Howard (Silverback Productions). There will also be dancing accompanied by music from JamJar Band.

WIFI

'Essex Guest' is our wifi network for visitors and guests. It's free to use and is available at all our campuses. **To connect, choose Essex Guest from your available networks, enter your personal email address and accept our IT Acceptable Use Policy (AUP).** Once connected you may need to verify your email address by following the link in the verification email sent to you.

If you have access to **eduroam** through your university, you may also use this while on our campus.

MEDIA PRESENCE

Credentialed media representatives will be present in person or virtually to cover programme proceedings and they may approach you with interview requests, which can be accepted or declined. If you have any questions or requests for any media-related queries, please reach out to the Local Organising Committee.

SOCIAL MEDIA

We enourage you to share highlights of the conference across your social media (unless stated otherwise by speakers).

When posting, please tag **@TheFSBI @fsbi2023 @CefasGovUK @Uni_of_Essex @EssexLifeSci #FSBI2023**

PHOTOGRAPHY & RECORDING

Please note that there will be people taking photos and film footage during the event. By taking part in this meeting, you are granting the organisers full rights to use the images resulting from the photography/video filming, and any reproductions or adaptations of the images for publicity or other purposes. This might include (but is not limited to), the right to use them in their printed and online publicity, social media and press releases.

CAMPUS AMENITIES

All campus buildings provide water fountains to refill water bottles.

Other amenities across the university campus include a small convenience store, the SU shop, a student bar (opening times vary, please see sign outside venue) and other cafe and food outlets. The closest large supermarket is Tesco Colchester Hythe, approx. 0.5 km from the University open (6am-midnight), except Sundays and Bank Holidays (10am-4am).

We encourage delegates to explore our 2022 award winning campus lakes, one of Britain's best 10 green spaces. Boasting three lakes, 2,800 trees, car-free jogging routes and 40 acres of sports fields, our 220-acre Colchester campus really does have something for everyone.

MULTI FAITH ROOM

The Faith Centre (room 3.305) is located off Square 3 and is fully accessible. Use https://findyourway.essex.ac.uk/ to find it. Please be aware that any staff member or student may use this area for a moment of quiet prayer or reflection. Please use the sign on the door to indicate whether the room is in use.

TOILETS

Toilet facilities are located on floors 1 and 2 of the EBS building. The closest gender neutral toilets are located a short walk away, in the Causeway Teaching Centre opposite the North Teaching Centre. Alternatively, please make use of accessible toilets on levels 1 and 2. The accessible toilet on level 1 is located on the corridor at the rear of Trading Floor. There are 2 toilets on level 2, one is located to the right as you face the EBS Student Services Reception, the other is located along the seminar rooms corridor.

NURSERY/CHILD CARE

The Wivenhoe Day Park Nursery is directly opposite the Symposium event location (EBS building) and provides a great childcare option if you are bringing young children. To book a place or ask questions, email nursery@essex.ac.uk or call on +44 (0) 1206 873244.

Alternatively, older children can attend Essex University CHUMS Multi-sport holiday camps, more information is provided at: https://www.essex.ac.uk/sport/childrens-activities/chums-holiday-camp

INSTRUCTIONS FOR PRESENTERS

Oral presentation

10 minute talks (again, we will be strict on time!).
Will include Q&A panels with other speakers in your mini-session afterwards.

Preferred format: powerpoint widescreen (16:9).

Please upload your slides here by 17:00 BST on 23rd July.
Filename format: SESSION_no_LASTNAME_FIRSTNAME.pptx, e.g. 5_STURROCK_ANNA.pptx

Speed talk

3 minute presentations (we will be strict on time!)
THREE slides maximum! One is also fine!
May include Q&A panels with other speakers in your mini-session afterwards.
3 minutes doesn't sound like a long time but you can get a lot of information across in that time! Just practice, practice, practice.
Check out this 3 min TED talk for inspiration!

Preferred format: powerpoint widescreen (16:9).

Please upload your slides here by 17:00 BST on 23rd July.
Filename format: SESSION_no_LASTNAME_FIRSTNAME.pptx, e.g. 5_STURROCK_ANNA.pptx

Poster

A poster consists of easily read text and graphics describing the objectives, methods, and findings of your study.
Preferred format = Portrait A0 size paper (841mm wide x 1189 mm high or 33.1 in x 46.8 in).
If you prefer landscape or a smaller portrait sized poster, go for it. But the key criteria is that the width cannot be greater than 860mm (34inches).
Posters should be a single sheet of printable stock that can be affixed to the display board using velcro stick ons that we will provide.
Posters should ideally be put up between 5pm and 7:30pm Mon (but you can also put them up on Tues prior to the start of the poster session at 5:30pm Tues).

ESSEX BUSINESS SCHOOL

The University of Essex presents and welcomes you to the Essex Business School, the heart of the FSBI 2023 Annual Symposium. We invite you to relax and be inspired by the arboresque, open-concept style of this stunning venue, where we encourage networking and collaborations.

For the majority of the week, FSBI 2023 Symposium will be held at our carbon-neutral venue, the Essex Business School (EBS). The innovative and uniquely designed building was completed in 2015 as the first ever zero-carbon business school building in the UK. The 5500 square metre building boasts a large foyer area where you can find the FSBI registration desk, overlooking the indoor winter garden. There is an on-site café, with an adjacent sun terrace and parking facilities, including electric charging points, in very close proximity.

The main event room is the large auditorium ('EBS 2.2') with all-natural light, hosting many of the week's exciting talks and activities, with capacity for 250 people. The building also contains several other lecture theatres and boardroom-style meeting rooms. Study pods and innovation booths are available for individual and group-working on most floors. There is also a large open-plan virtual trading lab providing students the opportunity to engage with local and regional businesses, at the forefront of business teaching and research.

The Essex Business School is a short walk away from the University library and large bespoke student working space, the Silberrad Student Centre. Many of the on-campus accommodation buildings are also nearby, as well as a variety of teaching spaces spread across the campus. At the stop just behind the building, buses frequent the university and provide access to Colchester town and the main train station, with London just over an hour away by train.

WIVENHOE HOUSE

The wine reception on Monday evening will be hosted in the Grade 2 listed Wivenhoe House, a mansion dating back to the 1750's.

Built in the gorgeous grounds of Wivenhoe Park adjacent to the university, the hotel and surroundings were immortalised in canvas by renowned British artist John Constable, when he was commissioned by the then owner Major-General Francis Slater Rebow in 1816. The painting now hangs in the National Gallery of Art, Washington DC.

This same General Rebow returned from the Peninsular Wars with two cork oak cuttings in his boots, smuggling these valuable ship building saplings away from the Iberian Peninsular. Today, those oak trees stand tall and proud in the grounds.

The house survived England's worst-ever earthquake in 1884 and was requisitioned by the War Department during both world wars, housing a tank regiment during WW2 and briefly the SAS.

In more recent times, the house has had distinguished guests such as Sir Winston Churchill, her late Majesty Queen Elizabeth II and the late Nelson Mandela.

In 1964, the hotel entered a new stage in its life when sold to the University of Essex. It has now been reborn as the Wivenhoe House hotel, and is home to the Edge Hotel School, a unique education concept within the UK giving Hospitality students the chance to get real world experience.

Wivenhoe House showing the lawn and outdoor terrace where (hopefully – can never really rely on British weather!) the Monday evening icebreaker will be. If it does rain we have plenty of space inside.

MONDAY ACTIVITIES

Morning: Excursions and DiadESland

On the Monday morning we will have two excursions off-site (09:30 to 13:30) and the DiadESland Board Game played on-site (11:00-13:30).

09:30-13:30 "River Excursion" - Darren Tansley from the Essex Wildlife Trust will take one group to Dedham Mill to visit a fish barrier and fish pass to see the fascinating work the trust is doing trying to maintain river connectivity. Packed lunch will be provided.

09:30-13:30 "Saltmarsh Excursion" - Dr Tom Cameron (University of Essex) will take a second group to visit the Essex Wildlife Trust's beautiful Abbots Hall coastal nature reserve to explore natural and created saltmarshes and discuss their use as fish nursery sites and the importance of this coastline for oyster fisheries. Packed lunch will be provided.

11:00-13:30 Dr Tea Basic (Cefas) will be running the fun and educational board game "DiadESland" in one of the EBS seminar rooms. DiadESland is a game aiming to ignite discussions on diadromous species management in a changing climate. Lunch will be provided as you play.

Afternoon: Workshops and Special Interest Groups

On the Monday afternoon everyone will be back in EBS and from 13:30 to 15:00 in EBS 2.2 we will have two workshops (*Shine a light on your research using graphical abstracts* by Kirsty Bradley and *How to get published* by Michel Kaiser). We will also show a short video "*Fishing for exposure: tips on how to promote your research on Twitter*" by FSBI Publicity Officer Will Perry.

Finally, from 15:30 to 17:30 we will have a number of "Special Interest Groups" for delegates to brainstorm 'hot topics' in fish research to seed syntheses for the Journal of Fish Biology Special Issue that will accompany this meeting (see section below). These will be loosely focused on the central themes of *Social-Ecological Connectivity; Predicting fish distributions; Fish in Food webs; Critical habitats and One health*, but when we are there you are also more than welcome to come up with your own ideas! During the conference (e.g. the two hour lunchtime on Wednesday), we hope that groups will continue to discuss their ideas and develop these papers, to exchange contact details and finish papers after the conference has ended.

Please contact David Murray (david.murray@cefas.gov.uk) if you have any questions.

SOCIAL ACTIVITIES

MONDAY

17:30-19:00 - Dinner in the Ivor Crew Lecture Theatre and putting your posters up
19:00-21:30 - Wine Reception Icebreaker in Wivenhoe House with the Motley Crew Sea Shanty group from Brightlingsea

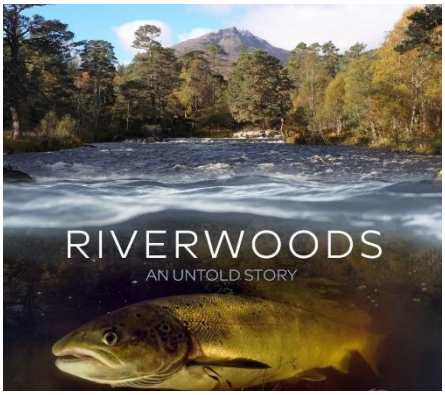
TUESDAY

17:15-19:30 - Poster Session and Dinner in the Ivor Crew Lecture Theatre
19:30-21:30 - Fish-based Pub Quiz also in the Ivor Crew Lecture Theatre

WEDNESDAY

06:10-07:15 - Spawning run along the river (see section below for further details)
17:30-19:30 - BBQ on the Plaza by the Silberrad Student Centre and visit the
"Connecting Shoals" Art Exhibition being held all week at the Art Exchange (see section below for further details).

19:30-21:30 - *Riverwoods* Documentary plus Q&A from Executive Producer Chris Howard in the Ivor Crewe Lecture Theatre. Chris is also our Thursday night banquet speaker!



Over many centuries, the loss of Scotland's natural woodlands and much of the wildlife that shaped them, has profoundly changed our rivers. Not so long ago, huge runs of Atlantic salmon returned each year from the sea, found their way into the cool, tree-lined headwaters of Scotland's rivers and having spawned the next generation, most of these titanic fish died, their carcasses fuelling entire ecosystems.

Today, many of those rivers flow through bare, treeless landscapes, the legacy of centuries of burning, felling and overgrazing. Without the shade and nutrients provided by trees, rising water temperatures are impacting Scotland's salmon and this magnificent creature is threatened like never before.

In 2022, SCOTLAND: The Big Picture launched a spectacular feature-length documentary, narrated by Peter Capaldi. Three years in the making, Riverwoods shines a light on the perilous state of Scotland's salmon, and tells the compelling story of a fish that once lived in the forest. And in the soil that feeds the forest. And in the predators, scavengers and even herbivores of the forest. Scotland's Atlantic salmon - the King of Fish - is not only the ultimate angler's prize, but a key building block in a complex forest ecosystem.

THURSDAY

17:45 Coaches from Car Park A (see map above) to Prested Hall for **Banquet & Medal Ceremony**

Held in the beautiful 14th century Prested Hall, the mansion is equipped not only with a partial moat but also the only hotel in the world with two "real tennis" courts - this being the original game of tennis from which the modern version was derived.

The banquet will include FSBI President awarding the FSBI 2023 Medal Award winners with medals and a Banquet Speech by ***Chris Howard (Silverback Productions).*** *There will also be dancing, accompanied by music from* ***JamJar Band.***

Return coaches will depart from Prested Hall at **23:15** to the University, with an earlier bus departing around 22:00 (or once reasonably full).

22:00 (approx) Early coach back to campus.
23:15 Last coach departs to return to campus.

FRIDAY

12:00-14:00 Awards and Closing ceremony at Lake View room in the Silberrad Student Centre.

REMINDER OF KEY LOCATIONS (also see campus map above): www.tinyurl.com/FSBI2023

WEDNESDAY SPAWNING RUN

Inspired by the American Fisheries Society we are having an early morning 'Spawning Run' along the riverside on Weds morning. This is a fun run, but we do expect you to take it seriously by wearing appropriate clothing (e.g. decent trainers, layers, sunscreen) and to come hydrated. The route can be narrow at points so please be considerate of each other and members of the public, and be respectful and quiet on the stretch that goes through a residential area. There will be marshalls and some water halfway round (see route below) - please say a big thank you to them for joining us so early!! And finally, please read the information below, which we will also read out to you before the run. If you do still take part you are accepting that you are doing so entirely at your own risk and that it is your responsibility to ensure that you are fit and able to take part in the event.

Participants on this 5km run are doing this activity at their own risk, and the University of Essex does not accept responsibility for injury, loss and damage sustained by a participant unless the above injury, loss and damage is proven to have been caused as a direct result of negligence on the part of the organisers.

Running is a physically active sport, and - if in doubt about your physical ability - you should seek advice from your doctor before taking part.

Detailed plan:

- Meet at the South Courts courtyard (starred below and also on google map) at 06:10am.
- Walk together to the starting point on the trail.
- Paddy Keith will recap on the route and the risks before the run begins.
- Run starts at 06:30am

Route is shown on map below and on google map linked above, but – in brief - run along the forest trail, with river on the right hand side. After approximately 1.5km take the righthand fork onto the trail along the river embankment (signalled by marshall and first-aider Prof Leanne Hepburn). At the end of the trail follow Old Ferry Road (signalled by marshall Nonny Scott) and stay on this road until you reach the roundabout at the train station. Turn left into the train station car park and grab a water from marshall Alice Malcom-McKay. Continue along the Wivenhoe Trail (adjacent to rail track) all the way back to the starting point where Mike Bevins Cameron will welcome you back in!

ART EXHIBITION AND ARTIST IN RESIDENCE

Connecting Shoals: an art exhibition to connect people to the coast and Ocean

'Connecting Shoals' is an exhibition which explores how art can enhance understanding and engagement with science, specifically the coast and Ocean. Through this exhibition, we will collect data to understand the effectiveness of art and our exhibition in engaging local communities with the issues affecting The Ocean and our scientific research. The exhibition showcases the work of three artists: Lucy MacBrayne (https://lucymacbrayne.com/), Jane Stewart (https://www.janestewartartist.com/), both local, and INSTAR (https://www.we-are-instar.co.uk/), as well as artwork from local school children (selected through an art competition!).

As an island country, the UK has so much wild and beautiful coastline, yet many people do not feel connected to it. Essex has one of the longest coastlines of any county in England, with over 350 miles of beautiful beaches, picturesque villages and vibrant towns. We hope this exhibition inspires you to connect with the coast and The Ocean, to wonder at our waters, shoals and shores, and spend more time enjoying our precious coastal environment.

The exhibition is showing all week at the Art Exchange (see times below) and we encourage you to drop in, but in particular we welcome you to visit during the **18:00-20:00 window on Wednesday** when we will be at the BBQ right beside it. On that evening, two of the artists will be there to talk to about their work.

In addition, Lucy MacBrayne will be with us all week as our Artist in Residence. She uses collage, painting, mark making and printing to create abstract, colourful and textured pieces. Nature is her "go to" inspiration and we encourage you to talk to her, to discuss your research and any interests you have in art and science communication, but also to talk about your fears and hopes in this period of global change.

Lucy MacBrayne, our Artist in Residence. Talk to her and visit our Connecting Shoals Art Exhibition!

https://lucymacbrayne.com/

JOURNAL OF FISH BIOLOGY SPECIAL ISSUE – Call for Papers

Fish habitat ecology in a changing climate (FSBI 2023 Symposium)

Submit here by Thursday, 31 August 2023. Email the Guest Editors if you are considering to submit a paper, but would need an extension.

Guest Editors:
Eoin O'Gorman; Anna Sturrock; Rui Vieira; David Murray; Martin Wilkes

Perspectives, reviews, and meta-analyses are strongly encouraged, especially with respect to future developments in the field. Consideration will also be given to other important or timely subjects that are related to, but not explicitly stated, in the themes above.

Submission Guidelines/Instructions
Please refer to the **Author Guidelines** to prepare your manuscript. When submitting your manuscript, please answer the question: "Is this submission for a special issue?" by selecting the special issue title from the drop-down list.

Topics for this call for papers include but not restricted to:

FISH BIOGEOGRAPHY
- Impacts of global change on fish life histories, ecophysiology, phenology, behaviour, or fitness
- Fish distribution, habitat, and niche modelling
- Climate change forecasting
- Assessing fish habitat needs, environmental tolerances and stock structure via telemetry, genetics, otolith chemistry, catch data, etc.

HABITAT MANAGEMENT / RESTORATION
- Essential fish habitat and nursery areas
- Habitat protection/restoration (e.g. MPA network design)
- Spatial planning and future proofing
- Habitat quality indices, e.g. fish abundance, growth, condition

SOCIAL-ECOLOGICAL CONNECTIVITY
- Fish migration and connectivity research using tagging, video analysis, biogeochemical tracers, isoscapes, genetics, biophysical modelling etc.
- Global change impacts on fish movement and phenology
- Social-ecological systems and policy
- Ecosystem and fisheries management

FOOD WEB DYNAMICS
- Trophic ecology, predator/prey dynamics, dietary studies, stable isotope analysis
- Match-mismatch dynamics
- Community ecology, biodiversity, ecosystem function, and resilience
- Intra and interspecific competition

ONE HEALTH
- Fish / human health and welfare in aquaculture, angling, fisheries, and the aquarium trade
- Behavioural and physiological responses of fish to environmental stressors
- Fish pathology, parasites, and sea lice
- Human seafood consumption habits and recommended intake levels

Keywords: *global change; distributions; biogeography; food webs; habitat restoration; life stages; socioecological connectivity; production; human wellbeing*

Date	VERY EARLY	MORNING				LUNCH	AFTERNOON			EVENING
Mon 24th July		REGISTRATION *in EBS Foyer*				LUNCH	***WORKSHOPS** in EBS 2.2* *1. Shine a light on your research using graphical abstracts (Kirsty Bradley)* *2. How to get published (Michel Kaiser)*	BREAK Coffee, tea	***SPECIAL INTEREST GROUPS (various rooms)** brainstorming reviews*	DINNER & PUTTING UP POSTERS - *Ivor Crewe Lecture Theatre* - THEN WINE RECEPTION *at Wivenhoe House*
			EXCURSION *with packed lunch (09:30-13:30). Tour of a fish pass on the River Stour (Dedham) or a saltmarsh restoration project (Abbotts Hall).*							
				DIADESLAND *board game with lunch (11:00-13:30). Managing diadromous fishes in the face of global change.*						
Tues 25th July		BREAKFAST *+ coffee in EBS foyer*	OPENING CEREMONY	*1 - PREDICTING FISH DISTRIBUTIONS*		LUNCH *EBS Foyer*	*1 - PREDICTING FISH DISTRIBUTIONS*			POSTER SESSION & DINNER THEN FISH QUIZ *in Ivor Crewe Lecture Theatre*
				JACK JONES LECTURE [STEVE CAMPANA] THEN TALKS	BREAK Coffee, tea	TALKS	KEYNOTE [DAVID SIMS] THEN TALKS	BREAK Coffee, tea	TALKS	
Wed 26th July	SPAWNING RUN *(5km fun run along river)*	BREAKFAST *+ coffee in EBS foyer*	*2 - FISH AND HABITAT MANAGEMENT*			AGM (2.34) & LUNCH	*3 - CRITICAL HABITATS*			BBQ ON PLAZA THEN MOVIE NIGHT *in Ivor Crewe Lecture Theatre (showing Riverwoods doc; Q&A with Exec Producer Chris Howard)*
			KEYNOTE [EMMA SHEEHAN] THEN TALKS		BREAK Coffee, tea	TALKS	KEYNOTE [RICHARD UNSWORTH] THEN TALKS	BREAK Coffee, tea	TALKS	
Thurs 27th July		BREAKFAST *+ coffee in EBS foyer*	*4 - FISH IN FOOD WEBS*			LUNCH *EBS Foyer*	*5 - ONE HEALTH*			BANQUET & MEDAL CEREMONY *in Prested Hall then band & dancing (buses there and back)*
			KEYNOTE [EOIN O'GORMAN] THEN TALKS		BREAK Coffee, tea	TALKS	KEYNOTE [BAUKJE DE ROOS] THEN TALKS	BREAK Coffee, tea	TALKS	
Fri 28th July		BREAKFAST *+ coffee in EBS foyer*	*6 - FISH MOVEMENT & CONNECTIVITY*			LUNCH & PRIZES *Lakeview Room*				
			KEYNOTE [BRONWYN GILLANDERS] THEN TALKS		BREAK Coffee, tea	TALKS				

FULL PROGRAMME

Monday 24th July

<table>
<tr><th>Start time</th><th>REGISTRATION</th><th>EXCURSIONS</th><th>DIADESLAND</th><th>WORKSHOPS & SPECIAL INTEREST GROUPS</th></tr>
<tr><td>08:30</td><td rowspan="12">Registration in Essex Business School (EBS) foyer</td><td></td><td></td><td></td></tr>
<tr><td>09:30</td><td>Meet at EBS then walk to bus stop (Car Park B)</td><td></td><td></td></tr>
<tr><td>10:00</td><td>Bus to field site ("river" = Dedham Mill with Darren Tansley or "saltmarsh" = Abbots Hall with Tom Cameron)</td><td></td><td></td></tr>
<tr><td>10:30</td><td rowspan="2">Walking tour then packed lunch</td><td></td><td></td></tr>
<tr><td>11:00</td><td rowspan="3">Play DiadESland in EBS (ask for room number at registration desk). Lunch at ~12:30pm</td><td></td></tr>
<tr><td>12:30</td><td>Bus back to campus</td><td rowspan="2">Lunch for folks arriving for afternoon workshops (EBS Foyer)</td></tr>
<tr><td>13:00</td><td>Walk back to EBS</td></tr>
<tr><td>13:30</td><td></td><td></td><td>Shine a light on your research using graphical abstracts - Kirsty Bradley (EBS 2.2)</td></tr>
<tr><td>14:05</td><td></td><td></td><td>Fishing for exposure: tips on how to promote your research on Twitter - Will Perry (EBS 2.2)</td></tr>
<tr><td>14:10</td><td></td><td></td><td>How to get published - Michel Kaiser (EBS 2.2)</td></tr>
<tr><td>14:45</td><td></td><td></td><td>David Murray instructions for Special Interest Groups (EBS 2.2)</td></tr>
<tr><td>15:00</td><td>Break</td><td></td><td></td><td></td></tr>
<tr><td>15:30</td><td></td><td></td><td></td><td>Special Interest Groups (small group discussions in EBS - various rooms)</td></tr>
<tr><td>17:30</td><td colspan="4">Dinner & putting up posters (Ivor Crewe Lecture Theatre)</td></tr>
<tr><td>19:00</td><td colspan="4">Ice breaker reception in Wivenhoe House with the Motley Crew Sea Shanty Group</td></tr>
<tr><td>21:30</td><td colspan="4">End of ice breaker</td></tr>
</table>

Tuesday 25th July - am

Talk ID	Start time	Description		Location
	08:30	Tea & coffee		EBS Foyer
	09:00	OPENING CEREMONY		EBS 2.2
		SESSION 1: UNDERSTANDING & PREDICTING FUTURE FISH DISTRIBUTIONS		
K1	**09:30**	**STEVE CAMPANA (Keynote)**	**JACK JONES LECTURE: A CENTURY-SCALE PERSPECTIVE ON SHIFTING BASELINES IN FISH DISTRIBUTION AND GROWTH**	**EBS 2.2**
O1	10:10	John Pinnegar	FUTURE PROJECTIONS OF SUITABLE HABITAT FOR 49 COMMERCIAL FISH SPECIES: HOW WILL FISHERIES ALLOCATION AND CONSERVATION OBJECTIVES BE AFFECTED?	EBS 2.2
O2	10:20	Sarah Gravel	FISH POPULATION DYNAMICS AND THE ROLE OF OXYGEN AS HABITAT	EBS 2.2
O3	10:30	Susanne Tanner	CLIMATE-DRIVEN SYNCHRONY IN MARINE AND TERRESTRIAL ECOSYSTEMS FROM THE MID-ATLANTIC RIDGE TO SOUTHERN EUROPE	EBS 2.2
	10:40	Q&A / discussion		EBS 2.2
	10:55	Break		EBS Foyer
O4	11:25	Eric Diaz-Delgado	CAN ISOTOPIC COMPOSITIONS OF VERTEBRAE AND TEETH ESTIMATE FIELD METABOLIC RATES IN ELASMOBRANCHS?	EBS 2.2
O5	11:35	Ming-Tsung Chung	MOVEMENT, TROPHIC, AND METABOLIC ECOLOGY OF MARINE FISH: EVIDENCE FROM A MULTIPLE-TISSUE ISOTOPE APPROACH	EBS 2.2
O6	11:45	Clive Trueman	THERMAL SENSITIVITY OF FIELD METABOLIC RATE IN MARINE TELEOSTS	EBS 2.2
S1	11:55	Asta Audzijonyte	TEMPERATURE, HUMANS AND FISH SIZES	EBS 2.2
S2	11:58	Alexia González-Ferreras	THERMAL ADAPTATION INCREASES ENERGETIC EFFICIENCY OF BROWN TROUT IN WARMER ENVIRONMENTS	EBS 2.2
	12:01	Q&A / discussion		EBS 2.2
	12:15	Lunch		EBS 2.2

Tuesday 25th July - pm

SESSION 1: UNDERSTANDING & PREDICTING FUTURE FISH DISTRIBUTIONS				
K2	**13:15**	**DAVID SIMS (Keynote)**	**TRACKING DYNAMIC SPACE USE OF OCEANIC SHARKS UNDER CLIMATE CHANGE, OVERFISHING & INCREASING MARINE TRAFFIC**	**EBS 2.2**
O7	13:55	David Righton	THE RETURN OF ATLANTIC BLUEFIN TUNA (THUNNUS THYNNUS) TO UK WATERS: OBSERVATIONS AND INTERPRETATIONS	EBS 2.2
O8	14:05	Warren Potts	HOOK AND LINE FISHING REDUCES THE POTENTIAL FOR PHYSIOLOGICAL ADAPTATION TO THE IMPACTS OF CLIMATE CHANGE	EBS 2.2
M1	**14:15**	**Nicholas Dulvy (Medal Winner)**	**GLOBAL BIOGEOGRAPHY OF SHARK CONSERVATION**	**EBS 2.2**
	14:30	Q&A / discussion		EBS 2.2
	14:45	Break		EBS Foyer
O9	15:15	Filipe Martinho	INTERANNUAL VARIABILITY IN EARLY LIFE PHENOLOGY IS DRIVEN BY CLIMATE AND OCEANIC PROCESSES IN TWO NE ATLANTIC FLATFISHES	EBS 2.2
O10	15:25	Marcelo Gomes	THE INFLUENCE OF ENVIRONMENTAL PARAMETERS ON THE LONG-TERM VARIABILITY OF SPECIES RICHNESS IN TRAIT-BASED COMMUNITIES IN THE SOUTHERN NORTH SEA AND ENGLISH CHANNEL	EBS 2.2
O11	15:35	Benjamin Ciotti	PHYSICAL DRIVERS OF HABITAT USE IN SURF ZONE FISHES	EBS 2.2
	15:45	Q&A / discussion		EBS 2.2
O12	15:55	Anaïs Janc	MARINE-ESTUARINE OPPORTUNIST FISH SPECIES FUTURE DISTRIBUTIONS IN THE NORTHEAST ATLANTIC OCEAN, UNDER ANTHROPOGENIC CLIMATE CHANGE	EBS 2.2
O13	16:05	Sam Fenton	THE ADAPTIVE DIVERSITY OF ARCTIC CHARR (SALVELINUS ALPINUS) IN SCOTLAND	EBS 2.2
O14	16:15	William Yeomans	RECOLONISATION OF THE RIVER CLYDE BY ATLANTIC SALMON (SALMO SALAR), A 40 YEAR CASE STUDY	EBS 2.2
S3	16:25	Domino Joyce	WHAT DETERMINES EMIGRATION SUCCESS OF ATLANTIC SALMON SMOLTS IN SCOTTISH RIVERS?	EBS 2.2
	16:30	Q&A / discussion		EBS 2.2
	16:40	Short break		EBS 2.2
S4	16:50	David Jacoby	COMBINED ENVIRONMENTAL STRESSORS REDUCE CORAL REEF RESIDENCY IN GREY REEF SHARKS (CARCHARHINUS AMBLYRHYNCHOS)	EBS 2.2
S5	16:53	Antonia Klöcker	ON THE EDGE – DECIPHERING DISTRIBUTION PATTERNS OF BASKING SHARKS IN THE ARCTIC	EBS 2.2
S6	16:56	Jonathan Ellis	CHANGES IN CELTIC SEAS COD DISTRIBUTION ARE NOT ALWAYS ASSOCIATED WITH DECLINES IN ABUNDANCE	EBS 2.2
S7	16:59	Joseph Watson	NORTHEAST ATLANTIC MACKEREL; AN INDIVIDUAL BASED MODEL TO AID SPATIAL MANAGEMENT.	EBS 2.2
S8	17:02	Phakama Nodo	FISH DISTRIBUTION IN THE SHALLOW MARINE NEARSHORE AND ESTUARINE SEASCAPES: NURSERY AREAS AND THE EFFECT OF ENVIRONMENTAL DRIVERS	EBS 2.2
S9	17:05	Bram Parmentier	SMALL BOTTOM FISH DISTRIBUTION IN THE DUTCH EEZ	EBS 2.2
	17:15	**Poster session & dinner**		**Ivor Crewe**
	19:30	**Fish Quiz**		**Ivor Crewe**

Wednesday 26th July - am

Talk ID	Start	Description		Location
	06:10	**SPAWNING RUN**	**5km fun run to Wivenhoe and back**	**See map**
	08:30	Tea & coffee		EBS Foyer
		SESSION 2: FISH AND HABITAT MANAGEMENT		
K3	**09:00**	**EMMA SHEEHAN (Keynote)**	**BUILDING ECOSYSTEM RESILIENCE AND PROSPEROUS SUSTAINABLE FISHERIES WITH A WHOLE SITE APPROACH TO MARINE PROTECTION**	**EBS 2.2**
O15	09:35	Paul Hart	CAN FISHERS BE GIVEN THE RESPONSIBILITY TO MANAGE THEIR OWN FISHERY? A MODELLING STUDY.	EBS 2.2
O16	09:45	Kieran Hyder	USING SPATIALLY EXPLICIT INDIVIDUAL-BASED MODELS TO SUPPORT MANAGEMENT OF THE EUROPEAN SEA BASS	EBS 2.2
O17	09:55	Joanna Ford	A CATCH TAG AND RELEASE PROGRAMME FOR ATLANTIC BLUEFIN TUNA IN THE UK - A CROSS-SECTIONAL APPROACH	EBS 2.2
	10:05	Q&A / discussion		EBS 2.2
	10:20	Break		EBS Foyer
O18	10:50	Phil Hollyman	TIME SERIES AND COMMUNITY BASED ANALYSIS OF A SUB-ANTARCTIC DEMERSAL FISH ASSEMBLAGE, USING A 36-YEAR SURVEY DATASET.	EBS 2.2
O19	11:00	John Robinson	RIVER RESTORATION IN ACTION: RECOVERING ENDANGERED ATLANTIC SALMON AND AQUATIC ECOSYSTEMS ONE NATIONAL PARK AT A TIME	EBS 2.2
O20	11:10	Colin Bull	A NEW MANAGEMENT DECISION-SUPPORT TOOL FOR PREDICTING THE RESPONSES OF ATLANTIC SALMON (SALMO SALAR) POPULATIONS TO CHANGING CONDITIONS	EBS 2.2
S10	11:20	Tea Bašić	ECOSYSTEM SERVICES PROVIDED BY DIADROMOUS SPECIES ACROSS THE NORTH ATLANTIC AREA: A SCOPING REVIEW AND ASSESSMENT OF EVIDENCE	EBS 2.2
S11	11:23	Graeme Cullen	A SEASCAPE APPROACH TO IMPROVING FISHERIES SUSTAINABILITY AND RESTORATION: DISTRIBUTION, HABITAT RELATIONSHIPS AND MOVEMENT ECOLOGY OF JUVENILE GADOIDS IN SCOTTISH WEST COAST INSHORE SEAS	EBS 2.2
S12	11:26	Mar Pineda	FISHING IN THE AMAZON: EXPLORING THE POTENTIAL FOR FISHING-INDUCED EVOLUTION IN THE AQUARIUM INDUSTRY	EBS 2.2
	11:29	Q&A / discussion		EBS 2.2
	11:45	Lunch / Free time to explore campus, walk to river, meet with SI groups		EBS Foyer
	12:00	**FSBI AGM (lunch provided in room)**		**EBS 2.34**

Wednesday 26th July - pm

		SESSION 3: PROTECTING & RESTORING CRITICAL HABITATS		
K4	**14:00**	**RICHARD UNSWORTH (Keynote)**	**ARE COASTAL HABITATS REALLY A SOURCE OF ESSENTIAL FISH HABITAT? EXAMINING THE EVIDENCE**	**EBS 2.2**
O21	14:35	Molly Kressler	ESTUARIES AND THEIR SHARKS: A STORY OF REFUGE AND PROTECTION	EBS 2.2
O22	14:45	Howard Freeman	WHAT MAKES A HABITAT A HOME: HABITAT ASSOCIATIONS OF JUVENILE EUROPEAN SEA BASS, DICENTRARCHUS LABRAX, IN ESTUARINE NURSERIES	EBS 2.2
O23	14:55	Nicola James	NURSERY ROLE OF RED ALGAE DOMINATED REEF IN TEMPERATE ALGOA BAY, SOUTH AFRICA	EBS 2.2
O24	15:05	Andrew McMains (AFS fellow)	DIEL MOVEMENT BEHAVIOR AND RESIDENCE TIME OF AN ESTUARINE FISH SPECIES ASSOCIATED WITH A COMMERCIAL OYSTER FARM	EBS 2.2
	15:15	Q&A / discussion		EBS 2.2
	15:30	Break		EBS Foyer
M2	**16:00**	**Rajeev Raghavan**	**SERENDIPITY, SOCIAL MEDIA AND CITIZEN SCIENCE: DISCOVERING AND UNDERSTANDING INDIA'S ENIGMATIC GROUNDWATER AND SUBTERRANEAN FISHES**	**EBS 2.2**
O25	16:15	Ashley Townes	THE INFLUENCE OF HABITAT CHARACTERISTICS AND DENSITY-DEPENDENCE ON SPATIAL DISTRIBUTIONS OF SPAWNING SOCKEYE SALMON (ONCORHYNCHUS NERKA)	EBS 2.2
O26	16:25	Malte Willmes	OTOLITHS REVEAL THE HIDDEN DIVERSITY OF THREATENED CALIFORNIAN SALMON ACROSS THE AGES	EBS 2.2
O27	16:35	Hanna ten Brink	EXPLORING THE ROLE OF THE WADDEN SEA AND OTHER NURSERY AREAS IN THE DECLINE OF MARINE JUVENILE GUILD FISH POPULATIONS	EBS 2.2
	16:45	Q&A / discussion		EBS 2.2
	17:00	Short break		EBS Foyer
S13	17:05	Kirsty Richards	A TEMPORAL ASSESSMENT OF FISH DIVERSITY AND ABUNDANCE WITHIN THE UNIQUE HYPER-SALINE ENVIRONMENT OF HAMELIN POOL, SHARK BAY UNESCO WORLD HERITAGE AREA, WESTERN AUSTRALIA	EBS 2.2
S14	17:08	Emily Cormier	USING REMOTE SENSING TO MAP SEAGRASS AND MANGROVE HABITAT CHANGES IN A LEMON SHARK NURSERY AREA OVER TWO DECADES, TO DETERMINE POTENTIAL IMPLICATIONS ON JUVENILE SHARK SURVIVAL.	EBS 2.2
S15	17:11	Morgan Piczak	KNOWLEDGE OF SPAWNING PHENOLOGY MAY ENHANCE SELECTIVE BARRIER PASSAGE FOR WETLAND OBLIGATE FISHES	EBS 2.2
S16	17:14	Marie Lamour	SEASONAL ESTUARINE HABITAT USE OF THE STOCKED EUROPEAN STURGEON (ACIPENSER STURIO) IN THE GIRONDE ESTUARY.	EBS 2.2
S17	17:17	Luke Pearson	REHABILITATION AND MANAGEMENT OF PONDS FOR CONSERVATION, WITH EMPHASIS ON SELF-SUSTAINING POPULATIONS OF FISHES OF CULTURAL HERITAGE CONCERN	EBS 2.2
S18	17:20	Leanne Hepburn	DISCOVERY OF CORALLIGENOUS REEFS AS ESSENTIAL FISH HABITAT IN THE AEGEAN SEA, EASTERN MEDITERRANEAN	EBS 2.2
	17:30	**BBQ on Plaza by lake & visit to Art Exchange at the Silberrad Student Centre**		
	19:30	**Riverwoods documentary with Q&A with film maker Chris Howard**		**Ivor Crewe**

Thursday 27th July - am

Talk ID	Start time	Description		Location
	08:30	Tea & coffee		EBS Foyer
		SESSION 4: THE ROLE OF FISH IN FOOD WEBS		
K5	**09:00**	**EOIN O'GORMAN (Keynote)**	**WARMING INDIRECTLY SIMPLIFIES FOOD WEBS THROUGH EFFECTS ON APEX PREDATORS**	**EBS 2.2**
S19	09:30	Patrick Eskuche-Keith	ECOMORPHOLOGY AND ALLOMETRIC FEEDING RELATIONSHIPS OF THE SOUTH GEORGIA GROUNDFISH COMMUNITY	EBS 2.2
S20	09:35	Amy Shurety	ENVIRONMENTAL DRIVERS OF NORTHERN ATLANTIC MARINE TROPHIC INTERACTIONS	EBS 2.2
O28	09:40	Emma Tyldesley	DECLINING FOOD AVAILABILITY FOR FORAGE FISH LARVAE IN THE NORTHEAST ATLANTIC: AN INDICATOR FOR ATLANTIC SALMON MARINE SURVIVAL	EBS 2.2
O29	09:50	Robert Thorpe	ACHIEVING "GOOD ENVIRONMENTAL STATUS" IN THE NORTH SEA FOR FOODWEBS: A NEW WAY OF THINKING?	EBS 2.2
O30	10:00	Georgina Hunt	LONG-TERM TRENDS IN THE DIET OF SIX PREDATORY FISH SPECIES IN THE WESTERN NORTH SEA	EBS 2.2
	10:10	Q&A / discussion		EBS 2.2
	10:20	Break		EBS Foyer
O31	10:50	Stina Kolodzey	SMALL SCALE DIFFERENCES IN BLUE COD LENGTH DISTRIBUTION, GROWTH, AND TROPHIC ECOLOGY IN NEW ZEALAND	EBS 2.2
O32	11:00	Naoki Kabeya (JSFS rep)	DIVERSIFICATION OF THE BIOSYNTHETIC PATHWAY OF LONG-CHAIN POLYUNSATURATED FATTY ACIDS IN FISH	EBS 2.2
O33	11:10	Casey Benkwitt	NATURAL NUTRIENT SUBSIDIES AFFECT BEHAVIOUR OF FUNCTIONALLY-IMPORTANT HERBIVORES ON CORAL REEFS	EBS 2.2
	11:20	Q&A / discussion		EBS 2.2
	11:30	Short break		EBS 2.2
M3	**11:35**	**Nick Polunin (Medal Winner)**	**'ISOTRIANGLES': EXPLORING PELAGIC VS BENTHIC DRIVERS OF CORAL REEF FOOD-WEBS**	**EBS 2.2**
O34	11:50	Oriol Canals	GENETIC TOOLS FOR TROPHIC ECOLOGY STUDIES: A STEP TOWARDS THE INTEGRATION OF DIETARY DNA ANALYSIS INTO FISHERIES RESEARCH	EBS 2.2
O35	12:00	Stephen Wing	OVEREXPLOITATION AND DECLINE IN KELP FORESTS INFLATE THE BIOENERGETIC COSTS OF FISHERIES	EBS 2.2
M4	**12:10**	**Sofia Graça Aranha (Medal winner)**	**A GLIMPSE INTO THE TROPHIC ECOLOGY OF DEEP-WATER SHARKS IN AN IMPORTANT CRUSTACEAN FISHING GROUND**	**EBS 2.2**
	12:25	Q&A / discussion		EBS 2.2
	12:35	Lunch		EBS foyer

Thursday 27th July - pm

		SESSION 5: ONE HEALTH		
K6	**13:35**	**BAUKJE DE ROOS (Keynote)**	**BUCKLAND LECTURE: FISH AS FOOD – HOW MUCH DO WE HAVE, WHAT DO WE EAT AND WHAT SHOULD WE BE EATING?**	**EBS 2.2**
O36	14:10	Katie Dunkley	MUTUALISTIC CLEANING INTERACTIONS ACROSS A SPECIES DIVERSITY GRADIENT	EBS 2.2
O37	14:20	Nildeniz Karakuş	PERSISTENCE OF A COINVADING PARASITE AFTER ERADICATION OF TOPMOUTH GUDGEON PSEUDORASBORA PARVA	EBS 2.2
O38	14:30	Lauren Nadler	HOW A BRAIN-INFECTING PARASITE ALTERS ENERGY METABOLISM IN A SHOALING FISH: IMPLICATIONS FOR CONDITIONED FEAR RESPONSES AND MECHANISMS OF BEHAVIOR-MODIFICATION	EBS 2.2
	14:40	Q&A / discussion		EBS 2.2
	14:50	Break		EBS Foyer
O39	15:20	Daniel Sadler	FISHERIES-INDUCED EVOLUTION DRIVE GENOMIC SHIFTS EVEN AFTER A PERIOD OF RECOVERY	EBS 2.2
O40	15:30	Ben Parker	FRESHWATER FISHES AND MICROPLASTICS IN AN ERA OF MULTIPLE STRESSORS	EBS 2.2
O41	15:40	Jonathan Gillson	MARINE STRESSORS IMPACTING ATLANTIC SALMON (SALMO SALAR), WITH AN ASSESSMENT OF THE MAJOR THREATS TO ENGLISH STOCKS	EBS 2.2
O42	15:50	Rachel Johnson	LINKAGES BETWEEN MARINE FOOD WEBS, THIAMINE DEFICIENCY, AND REPRODUCTIVE FAILURE IN CALIFORNIA SALMON, USA	EBS 2.2
	16:00	Q&A / discussion		EBS 2.2
	16:15	Short break		EBS 2.2
S21	16:18	Demetra Andreou	TEMPERATURE INFLUENCE ON FISH IMMUNITY	EBS 2.2
S22	16:21	Stellia Sebihi	USING DIAZEPAM TO INVESTIGATE THE EFFECT OF STRESS ON THE FACULTATIVE MIGRATION OF EUROPEAN GLASS EEL (ANGUILLA ANGUILLA)	EBS 2.2
S23	16:24	Colin Bouchard	ALTERATIONS BY A PSYCHIATRIC DRUG OF THE MIGRATORY BEHAVIOR OF ANGUILLA ANGUILLA	EBS 2.2
S24	16:27	Anneli Löfstedt	OPTIMISING FISH PRODUCTION FOR HUMAN HEALTH, A PROPOSAL FOR MSNY: MAXIMUM SUSTAINABLE NUTRITIONAL YIELD (*Note: updated title from printed programme*)	EBS 2.2
	16:30	Break		
	17:45	**Buses to Prested Hall**		
	18:15	**BANQUET, MEDAL AWARDS, BANQUET SPEECH (CHRIS HOWARD), JAMJAR BAND**		
	23:15	**Buses back to campus**		

The One Health keynote speaker was generously sponsored by The Buckland Foundation.

SEA-UNICORN
cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY
Funded by the European Union

Talk ID	Start time	Description		Location
	08:30	Tea & coffee		EBS Foyer
		SESSION 6: FISH MOVEMENT & CONNECTIVITY		
O43	09:00	Audrey Darnaude	UNIFYING RESEARCH ON MARINE FUNCTIONAL CONNECTIVITY TO ADVANCE KNOWLEDGE ON THE ECOLOGICAL IMPLICATIONS OF FISH MOVEMENTS	EBS 2.2
K7	**09:15**	**BRONWYN GILLANDERS (Keynote)**	**ESTIMATING MOVEMENTS AND CONNECTIVITY PATTERNS OF FISH ACROSS A CHANGING SEASCAPE**	**EBS 2.2**
O44	09:55	Chiara Papetti	HOW MUCH GENE FLOW IN CHIONODRACO RASTROSPINOSUS AMONG THE ANTARCTIC PENINSULA AND THE WEDDELL SEA?	EBS 2.2
S25	10:05	Tea Basic	INTERCONNECTIVITY BETWEEN TWAITE SHAD (ALOSA FALLAX) POPULATIONS IN THE NORTH ATLANTIC REGION	EBS 2.2
	10:10	Q&A / discussion		EBS 2.2
	10:25	Break		EBS Foyer
S26	11:00	Paul Franklin	SPATIO-TEMPORAL MOVEMENTS AND ENTRAINMENT OF SHORTFIN EELS AT FLOOD PUMPING STATIONS	EBS 2.2
S27	11:03	Michael Williamson	THE ENVIRONMENTAL DRIVERS OF MOVEMENT AND BEHAVIOUR OF EUROPEAN EELS IN UK RESERVOIRS	EBS 2.2
S28	11:06	Rachel Mawer	FISH PASSAGE AND HABITAT SELECTION IN AN ALTERED ENVIRONMENT: ANALYSING THE FINE SCALE HABITAT SELECTION OF UPSTREAM MIGRATING FISH NEAR A HYDROPOWER PLANT	EBS 2.2
S29	11:09	Michał Skóra	PINK SALMON (ONCORHYNCHUS GORBUSCHA) INVASION IN THE NORTH ATLANTIC	EBS 2.2
S30	11:12	Anthony Fontaine	HOMING AND STRAYING OF ATLANTIC SALMON (SALMO SALAR) IN THE NEW AQUITAINE REGION USING OTOLITH MICROCHEMISTRY	EBS 2.2
	11:15	Short break		EBS 2.2
S31	11:20	Lee Gutowsky	THE LAKE WINNIPEG BASIN FISH TELEMETRY PROJECT	EBS 2.2
O46	11:25	Edel Lheureux	DISTINGUISHING BIOLOGICAL FROM OBSERVATION PROCESSES TO BETTER UNDERSTAND ENVIRONMENTAL EFFECTS ON THE MIGRATION PHENOLOGY OF THE ATLANTIC SALMON (SALMO SALAR) IN A CLIMATE CHANGE CONTEXT	EBS 2.2
O47	11:35	Audrey Geffen	HOW WELL DOES DRIFT MODELLING STACK UP TO OTHER EVIDENCE OF DISPERSAL AND CONNECTIVITY – AND CASE STUDY OF IRISH SEA PLAICE	EBS 2.2
	11:45	Q&A / discussion		EBS 2.2
12:00-14:00		**Lunch, prize giving & Closing Ceremony in the Lake View Room in the Silberrad Student Centre**		

This final session was generously sponsored by COST Action CA19107 - *Unifying Approaches to Marine Connectivity for improved Resource Management for the Seas* (www.sea-unicorn.com; www.cost.eu).

ABSTRACTS

KEYNOTE SPEAKERS

K1 JACK JONES LECTURE: Prof Steven Campana, University of Iceland

Prof. Steven Campana worked as a Senior Scientist at the Bedford Institute of Oceanography in Canada for 32 years, where he headed both the Otolith Research Laboratory and the Canadian Shark Research Laboratory. He is now working as a Professor at the University of Iceland, where he leads an active research program on the population dynamics of bony fish and sharks, with particular emphasis on climate effects, age determination, satellite and acoustic tracking, and the development of new otolith-based applications.

A CENTURY-SCALE PERSPECTIVE ON SHIFTING BASELINES IN FISH DISTRIBUTION AND GROWTH

When each generation of fisheries scientists accepts as a baseline the stock abundance that occurred at the beginning of their careers, the baseline abundance is clearly a function of perspective; it is a shifting baseline. But what about measures of fish population health other than abundance or species composition? Using examples drawn from both marine and freshwater ecosystems, I will show that the shifting baseline syndrome can equally be applied to our perspective on the distribution and relative growth rate of many fish species. However, the perceived baseline is not always in the direction that one might predict, highlighting the importance of a century- or even millenial-scale perspective.

K2: Prof David Sims, Marine Biological Association

Professor David Sims is a Senior Research Fellow at the Marine Biological Association (MBA) Laboratory in Plymouth, and Professor of Marine Ecology at the University of Southampton's National Oceanography Centre Southampton (NOCS). His research focuses on behaviour and movement ecology of sharks, a main aim being to understand how movements, habitat use and spatial re-distribution patterns are influenced by environmental changes and anthropogenic impacts and the consequences for threatened species conservation. He obtained some of the first long-term trackings of sharks using satellites and initiated and leads the Global Shark Movement Project involving more than 150 scientists from 26 countries (www.globalsharkmovement.org). He has authored over 200 scientific papers including numerous articles in Nature, Science and PNAS. He is the recipient of research awards including the FSBI Medal (2007), the ZSL Marsh Award for Marine Conservation (2019), and an ERC Advanced Grant (2020).

TRACKING DYNAMIC SPACE USE OF OCEANIC SHARKS UNDER CLIMATE CHANGE, OVERFISHING AND INCREASING MARINE TRAFFIC

Oceanic pelagic sharks have declined globally over the past few decades with many populations continuing to decline. Conservation and management actions are hampered by basic knowledge gaps about behaviour, movement patterns, essential habitats, drivers of aggregations, climate change impacts, and knowing precisely where and when sharks overlap with anthropic threats such as fishing expoitation and ship strike across their entire population ranges. Without knowing where sharks go and when, and what they do in different habitats, it will remain challenging to understand the impacts of future environmental changes on populations in the face of continued threats. In this keynote I will describe my team's bio-logging research to understand how pelagic shark movement patterns alter in response to variations in environment, and what this means for understanding dynamic habitat use and their interactions with shipping and fishing vessel distributions. I will describe how this knowledge can underpin habitat models to help conserve shark populations, especially in the light of climate warming and ocean deoxygenation, because the interaction between climate change and fishing patterns will have important consequences for where and how sharks are managed in the warmer oceans of the future.

K3: Dr Emma Sheehan, University of Plymouth

Dr Emma Sheehan is an Associate Professor of Marine Ecology at the University of Plymouth. Her research is focused on Marine Protected Areas (MPA), spatial fisheries management and emerging blue industries such as marine renewables and offshore shellfish aquaculture, that if managed to exclude destructive human practices, have the potential to restore the health and functionality of biogenic habitats. To inspire and inform ambitious marine policy and management, Dr Sheehan leads the applied Marine Ecosystems Research unit (https://www.plymouth.ac.uk/research/applied-marine-ecosystems-research-unit/amer) that develops and utilises non-destructive techniques to assess the effectiveness of spatial management for species and habitats over large spatial and temporal scales.

BUILDING ECOSYSTEM RESILIENCE AND PROSPEROUS SUSTAINABLE FISHERIES WITH A WHOLE SITE APPROACH TO MARINE PROTECTION

With effective, strategic management and comprehensive monitoring Marine Protected Areas have the potential to deliver resilient, productive and prosperous seas resulting in benefits for conservation and fisheries.

In Lyme Bay, southwest UK, a mosaic of rocky reef and inter-reef sediment habitats were protected from bottom-towed fishing in 2008, adopting the Whole Site Approach. The Lyme Bay Marine Protected Area (MPA), 206km2, was the first and largest of its kind in the UK as most other MPAs are managed following the Feature Based Approach whereby destructive trawling and dredging is permitted on sediment habitats within MPAs.

Consistent management throughout the MPA across rocky reef features and inter-reef sediment areas has offered a unique opportunity for research on the effectiveness of whole site marine management, something that had never been tested before in the UK. In the following 13 years, interdisciplinary research has developed a unique and critically important dataset that has significantly changed reef management in the UK. The whole site approach increased functional reef habitat, built resilience and site integrity against extreme climatic events, and increased the abundance and diversity of species of conservation and commercial importance.

This research has led to greater protection of the marine environment; new and ambitious marine policy; economic and well-being benefits for fishermen and; a strengthened interdisciplinary evidence base for fisheries management and conservation.

Novel approaches to assess optimum static fishing gear density and the value and connectivity of MPAs for mobile species using acoustic telemetry as part of an Interreg Channel project (FISH INTEL) will also be presente

K4: Dr Richard Unsworth, Project Seagrass, Swansea University

Dr Richard Unsworth's passion lies in understanding the ecological structuring processes of marine systems and the implications of these systems for society. This focuses primarily on the interrelationships between foundation species, habitat, and associated productive fauna (mainly fish). He is particularly interested in the consequences of cross-scale environmental changes on seagrass meadows functioning and the implications of this for global food security and other ecosystem services. Richard is the vice-president of the World Seagrass Association and a founding director of Project-Seagrass and continues to work as a senior scientist at SeagrassWatchHQ.

ARE COASTAL HABITATS REALLY A SOURCE OF ESSENTIAL FISH HABITAT? EXAMINING THE EVIDENCE

Fisheries are globally in decline and although overfishing is a major part of that loss, the rebuilding of this marine life requires improving the coverage of key habitats in their support. In the US, legislation was passed in the 1990s to protect essential fish nursery habitat, arguably leading to sustained conservation in its support. Similar legislation is lacking in many parts of the world, even though the consensus is that complex coastal habitats such as seagrass do provide essential fish habitat. This means that the significant role seagrass meadows play in supporting fisheries productivity and food security across the globe is not adequately reflected in the decisions made by authorities with statutory responsibility for their management. This lack of appreciation for the value of coastal habitats within legal instruments indicates a lack of supporting data, however I argue that the knowledge is there even if significant gaps within it remain. In this talk I will provide an assessment of the evidence for this role, both as an ecological process and based on larger fisheries assessments on a local British Isles and then Global basis

K5: Dr Eoin O'Gorman, University of Essex

Dr Eoin O'Gorman completed his degree in biological sciences and PhD in marine ecology at University College Cork, with Mark Emmerson as his PhD supervisor. He secured a 2-year Irish Research Council fellowship at University College Dublin before moving across the pond to Queen Mary University of London for a post-doc with Guy Woodward, where he first started working on the Hengill geothermal system in Iceland – the subject of his keynote talk. He went on to a 5-year NERC fellowship at Imperial College London before securing a lectureship at the University of Essex, where he has been based since 2019. His research is focused on understanding the impacts of global change across multiple levels of biological organisation in marine, freshwater, and terrestrial ecosystems. He seeks simple rules that lead to stabilising structures, with a focus on body size as a key functional attribute that drives interactions and self-organisation in food webs.

WARMING INDIRECTLY SIMPLIFIES FOOD WEBS THROUGH EFFECTS ON APEX PREDATORS

Warming alters ecosystems through direct physiological effects on organisms and indirect effects via biotic interactions, but their relative impacts in the wild are unknown due to the difficulty in warming natural environments. Here, we bridge this gap by embedding manipulative field experiments within a natural stream temperature gradient to test whether warming and apex fish predators have interactive effects on freshwater ecosystems. Fish exerted cascading effects on algal production and microbial decomposition via both green and brown pathways in the food web, but only under warming. Neither temperature nor the presence of fish altered food web structure alone, but connectance and mean trophic level declined as consumer species were lost when both drivers acted together. A mechanistic model indicates that this temperature-induced trophic cascade is determined primarily by altered interactions, which cautions against extrapolating the impacts of warming from reductionist approaches that do not consider the wider food web.

K6 BUCKLAND LECTURE: Prof Baukje de Roos, University of Aberdeen

Baukje de Roos is a Professor of Nutrition at the Rowett Institute at the University of Aberdeen. She has >25 years of experience in the design and delivery of human dietary intervention studies. Her research focusses on precision and personalised nutrition, and the modelling of healthy and sustainable food systems, with a special focus on seafood. Her Scottish Government-funded research program investigates how production and supplies can be better aligned with consumption and dietary recommendations in the UK's seafood chain, as well as relationships and trade-offs between 'healthiness', 'carbon footprint', and 'cost' to identify the most important potential food switches in real-time UK diets. Her expertise in the area of diet and human health has formed the basis of multiple contracts and consultancies with large food companies, food levy boards, the food and drink support sector, and national UK television.

FISH AS FOOD – HOW MUCH DO WE HAVE, WHAT DO WE EAT AND WHAT SHOULD WE BE EATING? (Sponsored by the Buckland Foundation)

The popularity of fish as food can be traced back in part to Francis Buckland, who, two centuries ago, started to advocate the consumption of fish, believing it was an important source of nutrition for people may not be able to afford other types of meat such as beef, pork and lamb. At that time, fish were abundant in our rivers and oceans. Today, fish remains an important part of many diets around the world, especially for those living near the coast or in fishing communities. Fish is one of the few foods for which we have a dietary recommendation, aiming to enhance consumption, as fish intake reduces our risk for coronary heart disease and stroke. But the way we view and assess the nutritional impact and availability of fish has changed since the time of Buckland, due to the fact that local fish supply is now mostly dependent on global trade. Our research aims to understand how our consumption of seafood relates to food supply chains - what is being produced, what is imported and exported, and how does this relates to what we eat and what we should be eating for optimal health. This knowledge will help to reconsider national food supply chains, but also ensure that current national dietary guidelines take into account consumer health outcomes, as well as food supplies and the sustainability of food production systems. Initial analysis of our UK seafood supply chains, linking production (both capture and aquaculture), trade, purchase and consumption data, show that the UK is a net-importer of seafood - we export most of what we produce and import the majority of the fish that are processed or consumed. We also see that UK dietary recommendations for fish consumption are not satisfied by UK seafood supplies.

K7: Prof Bronwyn Gillanders, University of Adelaide

Professor Bronwyn Gillanders is based in the School of Biological Sciences at the University of Adelaide, Australia. She completed her BSc at the University of Canterbury (New Zealand), MSc at the University of Otago (NZ) and PhD at the University of Sydney (Australia). She has previously held three ARC Research Fellowships and is now a Faculty member at the University of Adelaide. Her research focuses on freshwater, estuarine and marine systems addressing fisheries, ecological and environmental questions. She uses calcified structures of aquatic organisms (otoliths, shells, teeth, and vertebrae or other bones) as innovative tools to understand past environments, population structure and biological processes, such as age, growth and movement patterns. Her most recent work is using portfolio effects as a conceptual model to characterise sub-population variation in migratory strategies of estuarine fish. She is past president of both the Australian Society for Fish Biology and the World Council of Fisheries Societies.

ESTIMATING MOVEMENTS AND CONNECTIVITY PATTERNS OF FISH ACROSS A CHANGING SEASCAPE (Sponsored by SEA-UNICORN)

Migration shapes the distribution and abundance of animals in space and time. While many people are aware of the migrations of charismatic species that fly or swim long distances, the intraspecific variation or portfolio of migratory strategies within a population, especially for species that may migrate over shorter distances, is less well understood. In particular, the range of migratory strategies that exist among fishes within an estuary and how these strategies vary among estuaries is poorly known for any species, yet important for ascertaining the resilience of populations to ecosystem transience and environmental change. In this presentation, I focus on estuarine fish using approaches that span different spatial and temporal scales to estimate movement and connectivity patterns, how these relate to changing environmental conditions and the potential impact on growth. Spatial and temporal trends in species abundance provided estimates of synchrony within populations, but little data on individual traits and life history variation. Acoustic tags provided data on an individual level but are cost prohibitive when it comes to comparing multiple populations and cannot usually capture the entire life history. Natural tags, such as those obtained from ear bones of fish, may provide individual-scale information on life history diversity, timing and duration of migrations, along with information on growth. Together with long term time series of growth and chemical variation, patterns can be related to environmental variables and provide insight on past and future impacts of environmental change.

BANQUET SPEAKER: Chris Howard, Silverback Productions

Chris Howard is Executive Producer of 'Riverwoods' - an ecological tale about salmon and their interconnectivity with the landscapes that they migrate through - and Director and Producer at Silverback Films. After attaining his Zoology BSc at the University of Edinburgh, started working at the world-famous Natural History Unit in Bristol. He worked on several BBC children's series before landing his dream job on 'Springwatch'. He worked his way up through the ranks, working on live productions such as 'Planet Earth Live', 'Big Cat Live' and 'Big Blue Live', before taking two years in London to work in the Science Unit and on a 3D film about pterosaurs with Sir David Attenborough. He then returned to Bristol, leading the development and launch of the BBC's first natural history YouTube channel before eventually returning to his spiritual home as producer then series producer of the Springwatch family.

For the last three years, Chris has been working on 'Wild Isles': a 'Planet Earth'-scale series about British wildlife which combines his love for British nature and passion for telling story in a new, David Attenborough-led show for BBC One in March 2023.

Throughout his career, Chris has also worked on smaller, conservation films on the side such as 'Riverwoods'.

Note from the organisers: We will be showing the Riverwoods documentary at the campus cinema, then having a live Q&A discussion with Chris after the Wednesday evening BBQ!

COMING UP FOR AIR: THE IMPORTANCE OF FILM, SCIENCE AND STORYTELLING IN ANIMAL (AND FISH) CONSERVATION

No one will protect what they don't care about; and no one will care about what they have never experienced" - Sir David Attenborough

Telling stories about the natural world is a vital tool in engaging the public to care about it, and its conservation. Traditionally this has been easier to do with animals that are familiar in some way to us - be that because we see them regularly in real life or the media, or because they share certain characteristics with us. It's much easier to engage people with a big-eyed, well-known cuddly mammal than an out-of-sight fish with scales and a face only a mother could love. But we can and should try to make people care about these other groups too - and by looking at some examples of how this has been done well in the underwater realm recently, and sharing some behind-the-scenes insights into how those stories were captured and told, this talk will get you thinking about story-telling and how to bring the underwater world up to the surface for its moment in the su

FSBI 2023 MEDAL WINNERS

BEVERTON MEDAL - Prof Nick Polunin

The Beverton Medal is awarded in recognition of ground-breaking research and lifelong contribution to the study of fish and fisheries science.The Beverton Medal is awarded in recognition of ground-breaking research and lifelong contribution to the study of fish and fisheries science.

Professor Polunin is a marine ecologist in the Newcastle University Ecology Group who uses macroecological and modelling approaches to help understand what holds marine ecosystems together. This work has long had a strong conservation science goal including interactions with the social sciences. A principal focus is on coral and temperate reefs, and recent projects include reef fish-habitat relationships (Caribbean), hydrothermal vent food webs (Southern Ocean), fisheries extinctions (Philippines), climate change effects on Arctic fishes (Barents Sea) and sustainability issues in fisheries (North Sea). This work has long had a societal purpose, relating to issues of biodiversity conservation, climate change impacts, food security and sustainability.

M3: 'ISOTRIANGLES': EXPLORING PELAGIC VS BENTHIC DRIVERS OF CORAL REEF FOOD-WEBS

Polunin, Nicholas VC*[1], Zhu, Yiou [2]

1. Newcastle University, UK

2. Institute of Marine Research Norway, Bergen, Norway

Carbon stable isotope data ($\delta^{13}C$) which distinguish production source types can be used to explore the roles of benthic and pelagic inputs to food-webs, and we use these and nitrogen stable isotope data ($\delta^{15}N$ as proxies of trophic position) to explore the relative importance of reef and pelagic production sources in 17 reefs (5 Atlanto-Caribbean, 12 Indo-Pacific) from published and unpublished data. We do this by triangulating the data for pelagic sources (more negative $\delta^{13}C$ values, low $\delta^{15}N$), reef benthic primary producers (less negative $\delta^{13}C$, low $\delta^{15}N$), and apex-predator fish (high $\delta^{15}N$ values). This indicates that food webs can be pelagic-driven (7 of the 17 cases), reef-benthic driven (8 cases) or substantially contributed to by both production sources (2 cases). At two locations with extensive fish community biomass data, a Bahamas site with a benthic-driven triangle had low biomass of planktivores relative to apex predators, while a pelagic-driven Maldives site had planktivore biomass greatly exceeding that of apex predators. Ocean-facing reefs in the Indo-Pacific seem more likely to be pelagic-driven, while Atlanto-Caribbean and less-exposed Indo-Pacific reefs appear to be predominantly benthic-driven, with significant implications for fish production.

FSBI MEDAL - Dr Rajeev Raghavan

The FSBI medal is awarded to an early career scientist who is deemed to have made exceptional advances in the study of fish biology and/or fisheries science.

Rajeev Raghavan is an Assistant Professor at the Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, India, where his research focuses on systematics, molecular ecology, biogeography, and conservation of freshwater fishes. 'Rajeev Lab' at KUFOS is internationally recognized for advancing the knowledge-base on understanding the diversity of freshwater fishes in South Asia, resulting in the discovery and description of 21 new species, three new genera and two new families. These include the first subterranean snakehead Aenigmachanna gollum – a living fossil representing a unique family (Aenigmachannidae), the world's largest cavefish, Neolissochilus pnar, and a new family of subterranean catfish, Kryptoglanidae. Two new species of fish, Channa rara and Indoreonectes rajeevi were recently named in honour of Rajeev for his contribution to freshwater fish taxonomy in South Asia. Rajeev has to his credit close to 200 publications in the peer-reviewed literature, is the Editor (Asian Freshwater Fishes) for Zootaxa, and the South Asia Chair of IUCN Freshwater Fish Specialist Group (FFSG).

M2: SERENDIPITY, SOCIAL MEDIA AND CITIZEN SCIENCE: DISCOVERING AND UNDERSTANDING INDIA'S ENIGMATIC GROUNDWATER AND SUBTERRANEAN FISHES

Raghavan, Rajeev [1]

1. Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, India

The Indian subcontinent is recognized as a global hotspot for the diversification of groundwater and subterranean fishes, including 'living fossils' from the Gondwanan era. Many of these species exhibit highly unusual, and bizarre morphological characters such as the absence of eyes, body pigments, as well as dorsal- and pelvic-fins. Two major centers of diversity are recognized on the subcontinent – the lateritic aquifers of southern peninsular India, and the limestone caves of northeast India. Though the aquifer-dwelling fishes of the southern peninsula have been known to science since the 1950s, they have only been collected opportunistically, often aided by serendipity. On the other hand, fishes in the limestone caves of northeast India have been collected through targeted exploratory surveys since colonial times. Twenty-six fish species representing seven families and nine genera are currently known from the groundwater and subterranean systems of the subcontinent, of which two families, three genera, and all but one species are endemic. The discovery of some of these species, e.g., Aenigmachanna gollum – the world's only subterranean snakehead, and Neolissochilus pnar – the world's largest cavefish, has triggered international scientific and media attention on these mysterious taxa, and the habitats they reside in. This talk presents an overview of the achievements of a seven-year-old study, that used a combination of conventional and unconventional approaches, resulting in the description of six enigmatic species, and helping improve our knowledge on the distribution, molecular ecology, threats and conservation of this exceptional subterranean fish assemblage.

LE CREN MEDAL - Prof Nicholas Dulvy

The Le Cren medal is awarded to one or more individuals who have made a lifelong contribution, with a focus on conservation, training or public understanding.

Nicholas Dulvy is a Distinguished Professor of Marine Biodiversity & Conservation at Simon Fraser University

M1: GLOBAL BIOGEOGRAPHY OF SHARK CONSERVATION

Dulvy, N.K.*[1]

1. Simon Fraser University, British Columbia, Canada

The oceans remain vast and inscrutable, while technology has revolutionised our capacity to track threats to biodiversity on land – yet our understanding of the status of marine biodiversity lags far behind. This is changing rapidly due to new methods of borrowing information (based on phylogenetic, spatial, and temporal proximity) combined with rigorous assessment methods applied by large networks of scientists. The scale and pattern of marine biodiversity, as well as anticipated biodiversity loss are being revealed by the International Union for Conservation of Nature (IUCN) Red List assessment process. I draw on key data products from the global reassessment of 1,199 species in Class Chondrichthyes – sharks, rays, and chimaeras. These data provide the foundation for dissecting the global biogeography of key dimensions of biodiversity, including species richness, endemicity, evolutionary distinctiveness, functional diversity as well as the loss of these elements due to extinction risk. From this comprehensive authoritative data-driven view we can identify priorities and set the conservation agenda for the next decade.

HUNTINGFORD MEDAL – Sofia Graça Aranha

The Huntingford medal is awarded to a member of the society with the most impactful paper in the Journal of Fish Biology.

Sofia is a PhD candidate in Marine and Environmental Sciences at the University of Algarve. Throughout her academic and professional career she has worked with the ecology, biology and conservation of elasmobranchs. For her Master studies she assessed the trophic ecology and nutritional status of seven deep-sea shark species on the southwest coast of Portugal, using stable isotopes analyses and nucleic acids. For her PhD, she is continuing the work from her masters, expanding the focus to deep-sea elasmobranchs and evaluating their survival rates from crustacean bottom trawl activities in the Algarve, Portugal. For that, she received grants for two research projects entitled "DELASMOP: is it possible for deep-sea sharks and skates thrive and survive in fishing grounds?" funded by Save our Seas Foundation where she is the Project leader and "The development of Electronic Monitoring and Reporting technology for fisheries in Portugal (EMREP)" funded by EEA grants Portugal where she is the co-PI.

M4: A GLIMPSE INTO THE TROPHIC ECOLOGY OF DEEP-WATER SHARKS IN AN IMPORTANT CRUSTACEAN FISHING GROUND

Graça Aranha, Sofia [1], Teodósio, Alexandra [1], Baptista, Vânia [1], Erzini, Karim [1], Ester Dias [2]

1. CCMAR – Centre of Marine Sciences, FCT, Universidade do Algarve, Faro, Portugal

2. CIIMAR/CIMAR - Interdisciplinary Centre of Marine and Environmental Research, Universidade do Porto, Portugal

Deep-water sharks are particularly vulnerable to overfishing due to their life-history strategies, which include late maturation, slow growth, and low reproductive rates. Despite their susceptibility, there is limited knowledge about the biology and ecology of these species. This study aimed to address this gap by exploring the trophic ecology of five deep-water shark species, namely birdbeak dogfish (Deania calceus), arrowhead dogfish (D. profundorum), smooth lanternshark (Etmopterus pusillus), blackmouth catshark (Galeus melastomus), and knifetooth dogfish (Scymnodon ringens) sampled from a crustacean bottom-trawler off the south-west coast of Portugal. A combination of carbon and nitrogen stable isotopes with RNA and DNA (RD) ratios was employed to examine the primary groups of prey consumed by these species and their nutritional status respectively. The stable isotopes indicated that there was little interspecific variation in the contribution of various taxonomic groups to the sharks' tissues or the origin of their prey. However, S. ringens had higher δ15N and δ13C values, indicating a reliance on bathyal cephalopods, crustaceans, and teleosts, while the other species probably assimilated bathy-mesopelagic prey. The RD ratios showed that most of the individuals had a satisfactory nutritional condition having recently eaten in the days prior to capture. This information, combined with the stable isotopes results, suggests that the sharks obtained their prey from local or nearby food webs, including commercially important shrimps. The findings reveal a potential overlap between the bottom-trawlers' fishing grounds and the sharks' foraging habitats, which warrants further attention.

ORAL PRESENTATIONS & SPEED TALKS

Ordered alphabetically by first author's surname.

Talk code preceded by S = Speed talk, O = Oral Presentation.

S21: TEMPERATURE INFLUENCE ON FISH IMMUNITY

Andreou, Demetra *[1], Ben Parker [1], Buchan, Sarah[1]

1. Bournemouth University

As ectotherms, fish heavily rely on behavioural thermoregulation to regulate and optimise their body temperature. Despite the importance of temperature on fish physiology, its relationship to fish immunity has yet to be thoroughly investigated. Climate change scenarios predict increasing water temperatures and reduced flows narrowing the thermal ranges available for fish thermoregulatory behaviour. This will have a number of physiological implications and fish immunity is not exempt. Specifically, increased temperatures could lead to increased immune responses at the cost of growth and /or reproductive outputs. In this metanalysis, we review the literature and make general predictions on how increasing temperatures could impact the immunity of wild fish populations.

S1: TEMPERATURE, HUMANS AND FISH SIZES

Audzijonyte, Asta *[1, 2], Heather, F. [1], Coghlan, A.R [1], Krueck, N. [1]

1. Institute for Marine and Antarctic Sciences, University of Tasmania, Australia

2. Centre for Marine Socioecology, University of Tasmania, Australia

Decreasing fish body sizes are considered a universal response to global warming. Negative relationships between temperature and body size are enshrined in several ecological rules (Bergman's, Jame's, temperature-size). Rapid accumulation of fish body size data from cameras and underwater surveys now allows us to test these predictions, and suggest that "shrinking" of fishes with warming is far from universal. When we look at mean population body sizes, many fish species are, on average, larger in warmer temperatures, and also increasing in size through time in warming locations. In this talk I will present possible drivers of mean body sizes across fish species, and implications for fisheries and species interactions. I will also test whether temperature affects on maximum body size are consistent across hundreds of fish species, and discuss whether we might need to revise some of these ecological rules. Understanding temperature impacts on fish body sizes and their distributions is essential for size-based population status assessments, fisheries yield predictions and conservation planning. Strong theoretical expectations about fish body size distributions could also enable a better use of diverse citizen science, social media, app and other digital data in fisheries research.

S25: INTERCONNECTIVITY BETWEEN TWAITE SHAD (ALOSA FALLAX) POPULATIONS IN THE NORTH ATLANTIC REGION

Bašić, Tea *[1], Daverat, Françoise [2], Roche, William [3], O'Leary, Ciara [3], Nachón, David José [4], Davison, Phil [1]

1. Cefas, UK

2. UMR 1224 INRAE UPPA ECOBIOP, France

3. Inland Fisheries Ireland, Ireland

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Aquatic biodiversity is disproportionately affected by global change, with one third of freshwater fish species threatened with extinction. Amongst those, migratory species are particularly vulnerable as they experience a broader range of threats due to their complex life cycle. Whilst there is a plethora of knowledge on salmonid species, there are many knowledge gaps on distribution and migration of less commercially important species, such as twaite shad (Alosa fallax), a protected anadromous shoaling clupeid. Like other anadromous species, twaite shad reproduces in fresh water, with juveniles migrating to marine habitats to grow and mature before returning back to their spawning grounds. The species, a repeat spawner, can explore alternate reproductive strategies, by either returning to their natal rivers to reproduce (homing) or by straying into different river systems. Previous studies show genetically separated populations at a regional level, but there is evidence of range overlap between different spawning populations mixing at sea. Therefore, within the Interreg-funded DiadES project, a retrospective approach based on otolith microchemistry was used to track shad natal origin in order to infer the level of exchange between spawners of different populations in southern Ireland, southern and eastern England and central and southern France. Samples of adults and juveniles from rivers, estuaries and marine environments were available for analysis. The results are discussed in the context of conservation and future management of twaite shad populations.

O33: NATURAL NUTRIENT SUBSIDIES AFFECT BEHAVIOUR OF FUNCTIONALLY-IMPORTANT HERBIVORES ON CORAL REEFS

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Bottom-up changes to nutrient regimes can have cascading effects on the foraging behaviour, demographics, and functional role of herbivorous fishes on coral reefs. Although the effects of increasing anthropogenic nutrients have been well-studied, humans have also disrupted the flow of natural nutrients to coral reefs. For example, introduced rats on islands threaten seabird populations, which normally transport large quantities of nitrogen and phosphorous from pelagic food webs to nearshore coral reefs. Here, we test how herbivorous fishes respond to, and modify the effects of, cross-ecosystem nutrient subsidies provided by seabirds. Within a Pacific atoll that is home to a range of seabird densities corresponding to the presence or absence of invasive rats, we analyzed nutrient content of algae, surveyed benthic and fish communities, and conducted both in situ and video observations of herbivorous fish foraging behaviour. Nutrient content of macroalgae and turf algae varied across the atoll, with some clear hotspots of high seabird nutrient input. In turn, herbivorous fish behaviour and grazing rates differed as a function of seabird-derived nutrient content of their algal food sources. For example, surgeonfish had decreased bite rates and distances between feeding forays when consuming algae rich in seabird-derived nutrients. By determining the cascading effects of seabird-derived nutrients on herbivorous reef fishes and benthic community dynamics, these findings can help predict the benefits of removing invasive rats and restoring seabird populations for coral reefs.

S23: ALTERATIONS BY A PSYCHIATRIC DRUG OF THE MIGRATORY BEHAVIOR OF ANGUILLA ANGUILLA

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In the Anthropocene, the current biodiversity losses caused by human activities have various features, from individuals to populations. Chemical pollution of aquatic environments caused by emerging pollutants such as psychiatric drugs raises concerns for freshwater taxa, such as fish. Yet, most studies in ecotoxicology focus on the effects on survival or development, losing sight of the potential impacts on biodiversity, especially on individual behaviour.

Glass eels are migrating from the sea towards rivers crossing estuaries and wastewater treatment plant effluents. Results from previous studies have shown that anxiolytics' effects on fish behaviour are various but it remains difficult to understand the effects on migration behaviour.

In this study, we assessed the effects of a psychiatric drug on European glass eels' migratory behaviour. 40 control individuals and 40 individuals contaminated with diazepam at an environmentally relevant concentration through 7-day chronic contamination were introduced in a behavioural monitoring tank that mimics river water flow. Since the depuration of diazepam by glass eels takes seven days, we video-recorded the individuals' swimming activity over seven days.

As expected, contaminated individuals were bolder but less active than control individuals. The contamination altered individual migratory behaviour since they swam less at counter-current. Surprisingly, behavioural alterations also became more pronounced with time despite the depuration, possibly through the effect of psychoactive metabolites. These alterations could have implications for local density, potentially leading to impacts on population processes and ecosystems, as many fish and birds predate on glass eels.

O20: A NEW MANAGEMENT DECISION-SUPPORT TOOL FOR PREDICTING THE RESPONSES OF ATLANTIC SALMON (SALMO SALAR) POPULATIONS TO CHANGING CONDITIONS

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Atlantic salmon (Salmo salar) are an important diadromous fish species that are experiencing population declines across their range. These are largely being driven by basin-wide climate -related changes to their growth and survival during their marine phase. Just how these changes may be manifest as wider salmon stock dynamics in the future (e.g. as alteration to stage-specific biomass and abundance and egg deposition rates) can only really be determined by considering the influence of global, regional and local processes set within a whole life cycle modelling framework. For such a framework to provide novel support and direction for future salmon management and conservation actions requires considerable cooperative support in mobilising and integrating knowledge from environmental and biological monitoring and research programmes, as well as the recognition of the importance of evolutionary population structuring when considering responses to changes.

Here we report on the development of a new Atlantic salmon Management Decision Support Tool, underpinned by a stage-state mortality and growth-modelling framework. Developed as part of the Likely Suspects Framework programme, this powerful online tool provides a new interface for users to quantitatively explore how variations in life-stage related processes (e.g. those influencing growth or survival) can influence lifetime survival chances, and the future status of focal salmon populations. New scenario-testing features, and outputs that are specifically designed to engage users with varied experiences, will provide much-needed decision-support to direct our future efforts at population protection, conservation and restoration.

O34: GENETIC TOOLS FOR TROPHIC ECOLOGY STUDIES: A STEP TOWARDS THE INTEGRATION OF DIETARY DNA ANALYSIS INTO FISHERIES RESEARCH

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Multispecies and ecosystem models, which are key for the implementation of ecosystem-based approaches to fisheries management, require data on the trophic interactions between marine organisms, including changes over time. Trophic interactions are mainly studied through visual identification and quantification of prey in stomach contents. However, this method is time-consuming, requires taxonomic expertise and cannot accurately identify degraded preys. Alternatively, DNA metabarcoding (the simultaneous identification of all taxa in a sample by sequencing a short DNA region) could be used for large-scaled stomach content data collection. Yet, for DNA metabarcoding to be routinely implemented, technical challenges should be addressed, such as the presence of a high proportion of predator DNA and the inability to provide reliable abundance estimations. Here, we present a metabarcoding assay developed to examine the diet of five commercially important fish, which prevents the amplification of predator DNA by using blocking primers. Tested in mock samples with alternative proportions of predator and presumed prey DNA, the method has proven effective. Tested in real stomachs, the method shows great effectiveness discerning diet variations due to predator ecology or prey availability, even when stomachs are not dissected but analysed as a whole. Additionally, applying DNA metabarcoding to stomachs previously analysed by visual inspection revealed an unnoticed importance of gelatinous organisms in mackerel diet. Our work reinforces the potential of DNA metabarcoding for studying fish trophic interactions and provides a basis for its incorporation into routine monitoring programs, which will be critical for the implementation of ecosystem-based approaches to fisheries management.

O5: MOVEMENT, TROPHIC, AND METABOLIC ECOLOGY OF MARINE FISH: EVIDENCE FROM A MULTIPLE-TISSUE ISOTOPE APPROACH

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Under environmental pressure and anthropogenic disturbance, the response of marine fishes is dynamically changing, reflecting on their habitat and dietary shifts and the adjustment of energy use. However, the adapted or acclimated behaviours of marine fishes in the natural environment are difficult to investigate. Accordingly, the isotope-based method has been widely applied to fish biological studies, because stable isotope values recorded in organic tissues or calcified structures provide a possibility to evaluate the movement, trophic levels, and metabolism of marine fishes. To introduce the applicability, we summarise the current use of stable isotope systems in marine fish studies, including stable oxygen, carbon, and nitrogen isotopes. Also, we detail the advantage and limit to analyse these isotopes in various tissues or structures, such as blood, muscle, eye lens, otoliths, vertebrae, and tooth. Most importantly, we demonstrate a multiple-tissue isotope approach to obtain more comprehensive life history information in an individual, which is valuable for fisheries management and model predictions in the future ocean.

O11: PHYSICAL DRIVERS OF HABITAT USE IN SURF ZONE FISHES

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Sandy beaches cover 70% of open ocean coasts and are of great societal value, but their position at the land-sea interface exposes them to threats from climate change and localized human impacts. Surf zones on sandy beaches are known to support socioeconomically important fish populations, but most existing research focuses on a narrow diversity of beach types with low wave energy. Through small net surveys and novel use of citizen science data we have characterized variation in fish abundance at hourly to interannual scales across a wide diversity of beach types in southwest England, in relation to overarching physical characteristics of surf zone environments. By identifying drivers of fish habitat use across diverse spatial and temporal scales, our findings provide a basis for predicting recruitment variability and identifying essential habitats for important fish species in the face of natural environmental dynamics and human impacts in the coastal zone.

S14: USING REMOTE SENSING TO MAP SEAGRASS AND MANGROVE HABITAT CHANGES IN A LEMON SHARK NURSERY AREA OVER TWO DECADES, TO DETERMINE POTENTIAL IMPLICATIONS ON JUVENILE SHARK SURVIVAL.

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Many shark species are important for the structure and functioning of marine ecosystems. Currently, shark species worldwide are facing high extinction risk due to their slow reproductive rates and high age at maturity. Habitat loss may play an important role in population declines, especially for species which require specific habitats for critical life history stages. In Bimini, the Bahamas, juvenile lemon sharks (Negaprion brevirostris) show philopatry to specific mangrove and shallow seagrass nursery habitats. However, over the past several decades, dredging and development have removed large areas of mangrove and seagrass, potentially impacting the lemon shark's use of this habitat. My project uses satellite remote sensing to create habitat maps from the late 1990s to 2020, to quantify change in seagrass and mangrove distribution and coverage; these maps will be paired with annual standardized juvenile lemon shark mark-recapture datasets and fin-clip isotope samples to understand the long-term impacts of change in habitat availability on juvenile lemon shark survival and diet. Use of random forest and automated adaptive signature generalization algorithms allow for the standardized mapping of benthic habitat over long time scales, even in situations with little in-situ habitat data availability, and this project provides a framework with which to assess past habitat distributions with relatively high accuracy.

O43: UNIFYING RESEARCH ON MARINE FUNCTIONAL CONNECTIVITY TO ADVANCE KNOWLEDGE ON THE ECOLOGICAL IMPLICATIONS OF FISH MOVEMENTS

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With the growing recognition that marine habitats and living resources are strongly but variably interconnected, research in marine ecology is increasingly focusing on connectivity and its consequences for ecosystem functioning. Functional connectivity characterizes all flows of organisms in space and time that determine the ecological interdependency of populations, species and ecosystems. In this respect, fish play a key role, as they connect habitats in many ways, through the exchange of biomass, genes, functional traits and energy resulting from their lifetime movements and/or transgenerational habitat shifts. Gathering knowledge on Marine Functional Connectivity (MFC) in general, and on fish distribution and movements in particular, can greatly improve our ability to predict species and ecosystem responses to environmental changes, at sea and at the land-sea interface. With this regard, while most research to date has focused on species-specific approaches, recent methodological developments now allow linking individual movements and trait expression to ecosystem processes, and expand the boundaries of the multidisciplinary MFC research field, to infer the consequences of changes in MFC at the community and ecosystem levels. In this talk, I discuss the main challenges and steps required to unify fish connectivity research and integrate it into an overarching conceptual MFC framework, and how to place this emerging multidisciplinary research field at the heart for marine ecological science and forecasting. This is essential to produce the comprehensive and standardized data needed for informed management of marine systems and resources to mitigate the global impacts of human activities.

O4: CAN ISOTOPIC COMPOSITIONS OF VERTEBRAE AND TEETH ESTIMATE FIELD METABOLIC RATES IN ELASMOBRANCHS?

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Metabolic rate reflects the energy used in a system for fuelling behavioural and physiological processes, that determine the production of biomass. Metabolism in poikilotherm fishes is directly related to body mass and ambient temperature, however inter-individual variation is large even under the same environmental conditions. Estimating time-integrated individual field metabolic rates (FMR) is crucial to better understand the relationship between fitness, behaviour, and a complex dynamic environment. A novel proxy demonstrated that FMR can be estimated directly from the isotopic composition of carbon in fish otoliths (δ13Coto). This approach has been validated for teleost fishes. However, the same approach cannot be applied to elasmobranchs since they lack otoliths. Teleost fishes have a positive relationship between the δ13C values of otoliths and the carbonate component of vertebrae, suggesting that vertebrae (and jaw) may also record metabolic rates. We chose elasmobranch species at different life stages and with different lifestyles (pelagic, demersal, benthic) that we expect a priori to have different metabolic rates. We sampled the outermost layer of otoliths, vertebrae, and jaws (root of teeth) that represent the most recent period of life of the individuals. Carbon (δ13C) and oxygen (δ18O) isotope ratios were measured. δ18O values were measured to reconstruct experienced temperatures and to estimate basal metabolic rate with bioenergetics models, needed to predict FMR from δ13C. Results from this study could validate a new approach to estimate FMR for chondrichthyan fishes.

O36: MUTUALISTIC CLEANING INTERACTIONS ACROSS A SPECIES DIVERSITY GRADIENT

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Cleaning interactions, where a cleaner fish removes parasites and debris from the body of another fish ("client"), can promote the health and biodiversity of reef environments. For example, the presence of cleaners can attract fish to reefs, while the cleaning service provided promotes fish health. These cleaning interactions, however, also rely on this biodiversity to successfully function in the first place; with too few clients species on the reef, cleaning may no longer be beneficial and cleaners may stop providing a cleaning service. Such a loss of cleaning could accelerate species loss further. This feedback loop is particularly worrying, given that human induced actions, including climate change and overfishing, are leading to large-scale losses of habitat and associated communities. Here we questioned how cleaning interactions change as a function of the number and abundance of fish species on reefs. We tested this question in the Galapagos, where neighbouring reefs differ in the numbers and diversity of fish species they contain. Galapagos reefs therefore provide a natural system to test how cleaning frequency changes depending on fish abundance and diversity. To capture detailed observations of cleaning, we designed, and used, underwater stereo-rigs which can record cleaning interactions in three-dimensions for up to twelve hours per day. We deployed these rigs across Galapagos reefs, and used machine learning techniques, and surveys, to quantify the presence of cleaning across this fish species diversity gradient. By understanding how ecological interactions (like cleaning) change depending on biodiversity, we can better predict how these interactions are likely to function when species are lost from ecosystems.

S6: CHANGES IN CELTIC SEAS COD DISTRIBUTION ARE NOT ALWAYS ASSOCIATED WITH DECLINES IN ABUNDANCE

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Many cod stocks in the Northern Atlantic are in a depleted state. Total mortality estimates remain high, and despite decades of active fisheries management, exploitation rates are probably high, but uncertain. Rising sea temperatures over the last 50 years could also be shifting cod distributions outside of current stock management areas. Here, we analysed data from trawl surveys to investigate the distribution of three cod stocks in the Celtic Seas: Irish Sea, Celtic Sea, and West of Scotland. Trawl survey data were sourced from the DATRAS database and geostatistics were performed to map cod density, calculate the centre of gravity of their distribution, and examine other spatial trends. The distribution of the west of Scotland stock shifted north-east, the Irish Sea south-west, but the Celtic Sea showed no trend. Changes in the mean depth of fish showed no clear trends, but the equivalent stock areas showed decreasing or no trends over time. The shift in distribution of the West of Scotland cod stock towards the North Sea may be impairing recovery, but in the case of the Irish Sea and Celtic Sea cod stocks, other factors are more likely to be responsible for their demise.

S19: ECOMORPHOLOGY AND ALLOMETRIC FEEDING RELATIONSHIPS OF THE SOUTH GEORGIA GROUNDFISH COMMUNITY

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The study of ecomorphology links the physical attributes of organisms to their environment or ecological niche. In fishes, characteristics such as body size and gape morphology limit the size range of prey consumed, while traits including fin morphology determine maneuverability and potential acceleration/deceleration, further reflecting trophic ecology. Differences in allometric relationships for these traits, both between species and between size-classes within species, may influence levels of resource partitioning and competitive interactions within the fish community. It is therefore important to consider these traits to improve our understanding of the constraints on community structure and energy flow through marine food webs. The island of South Georgia, in the South Atlantic Ocean, has a diverse demersal fish community which has previously been the focus of a commercial fishery for some species. Regular biomass surveys are carried out every two years and the general diets and population dynamics of individual species are well understood. However, there has been little investigation of size-based feeding relationships, particularly at the community level. In this study, we investigate allometric morphological scaling relationships and trophic niche breadths (both the taxonomic diversity and size-range of prey consumed) in eleven demersal species around South Georgia. Differences in the scaling of morphological traits and prey size-selectivity with predator body size provide insight into food web dynamics, and improve our understanding of how ecosystem functioning might change in response to future warming-driven declines in body size.

O13: THE ADAPTIVE DIVERSITY OF ARCTIC CHARR (SALVELINUS ALPINUS) IN SCOTLAND

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Studies of Arctic charr (Salvelinus alpinus) from across Scotland have noted incredibly high diversity, both in phenotype and genotype, within and across lakes. The high diversity seen in the species gives it, and the environments that gave rise to it, high conservation value which is currently not reflected in conservation policy. High population differentiation within river catchments due to colonisation by multiple distinct lineages at the end of the last ice age, ca. 11,000 years ago, complicates the patterns of genetic differentiation across Scotland. Understanding the true extent of the variation and the major lineages that make up the species' distribution are both critical in helping us to protect this diversity by creating accurate conservation policies.

To explore this, we conducted a national scale genetic study of populations of Arctic charr found in Scotland. Our dataset of 24,878 SNPs from 410 individuals across 55 different lake populations covers all 27 of Hydrometric Areas known to contain to Arctic charr in Scotland, the first study to do so. I will present the latest findings of this study which has been investigating patterns of neutral and adaptive genetic variation across Scotland to identify groups of populations as Evolutionary Significant Units (ESUs) for the purposes of conservation. I will discuss how populations split into two major genetic groups based largely on which way their river system flows, East or West, and how glacial lakes during the Loch Lomond Stadial have influenced deviations from this pattern.

S30: HOMING AND STRAYING OF ATLANTIC SALMON (SALMO SALAR) IN THE NEW AQUITAINE REGION USING OTOLITH MICROCHEMISTRY

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Although straying can be perceived as a lack of success from a populational perspective, it is «critical to genetic resilience, demographic stability and range expansion into unexploited habitats» (Keefer and Caudill, 2012) from a metapopulation context. In the Bay of Biscay, including France and Northern Spain, even if exchanges of individuals are common, salmon populations are largely supported by local stocking programs. However, considering the expected increase of straying in a global change context and the higher dispersal rate for hatchery salmon compared to wild fish, it was critical to identify the movement patterns of Atlantic salmon from broad (basin) to fine (sub-catchment) spatial scale in this large region. In our study, we collected otoliths of returning adults from 2009 to 2018 in the Adour basin, as well as from seven basins or region along the Bay of Biscay (from North to South: South Britany, Allier, Garonne-Dordogne, Nivelle, Bidasoa, Asturias and Galicia). Using otolith microchemistry data in a discriminant analysis, we quantified the proportion of strayers captured in the Adour estuary and the upstream part of the watershed and examined their natal origin. Although homing is prevalent in the Adour basin with 92 to 98 % of individuals originating from this basin, fluctuations could be observed across the years and possibly explained by extreme climate events such as floods and droughts. Strayers were mostly determined to be from adjacent basins (Garonne-Dordogne and Bidasoa) but also episodically from more distant region (Allier). Our preliminary results highlight the importance of dispersion and connectivity in management decisions, especially considering the ubiquity of restocking programs in the New Aquitaine region.

O17: A CATCH TAG AND RELEASE PROGRAMME FOR ATLANTIC BLUEFIN TUNA IN THE UK - A CROSS-SECTIONAL APPROACH

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Atlantic bluefin tuna have been observed off the south-west English coast with increasing frequency over the last decade. With their return came a growing interest from the recreational sea angling community to target them. In 2020, the Department for Environment, Food and Rural Affairs (Defra) instigated a scoping project to assess the feasibility of a CatcH And Release Tagging (CHART) programme resulting in a pilot study in 2021. The fishery was co-designed under the auspices of a Defra steering group with membership from the Centre for Environment Fisheries and Aquaculture Science, the Marine Management Organisation, Inshore Fisheries and Conservation Authorities, Natural England, the UK Bluefin Tuna Association, the Angling Trust, and recreational sea angling stakeholders. The aim of this fishery was to develop a better understanding of the demographic and geographic distribution of tuna whilst assessing the potential economic benefit this fishery could generate. Central to its operation were training workshops, which taught charter fishing skippers how to catch, tag and release tuna whilst giving the highest consideration to fish welfare. To date, nearly 2000 tuna have been tagged, and the community of practice created in 2021 led to improvements in scientific protocols for CHART 2022. Furthermore, the fishery has provided socioeconomic benefits of angler participation, with more than 2,500 anglers paying to participate in the programme, putting an estimated £740,000 into the regional economy. Through co-design and co-delivery CHART has successfully generated multi-sectoral evidence that will help to inform the development of Government policy for recreational bluefin tuna fishing.

S26: SPATIO-TEMPORAL MOVEMENTS AND ENTRAINMENT OF SHORTFIN EELS AT FLOOD PUMPING STATIONS

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Land drainage infrastructure such as flood pumps, tide/flood gates and levees are used to mitigate flood hazards and maintain productive land, but can impact on the migration behaviour and long-term persistence of aquatic species. A particular concern is the impact of flood pump entrainment on freshwater eels. Eels migrate from freshwater habitats to the ocean to spawn. When eels encounter flood pumps during this downstream migration, there is often no alternative but to pass through the pumps resulting in injury and mortality.

To understand the risks to eels at flood pumps, we undertook PIT tag studies evaluating the movements of shortfin eels (Anguilla australis) in the vicinity of two flood pumps in New Zealand. We observed clear diel and seasonal patterns in eel movements, with eels most active at dusk and during summer. The timing and frequency of pump entrainment varied between sites based on site configuration, temperature, and flow conditions. At a site with a bypass, and where pump operation did not coincide with the autumn migration, peak eel entrainment occurred in winter and spring and primarily impacted non-migrant life stages. At a site without a bypass where pump operation coincided with the autumn migration, peak entrainment primarily impacted downstream migrant silver eels. These results highlight that the risk to eels of pump entrainment and mortality extend beyond the main period of downstream migration that has been the focus of most studies and that climate change could further exacerbate these impacts.

O22: WHAT MAKES A HABITAT A HOME: HABITAT ASSOCIATIONS OF JUVENILE EUROPEAN SEA BASS, DICENTRARCHUS LABRAX, IN ESTUARINE NURSERIES

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Estuarine nursery habitat selection in juvenile fish is poorly understood. Few studies explore the role of the complex estuarine mosaic of structurally different habitats in driving juvenile fish distributions, with most studies focussing only on saltmarshes. Here we determined how abundance and condition of juvenile European bass (Dicentrarchus labrax) differs between low and high tide estuarine habitats: saltmarshes, oyster reefs and shingle, sand, and mud edge habitat. Our findings suggest that at high tide, juvenile sea bass show no differential selection among shallow habitats, but saltmarsh and sand may exhibit a higher foraging potential. At low tide a shift to the use of more complex, less profitable shingle and oyster reef occurs, resulting in a trade-off between foraging potential and predator avoidance. Our findings provide evidence that multiple habitats in the estuarine mosaic are important to juvenile sea bass and should be given due consideration in further studies of juvenile fish habitat usage.

O47: HOW WELL DOES DRIFT MODELLING STACK UP TO OTHER EVIDENCE OF DISPERSAL AND CONNECTIVITY – AND CASE STUDY OF IRISH SEA PLAICE

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Plaice Pleuronectes platessa are one of the best documented species in the fish biology and fisheries literature. Despite the volume of studies on spatial movements of adults and dynamics of juvenile nursery grounds, we have little direct information on the connectivity between spawning populations and juvenile settlement. North Sea plaice move seasonally between feeding and spawning grounds, with a high degree of individual fidelity. In the Irish Sea, plaice also show seasonal movements, with some degree of weak genetic structure operating at temporal and spatial scales. Behavioural studies of juvenile plaice indicate that their movement is limited, at least in the period after settlement. In contrast to genetic data, the trace element composition of plaice otoliths is consistent with direct tagging data, showing distinct groups of plaice at least within basins such as the North Sea or the Irish Sea. The question, then, is which life stages are most likely to contribute to mixing sufficient to obscure genetic structure. Hydrodynamic modelling suggests that substantial transport of eggs from spawning grounds in the western Irish Sea to areas in the eastern Irish Sea. We measured the trace elements in otoliths of newly settled plaice juveniles from beaches along the Irish, English, and Welsh coasts to identify any composition differences that could indicate the mixing of fish during the early life history stages. We compare this evidence for transport with model predictions, and evaluate the likelihood of reconciling the modelled and observed estimates of connectivity in the Irish Sea and elsewhere.

O41: MARINE STRESSORS IMPACTING ATLANTIC SALMON (SALMO SALAR), WITH AN ASSESSMENT OF THE MAJOR THREATS TO ENGLISH STOCKS

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Many Atlantic salmon (Salmo salar) populations have suffered synchronous declines around the North Atlantic over the last five decades. Reduced marine survival has been implicated as a key driver of these declines, yet the relative importance of different stressors causing mortality at sea is not well understood. Accordingly, we present a synopsis of the 13 principal stressors impacting Atlantic salmon in estuarine and marine environments, and then apply a semi-quantitative 2-D classification system informed by a literature review and regional experts to evaluate their relative effects on English salmon stocks and likely development over the next decade. Climate change and predation were perceived to be the biggest threats at present and over the next decade. Poor water quality and bycatch were considered as relatively high impact stressors, but with a lower likelihood of becoming more prevalent in the future due to available mitigation measures. Other stressors considered less influential included tidal barrages, artificial light at night, impingement in power-station cooling waters and thermal discharges, pile-driving noise pollution, invasive non-native species, electromagnetic fields, salmon mariculture, and tidal lagoons. Targeted fisheries exploitation was not regarded as an important stressor at present because exploitation rate controls have been implemented to substantially reduce fishing pressure. Future research priorities include addressing knowledge gaps on expanding stressor impacts from climate change, predation, renewable energy developments, and artificial light at night. Local management actions aimed at improving freshwater and estuarine habitats to maximise ecosystem resilience to stressors and minimise their cumulative impacts are recommended.

S2: THERMAL ADAPTATION INCREASES ENERGETIC EFFICIENCY OF BROWN TROUT IN WARMER ENVIRONMENTS

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Theory suggests that the rate at which energy demand increases with temperature outpaces energy intake, resulting in a decreased energetic efficiency. This could lead to reduced fitness or even local extinctions of predators in warmer environments, with consequences for community structure and ecosystem functioning. Thermal adaptation could help to mitigate these responses, but its effects on energetic efficiency have rarely been investigated. Here, we characterized the effects of thermal adaptation on metabolic rate, feeding rate, and energetic efficiency of brown trout from cold and warm streams in the Hengill geothermal valley in Iceland. Population genetics indicated that fish from the cold and warm streams were genetically distinct, increasing the likelihood of local adaptation to these contrasting thermal environments. Thermal adaptation had no significant effect on fish metabolic rate, but adaptation to warmer environments increased the thermal sensitivity of feeding rate, leading to greater energetic efficiency of brown trout with increasing temperature. This adaptive response is important because it could help brown trout to overcome the greater energetic constraints of warmer environments. As a major implication, we highlight the importance of studying thermal adaptation for anticipating future responses of salmonids and other species to global warming.

S11: A SEASCAPE APPROACH TO IMPROVING FISHERIES SUSTAINABILITY AND RESTORATION:

DISTRIBUTION, HABITAT RELATIONSHIPS AND MOVEMENT ECOLOGY OF JUVENILE GADOIDS IN SCOTTISH WEST COAST INSHORE SEAS

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There is currently a critical lack of understanding of distributions and habitat relationships for fish species. Environmental managers therefore cannot make fully informed decisions in order to achieve optimal ecosystem services. Juvenile fish are highly dependent on specific habitat types, resulting in nursery grounds having a high degree of influence on success in reaching adult life stages. Spatial measures for fisheries management and biodiversity protection currently do not incorporate wider ecological metrics into analysis and decision making. There is understanding in terrestrial ecology of how landscape attributes effect species distribution. Multiple habitat use and movement at landscape scale are starting to be applied in seascapes. Seascape ecology explores the configuration, connectivity, context and consideration of both spatial and temporal scales of habitats in marine environments.

The West Coast of Scotland (WcoS) (ICES division VI.a) has had a long-term issue with gadoid fishing sustainability. Cod (Gadus morhua), haddock (Merlanogrammus aeglefinus) and whiting (Merlangius merlangus) populations were below safe biological limits since the early 2000s and are only starting to recover in recent years. Here we use stereo baited remote underwater video (SBRUV) in two WcoS lochs to record relative abundance and length of juvenile gadoids (cod, haddock and whiting). Species distribution models (SDM) will be produced to understand the role played by seascape attributes, such as patch configuration and connectivity, in influencing the distribution of juvenile gadoids. Developing knowledge of which combinations and arrangements of habitats are important for nursery habitats can help inform more effective spatial management and protection measures.

O2: FISH POPULATION DYNAMICS AND THE ROLE OF OXYGEN AS HABITAT

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The maximum intrinsic rate of population increase (rmax) estimates a population's maximum turnover rate at low adult abundance, and hence reflects the summed performance of individual organisms. Both temperature and oxygen availability are key environmental factors shaping the metabolism and fitness of ectothermic fishes, and there is increasing evidence that population growth rates vary latitudinally and with depth, suggesting a metabolic basis of population dynamics. Yet, little is understood of how oxygen and temperature effects on physiological performance relate to population dynamics. We bridge from the individual to population scales with a comparative analysis of rmax and metabolic rate, in relation to oxygen, temperature, and body size across 38 chondrichthyan and 102 teleost species, using population-matched life history and metabolic traits mined from primary literature and environmental data from the World Ocean Atlas. Specifically, we ask whether: (1) variation in metabolic rates across species are best explained by models including mass, temperature and oxygen, (2) the same can be said when modeling variation in rmax. Using model selection, we found that body mass, temperature and oxygen best explained variation in metabolic rates and rmax, including an interaction between oxygen and mass. Our results corroborate previous findings of the effects of temperature and body mass on metabolism and further support these underpin similar patterns in population growth rates. These also highlight the central role of oxygen availability in shaping population patterns underlined by metabolic physiology in aquatic ectotherms, and the importance in considering how it affects smaller and larger species disparately.

S31: THE LAKE WINNIPEG BASIN FISH TELEMETRY PROJECT

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The Lake Winnipeg basin watershed covers 1,000,000 km2 and reaches across four Canadian provinces and several U.S. states. The basin contains a diverse fish community and some of North America's largest lakes and rivers that attracted early settlers to the productive land and fisheries. As a result of exploitation, habitat degradation, barriers to movement, and other cumulative stressors, several of the freshwater fishes inhabiting the basin are today listed as imperiled under Canada's Committee for the Status of Endangered Species (COSEWIC). As such, it has become imperative to understand how these and co-occurring species use the aquatic habitats of this basin. Since 2016, the Department of Fisheries and Oceans Canada (DFO) has led a multi-species telemetry-based investigation of eight species of freshwater fishes (~1,000 tagged individuals) across an acoustic telemetry array consisting of ~250 hydrophones covering a large portion of the Red River, Assiniboine River, and Lake Winnipeg. For nine years, the receiver array and its tagged fish have provided an unprecedented look into the movement ecology of species ranging from the economically important Walleye (Sander vitreus) to the enigmatic Lake Sturgeon (Acipenser fulvescens) and threatened centenarian Bigmouth Buffalo (Ictiobus cyprinellus). Here, we describe the project, highlight collaborations, and present some of the most fascinating and relevant results for the management of fishes in the Lake Winnipeg basin.

O15: CAN FISHERS BE GIVEN THE RESPONSIBILITY TO MANAGE THEIR OWN FISHERY? A MODELLING STUDY.

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In a paper published in 2021 I proposed a scheme whereby fishers could be given the responsibility of managing their own fishery in return for access to the resource (Hart 2021). It would be difficult to test the proposal in a real fishery. One way to advance the idea is to model a fisher managed system and to then use the model to explore the limits of the approach. To this end an Individual Based Model (IBM) of a pelagic fishery has been developed. A given number of vessels is set to fish a pelagic resource which varies spatially in abundance. The programme allows fishers to choose to keep fishing where they are or to move location in the expectation of a higher catch. The decision is based on an evaluation of the final value of the catch if the fisher either stayed put or moved to a new location. Fishers are required to transmit their total catch to a management unit which check whether or not the fisher is keeping within the management measures currently applied. Different management regimes such as quotas or hours at sea are explored as potential management approaches. A suitable penalty can be applied to fishers who transgress the rules. In the paper the stability of such a system will be explored and discussed.

Hart, P. J. B. (2021) Stewards of the sea. Giving power to fishers. Marine Policy 126 104421.

O18: TIME SERIES AND COMMUNITY BASED ANALYSIS OF A SUB-ANTARCTIC DEMERSAL FISH ASSEMBLAGE, USING A 36-YEAR SURVEY DATASET.

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The marine environment at South Georgia is a highly regulated and well monitored ecosystem, located within the South Georgia and South Sandwich Islands Marine Protected Area (SGSSI MPA). Two finfish stocks are harvested within the MPA: Patagonian toothfish (Dissostichus eleginoides) and mackerel icefish (Champsocephalus gunnari). A random stratified trawl survey had been undertaken since 1987 on the South Georgia shelf and neighbouring Shag Rocks shelf. In recent decades this survey has been the main data source for the C. gunnari stock assessment and a key source of information on juvenile recruitment for the D. eleginoides stock assessment. Species-specific data is also collected for non-commercially important species, allowing for community-based and time-series analyses of the fish assemblage of the South Georgia shelf.

Here we present an RCP (regions of common profile) approach to understand the spatial variability in fish communities, highlighting clear differences between the Shag Rocks and South Georgia shelves as well as differences with depth. We investigate the environmental factors that may be driving these differences. We also examine how the community has changed over the last 37-years along with changes in the populations of key species and discuss the wider ecosystem effects which may be influencing them.

O30: LONG-TERM TRENDS IN THE DIET OF SIX PREDATORY FISH SPECIES IN THE WESTERN NORTH SEA

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Anthropogenic stressors such as trawling and eutrophication have led to widespread changes in the species composition of demersal fishes and their benthic prey in the North Sea, yet relatively few studies have quantified long-term changes in diets of marine fish species. We use unique stomach content data spanning 1896-2015 to examine temporal patterns in the diet composition of six dominant bottom-dwelling fish species in the North Sea from north-east England to the Dogger Bank. Three of the six predators exhibited general diet shifts between the late 19th century and 21st century. Bivalves dominated plaice, dab and haddock diet in the early and mid-20th century and declined in subsequent decades. Conversely, polychaetes increased in importance overtime and were the main prey resource for plaice in the 1970s and 2000s by number and mass. These diet shifts are attributable to changes in the benthic prey base of the North Sea, linked to increased beam trawling in the 1960s-1970s, eutrophication, and climatic processes. This work underlines the value of historical diet data to elucidate broad-scale and long-term changes in marine food webs. It further provides a benchmark for improving ecosystem status and implementing management plans for the recovery of benthic communities on continental shelves in the future.

O16: USING SPATIALLY EXPLICIT INDIVIDUAL-BASED MODELS TO SUPPORT MANAGEMENT OF THE EUROPEAN SEA BASS

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The European sea bass (Dicentrarchus labrax) is a high value fish that is exploited by both commercial and recreational fisheries. Scientific assessments of the northern stock have shown a rapid decline in the spawning stock biomass attributed to poor recruitment and high fishing mortality, and significant reductions in the harvest of sea bass have been implemented to conserve stocks. Individual-based models (IBMs) are simulations of individual 'agents' of organisms that interact with each other and their environment locally and have been shown to be effective management tools in many systems. Here, we present two examples of the application of IBMs to sea bass: a pelagic phase model to assess interannual variation in settlement; and spatiotemporally explicit model to evaluate management strategies. The pelagic phase IBM is used to assess connectivity between spawning and nursery areas. It includes hydrodynamics to simulate the drift of eggs and larvae, temperature dependent growth and mortality, and behaviour affecting position in the water column. The second IBM includes all life stages and individual fish have their own realistic energy budgets driven by observed dynamic maps of phytoplankton density and sea surface temperature. The outputs from these models are discussed in the context of seabass conservation and sustainable management of sea bass fisheries.

O23: NURSERY ROLE OF RED ALGAE DOMINATED REEF IN TEMPERATE ALGOA BAY, SOUTH AFRICA

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Structurally complex macroalgae within coastal seascapes are important as nursery areas for many marine fish species. Although several algal species may perform similar nursery functions, the nursery provision of canopy forming brown algae has been the focus of research. This study examines the nursery role of a mosaic of red algae dominated habitats in a shallow (< 5 m), sheltered rocky cove in Algoa Bay, South Africa. As an indicator of nursery function within the cove we assessed and mapped macroalgal communities and complexity of different habitat patches within the cove, the resource seascape (epiphytes and invertebrates), as well as fish assemblages (abundance, size structure and species richness). We also looked at the trophic ecology and movement of dominant juvenile fish species within the cove. Red algae, particularly canopy forming Plocamium spp. and the lower growing Laurencia spp. dominated subtidal low and high profile reef, with intertidal reef flats dominated by coralline turf (Jania spp.). Structural complexity was not positively correlated with the biomass of resources, with the biomass of epiphytic algae and amphipods highest on turf and low growing Laurencia natalensis. Juvenile sparids (particularly Sarpa salpa and Diplodus capensis) dominated the fish assemblage throughout the cove. Although results from this study indicate that lower complexity algae likely provide more food for juvenile sparids, fish spent more time in high complexity macroalgal habitats, which likely provide more protection from predation. This shows that macroalgal habitats comprising several functional forms have the potential to support higher juvenile diversity and abundance.

O12: MARINE-ESTUARINE OPPORTUNIST FISH SPECIES FUTURE DISTRIBUTIONS IN THE NORTHEAST ATLANTIC OCEAN, UNDER ANTHROPOGENIC CLIMATE CHANGE

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Marine-estuarine opportunist (MEO) species are fish occurring in the continental shelf, where estuaries and/or shallow coastal areas act as nurseries. These commercially important resources are facing significant environmental modifications caused by direct (e.g., warming waters) and/or indirect (e.g., shifts in prey availability) anthropogenic climate change effects. In this study, we investigated the directionality and the magnitude of the distribution shifts (i.e., range size, gravity centroids, and margins) in marine environment suitability for six main MEO fish species within the Northeast Atlantic, following two possible emission scenarios expected for the end of the 21st century. This work included four 'sub-boreal' (sea bass, Dicentrarchus labrax; flounder, Platichthys flesus; plaice, Pleuronectes platessa; and common sole, Solea solea) and two 'sub-tropical' (meagre, Argyrosomus regius; and Senegalese sole, Solea senegalensis) species . The 'hierarchical filters' concept was adopted for modelling the potential species distributions and combined the predictions of i) a bioclimatic model with ii) a habitat model. The bioclimatic model is based on large-scale and time-varying variables while variables of the habitat model are fine-grained and no time-varying. Two IPCC scenarios are tested: an intermediate (SSP2-4.5) and a pessimistic one (SSP5-8.5). We applied this framework using international databases of biodiversity occurrences, ensemble forecasting producing consensual predictions issued from several statistical techniques, and innovative indices of distribution shifts. A significant north-westward shift was predicted for all six species in our study area. However, the northward expansion was greater for 'sub-tropical' than for 'sub-boreal' species due to faster gravity centroid displacement shifts (i.e., ~ 10 km.decade-1 or 43 km.°C-1 versus ~ 1 – 3 km.decade-1 or 4 – 12 km.°C-1) and faster margins shifts (i.e., ~ 79 – 97 km.decade-1 versus 0 – 3 km.decade-1). These range shifts may lead to major ecological and socio-economic impacts (e.g., changes in recruitment to estuarine and coastal nurseries, as well as changes in spawning grounds) that may alter populations' connectivity.

O42: LINKAGES BETWEEN MARINE FOOD WEBS, THIAMINE DEFICIENCY, AND REPRODUCTIVE FAILURE IN CALIFORNIA SALMON, USA

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Understanding how factors in one aquatic habitat influences an organism's growth, survival and reproductive success at later life stages is one of the greatest challenges in the conservation and management of migratory fishes. Thiamine Deficiency Complex (TDC) is a nutritional deficiency of thiamine (vitamin B1) that has been observed worldwide in diverse taxa. However, it has recently emerged as a significant stressor to Pacific Salmon linked with high mortalities of early life stages of Chinook salmon in California's Central Valley, USA. TDC is caused by female Chinook salmon not acquiring enough thiamine from their ocean diets to provide needed nutrition in their eggs that their young require for proper development. Here, we use $\delta^{13}C$ and $\delta 15N$ in archival tissues (salmon eye lenses) to test the hypothesis that females with low egg thiamine levels fed on a narrow diet of anchovies. Anchovies are known to produce thiaminase an enzyme that destroys thiamine in consumers. Anchovy abundances were found to be anomalously high in 2019-2022. Our work to-date has revealed low levels (3.1 ± 1.5nmol/g) of egg thiamine in endangered winter run Chinook salmon prior to spawning resulting in ~50% thiamine-dependent mortality in 2021 and 2022. Stable isotopes of $\delta^{13}C$ and $\delta 15N$ measured in sequential eye lens laminae provide a chronology of ocean diets prior to spawning that will be linked to egg thiamine concentrations. TDC is an emerging stressor to California salmon and understanding these aquatic linkages will be critical in assessing causes, impacts, and potential mitigation opportunities.

O32: DIVERSIFICATION OF THE BIOSYNTHETIC PATHWAY OF LONG-CHAIN POLYUNSATURATED FATTY ACIDS IN FISH

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Marine fish are important sources of the physiologically essential “omega-3” (or n-3) long-chain (≥C20) polyunsaturated fatty acids (LC-PUFA) including eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3) for human consumption. The bioconversion capability of LC-PUFA from C18 polyunsaturated fatty acid (PUFA) precursors such as α-linolenic acid (ALA, 18:3n-3) is greatly diversified among fish. Fatty acid desaturases (Fads) and elongation of very long chain fatty acids (Elovl) proteins are two key enzymes involved in LC-PUFA biosynthesis; the former introduce a new double bond into the acyl-chain of PUFA and the latter catalyse the initial condensation step of acyl-chain elongation. A comprehensive retrieval of putative genes encoding Fads and Elovl from publicly available fish genomes and transcriptomes allows to predict the LC-PUFA biosynthetic capacity in a given species. Functional analysis has revealed a remarkable diversification of substrate preferences and regioselectivities of those enzymes as a result of species-specific evolutionary history and environmental factors including habitat (e.g. marine vs freshwater) and feeding habit (e.g. carnivorous vs herbivorous). Importantly, many marine carnivorous species within Acanthopterygii have shown limited capability for endogenous LC-PUFA biosynthesis, and thus largely rely upon preformed n-3 LC-PUFA acquired through their diet. Given the substantial decline of LC-PUFA production from primary producers has been predicted due to the climate change, fish species with limited LC-PUFA biosynthetic capacity will be likely impacted by the rapidly occurring environmental changes.

O37: PERSISTENCE OF A COINVADING PARASITE AFTER ERADICATION OF TOPMOUTH GUDGEON PSEUDORASBORA PARVA

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Invasive alien species are second only to habitat loss in their global threat with their impacts to biodiversity and the complete and permanent removal of a population of invasive species by lethal or nonlethal means is integral to legislation and policy. Since 2005, a programme of Pseudorasbora parva eradication from ponds in England has been used to prevent its invasion and halt Sphaerothecum destruens spreading to native fish. Generalist parasites are more likely to be transported, become established and infect new hosts, and pose a high risk to biodiversity across ecosystems. A recent epidemiological model predicted that following eradication, S. destruens still persists in neighbouring fish communities. Thus, the aim of the present study is to investigate the presence of S. destruens in waterbodies connected to ponds where P. parva has been eradicated. The study was completed in Test River (Hempshire, Southampton) and environmental DNA and Real Time PCR method was used to detect S. destruens targeting the 18S rRNA gene. The results revealed that S. destruens persists in Test River especially in areas of Salmonid fish population inhabits. This suggests that transmission of parasite might be severe and increase its virulence through higher within-host replication rates. The long-term ecological and evolutionary impacts on native fish communities must be monitored.

S5: ON THE EDGE – DECIPHERING DISTRIBUTION PATTERNS OF BASKING SHARKS IN THE ARCTIC

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Experiencing increased pressure from fisheries, coastal development, and climate change, the basking shark (Cetorhinus maximus) is considered Endangered. Studies conducted in temperate waters suggest its distribution to be patchy and strongly driven by sea surface temperature and food availability. Yet, for the northern edge of its distribution, we lack fundamental information on the spatio-temporal habitat use of basking sharks, relevant environmental drivers and potential temporal trends. Species distribution models can provide a powerful tool to investigate how environmental factors influence shark occurrence over annual and sub-annual time scales. In my talk, I will present results from such a model based on basing shark observations from the Citizen Science platform “Dugnad for Havet”. I will highlight predicted hotspots of basking shark occurrence in Norwegian waters, inspect possible drivers and discuss possible distributional changes over time. With climate change set to alter conditions in northern latitudes at the range edge of this species, this knowledge is pivotal to contrast with existing data from more central areas of the shark’s distribution. In conjunction with in-situ tracking data, these results will contribute to a spatio-temporally integrated view of how current and future human activities i.e., fisheries or marine traffic, overlap with shark habitats and space-use in light of competing management priorities and a changing climate.

O31: SMALL SCALE DIFFERENCES IN BLUE COD LENGTH DISTRIBUTION, GROWTH, AND TROPHIC ECOLOGY IN NEW ZEALAND

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Growth and reproduction in marine fish populations can be strongly influenced by local habitat quality and nutritional resources. Habitat degradation can alter prey composition and availability, and, consequentially, trophic position and dietary niche breadth of marine fish. In the present study, we compared length-frequency distributions, growth, stomach contents, and isotopic values (δ13C and δ15N) of blue cod (Parapercis colias) subpopulations from biogenic reef habitats and habitats that were influenced by shellfish dredges and fine sediment in New Zealand. Blue cod inhabiting more degraded regions were significantly smaller and relied on different prey items than blue cod from biogenic reef habitats. SIBER results indicated that the isotopic niche areas of blue cod occupying degraded habitats were smaller than those of blue cod inhabiting relatively undisturbed biogenic reefs. The simmr isotopic mixing models demonstrated that blue cod from one of the biogenic reef regions relied predominantly on suspended particulate organic matter, while blue cod from the other biogenic and degraded regions primarily relied on macroalgae as their organic matter source. Dietary niche overlap was likely higher for blue cod from degraded habitats, with potential consequences for growth and reproduction. Blue cod inhabiting biogenic reefs showed a high degree of individual specialisation. The present study demonstrated that differences in length distribution, growth, and trophic ecology among blue cod subpopulations coincided with differences in habitat degradation. Ecosystem-based management solutions can help regenerate high quality biogenic habitats while reducing fisheries mortality within these critical habitats.

O21: ESTUARIES AND THEIR SHARKS: A STORY OF REFUGE AND PROTECTION

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Estuaries are recognised globally as an important habitat for early-life stage vertebrates, and yet regional protection against human perturbation can lapse. In the face of a decade of punctuated coastal development on the north-western interior coast of Bimini, The Bahamas, we lack a full understanding of the contemporary habitat or resource selection of resident juvenile lemon sharks (Negaprion brevirostris) and their associated faunal community in this estuary. Over consecutive studies of spatial behaviour using data spanning four field seasons, we investigated the habitat and resource selection of these sharks. In addition to applying classic models of habitat selection, we assess the association between predator sharks and their teleost prey, and the ability to predict one from the other using hierarchical modelling. Furthermore, we predicted foraging hotspots across the wider estuary habitat using Bayesian updating and data from previous identification of isolated foraging events by these juvenile lemon sharks. While many questions remain unanswered, our findings provide evidence that habitat type is not necessarily the main driver of juvenile shark behaviour, and that often under-protected refuge areas, such as the central mangrove reserve studied here, are critical for vulnerable life stages of marine vertebrates. In addition to underlining the ecological value of mangroves in Bimini, our study provides an example of how to navigate the challenges of combining historical data from multiple sources (over often misaligned spatiotemporal scales) with hierarchical modelling towards the aims of predicting fish distributions into the future and addressing pressing ecological questions in the present.

S16: SEASONAL ESTUARINE HABITAT USE OF THE STOCKED EUROPEAN STURGEON (ACIPENSER STURIO) IN THE GIRONDE ESTUARY.

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Acipenser sturio is a critically endangered anadromous fish species with the last remaining population living in the Gironde estuary, thanks to restocking programs. Between 2010 and 2018, trawling surveys (n = 1022 trawl tows) in the estuary have caught 452 sturgeons (fork length (FL) 25.5cm to 154cm). Individuals have been categorized into two groups, estuarine dwellers (ED; below 68cm FL) that are using mainly the estuary and sea explorers (SE; equal or above 68cm FL) that could accomplish migration at sea. Hotspots analysis were made at a seasonal scale to localise ED and SE concentrations. Differences were analysed according to environmental variables extracted from a hydrodynamic model (Mars3D). In spring and summer, both groups are using common areas located downstream (high overlap: 21 to 31%) whereas in winter and autumn, different areas are used (overlap from 6 to 0%).

Temperature and salinity appeared as the main drivers. Suspended matters, depth and velocity contributed partly. In spring and winter, ED did not select areas with environmental variables different from the sampling area, suggesting that the abiotic environmental variables considered were not explaining their distribution. In summer, ED and SE used similar environmental conditions (salinity: 25.78 ± 1.66ppt; temperature 18.90 ± 0.47 °C), whereas in autumn, they used different environmental conditions (higher salinity for SE: 27.32 ± 1.90 ppt vs 16.5 ± 5.43ppt; lower temperature for ED: 13.6 ± 0.28 °C vs 12.94 ± 0.15°C). Those results highlights important areas for both groups that are of high interest for conservation measures.

O46: DISTINGUISHING BIOLOGICAL FROM OBSERVATION PROCESSES TO BETTER UNDERSTAND ENVIRONMENTAL EFFECTS ON THE MIGRATION PHENOLOGY OF THE ATLANTIC SALMON (SALMO SALAR) IN A CLIMATE CHANGE CONTEXT

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Atlantic salmon (Salmo salar) juveniles (smolts) migrate from their natal rivers to the sea where they grow before coming back for the reproduction. The phenology of this seaward migration is especially important because fish's body size and date of arrival at sea influence its subsequent survival and growth. Nevertheless, little is known on how changes in river growth conditions or environmental determinants of migration can disrupt smolt migration phenology and ultimately population dynamics. This is partly due to incomplete data and/or inadequate statistical approaches. Especially, data collected in natural environments are subject to variation in the observation, potentially leading to bias and misinterpretation. Here, we investigated how environmental factors (e.g. temperature, discharge) and individual variations (e.g. size, growth) influence the migration phenology of the Atlantic salmon using a long-term tagging/recapture experiment of juveniles in the Scorff river (Brittany, France). We developed a Bayesian model that explicitly separates the observational (capture at traps) and dynamic (migration) processes, as well as the different effects of the environmental factors. Through this model, we were able to disentangle the discharge effect on the migration from the effect on the trap efficiency. This way, we were able to understand how changes in the dynamics of river discharge could influence smolt migration. Therefore, our study provides a better understanding of the processes underlying phenology migration, ultimately increasing our ability to anticipate the adaptation response of salmon to cope with climate change.

S24: OPTIMISING FISH PRODUCTION FOR HUMAN HEALTH, A PROPOSAL FOR MSNY: MAXIMUM SUSTAINABLE NUTRITIONAL YIELD

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Fisheries management is largely focused on maximising sustainable yield with little regard for nutritional value. Combining top-down modelling approaches with bottom-up data provision through compositional analysis, we present a novel way to manage fisheries: fishing at Maximum Sustainable Nutritional Yield (FMSNY), the fishing rate where the essential nutrients supplied from a population are maximised indefinitely. Using Atlantic mackerel (Scomber scombrus) as a case study, we compared nutrient yields between catch seasons and found that total lipids, omega-3, and iron content were maximised below current fishing levels that maximise for yield. Developing management strategies maximising nutrients rather than yield, will maximise the contribution of fisheries to global food and nutrition security at a time when fisheries yields are unlikely to increase.

(Note that this abstract has been changed since the mini-programme was printed)

O10: THE INFLUENCE OF ENVIRONMENTAL PARAMETERS ON THE LONG-TERM VARIABILITY OF SPECIES RICHNESS IN TRAIT-BASED COMMUNITIES IN THE SOUTHERN NORTH SEA AND ENGLISH CHANNEL

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Shifts in species distributions in the Northern Atlantic reported since early 2000's have been attributed to climate and environmental changes, but little is known about them drivers. Investigating the longer-term variability of trait-based communities is useful to understand the dynamics of marine ecosystems. Species records were obtained from the International Bottom Trawls Survey database and classified into mobility traits. We investigated the influence of sea surface temperature (SST), North Atlantic Oscillation Index (NAOI) and nutrient concentration trends on the variability of overall species richness in the southern North Sea and eastern English Channel between 1998 and 2020 via linear regression modelling. Unexpectedly, we found weak evidence of SST and NAOI, and strong evidence for the influence of nutrient concentration trends on overall species richness in all traits. Species were then classified by their occurrence along the study period as Core (>50% throughout), Increasing (mostly at the second half), Decreasing (mostly at the first half) and Rare (one-record throughout). We found trends of declining Core species while Increasing species were consistently rising. Fish species were included in the free-movement trait, mostly (> 90%) comprised by Increasing and Core species. Fishes were shown more resilient when compared to other taxonomic groups. We found strong evidence that nutrient concentration may have driven overall species richness in all functional mobility trait groups in the study area, possibly representing a temporal boundary for overall Increasing species rising. Further studies may find the importance of such Increasing species for fish distributions northwards in the North Sea.

O9: INTERANNUAL VARIABILITY IN EARLY LIFE PHENOLOGY IS DRIVEN BY CLIMATE AND OCEANIC PROCESSES IN TWO NE ATLANTIC FLATFISHES

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Early life phenology is a crucial factor for population dynamics and connectivity. As such, understanding how the early life cycle of marine fishes is influenced by key oceanic and climate drivers is of chief importance for sustainable fisheries, particularly those with complex life cycles that include migrations between coastal areas and estuaries. This study documents interannual changes in early life phenology of two commercial flatfishes in the western Iberian coast: European flounder (Platichthys flesus) and common sole (Solea solea) from 2010 to 2015 based on otolith microstructure. Using GAMs, we looked for correlations of the North Atlantic Oscillation (NAO), Eastern Atlantic pattern (EA), sea surface temperature (SST), chlorophyl a concentration (Chla) and upwelling (Ui) variation with the onset of hatch, metamorphosis, and benthic settlement day. We concluded that higher SST, more intensive upwelling, and EA were coincident with a later the onset of each stage, while increasing NAO induces an earlier onset of each stage. Although similar to S. solea, P. flesus showed a more complex interaction with the environmental drivers, most possibly because it is at its southern limit of its distribution. Our results highlight the complexity of the relationship between climate conditions and fish early life history.

O24: DIEL MOVEMENT BEHAVIOR AND RESIDENCE TIME OF AN ESTUARINE FISH SPECIES ASSOCIATED WITH A COMMERCIAL OYSTER FARM

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As oyster aquaculture continues to expand within the estuaries of the United States it is important to understand how structure-oriented species will use leased areas and culture gear as habitat. Oyster aquaculture farms (referred to as leases) typically represent a conversion of a previously unstructured habitat into a densely structured one. Sheepshead (Archosargus probatocephalus) are an economically important species that are known to depend on structured habitat throughout their life. To address the question of oyster leases serving as habitat, we installed an Innovasea acoustic receiver array (VPS) surrounding a water column oyster lease in Cedar Island Bay, North Carolina and surgically tagged 27 juvenile sheepshead (103mm - 193mm) with acoustic transmitters in order to track their fine-scale movements from July through November 2020. Juvenile sheepshead were detected significantly more frequently in the lease than in the surrounding embayment when the results were standardized by area. Tagged individuals frequently left the lease area to move along a mudflat or marsh edge and returned to the lease later in the same day, we expect that these movements were related to foraging behavior. Sheepshead showed particularly high residency during nighttime hours when fish were dormant, appearing to use the farm as a refuge. Both sheepshead home-range and range-overlap with the oyster lease varied seasonally. These results show that juvenile sheepshead are frequently associated with oyster leases; lease habitat appears to provide refuge from predators and access to prey items associated with oyster communities. These data and analyses will provide insight into the amount of available habitat for juvenile sheepshead and the ecological benefits of oyster aquaculture.

S28: FISH PASSAGE AND HABITAT SELECTION IN AN ALTERED ENVIRONMENT: ANALYSING THE FINE SCALE HABITAT SELECTION OF UPSTREAM MIGRATING FISH NEAR A HYDROPOWER PLANT

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Freshwater fish migration is increasingly hindered by riverine barriers. Fish passes are a common mitigation option - providing fish with an alternative route - yet fish pass effectiveness varies. Barriers can greatly alter the hydraulic environment through which fish must navigate, leading to difficulty in locating a fish pass. To improve fish pass design, more knowledge is required on fish behaviour and habitat selection as they approach a barrier and fish pass. Here, we evaluate the habitat selection of upstream migrating barbel Barbus barbus and grayling Thymallus thymallus at a hydropower plant in southern Germany. Fish were tracked using fine scale 2D acoustic telemetry during their spawning migration in 2018. Resulting positional data will be analysed alongside fine-scale hydraulic models using step selection functions to determine if fish select for or against hydraulic parameters. Step selection function models will be developed for each individual fish to determine the parameters explaining the movement on the level of the individual. A broader model structure will then be developed for each species and applied to each individual. Coefficients from the broader model will be averaged to provide general trends for each species and to quantify individual variation. By identifying hydraulic preferences of the fish, dam operation could be altered to provide more suitable conditions during migration periods.

S3: WHAT DETERMINES EMIGRATION SUCCESS OF ATLANTIC SALMON SMOLTS IN SCOTTISH RIVERS?

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Atlantic salmon (Salmo salar L.) have suffered substantial declines across Europe over the last 70 years. Mortality is typically very high (e.g., approximately 50% in the east coast Scottish rivers) when smolts leave their home rivers to undertake their seaward feeding migration, due to predation, river fragmentation, pollution and diseases. Although several studies have addressed the direct causes of smolt mortality, the factors that differentially affect the ability of individual fish to respond to these stressors are not well understood.

Here we investigated the effect of body shape and genotype on river migratory success of Atlantic salmon smolts which were acoustically tagged in the River Spey (n = 75) and River Oykel (n = 65), Scotland. Geometric morphometric analyses did not find any body shape differences between successful and unsuccessful migrants in either river. However, we found that some genomic regions enabled us to predict the migratory outcome for these fish. Although further research is needed to properly understand the potential for using genetics to predict migratory outcomes beyond these rivers and across a temporal sample, we have shown that migration success can differ according to genotype at a few key loci. Conservation strategies should therefore aim to preserve genetic diversity in natural populations facing increasing natural and anthropogenic pressures.

S10: ECOSYSTEM SERVICES PROVIDED BY DIADROMOUS SPECIES ACROSS THE NORTH ATLANTIC AREA: A SCOPING REVIEW AND ASSESSMENT OF EVIDENCE

Muench, Angela [1], Murillas, Arantza [2], Bašić, Tea *[1], Ashley, Matthew [3], Marta-Pedroso, Cristina [4], Rodwell, Lynda [3], Rees, Sian [3], Díaz, Estibaliz [2], Rendle, Emma [3], Copp, Gordon H. [1,5,6,7], Lambert, Patrick [8], Lassalle, Géraldine [8]

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Diadromous fishes and lampreys provide a range of benefits to local communities within the Europe's North Atlantic Area (NAA), including food provision, nutrient exchanges and cultural values. However, their stocks have declined in recent years due to multiple human-generated stressors that operate throughout their complex diadromous life cycle. Depleted stocks are expected to be less resilient to predicted, near-future changes in climate, with the displacement of benefits they provide to society expected to mirror their simulated species distribution shifts. Thus, understanding those societal and economic benefits provided by diadromous species is essential to inform managers and policy-makers to consider during decision-making process. The Interreg-funded DiadES project reviewed existing peer-reviewed and grey-literature evidence on ecosystem services of eleven diadromous species in the NAA, with special emphasis on local-expert stakeholder knowledge in case studies across England & Wales, Ireland, France, Spain and Portugal. The wide variety of ecosystem services identified for diadromous species ranged from food provisioning to cultural (e.g., recreational fishing, natural heritage) and regulating services (e.g., nutrient exchanges between habitats). The evidence base was greater for commercially important species (e.g., Atlantic salmon) and provisioning services, although a shift over the last decades from provisioning to cultural services was evident for several declining species. Large regional difference became apparent in the benefits that individual species provided to society. Initial quantitative valuations of the ecosystem service benefits provided by diadromous species in the case study areas were conducted and implications discussed in the context of future management needs.

O38: HOW A BRAIN-INFECTING PARASITE ALTERS ENERGY METABOLISM IN A SHOALING FISH: IMPLICATIONS FOR CONDITIONED FEAR RESPONSES AND MECHANISMS OF BEHAVIOR-MODIFICATION

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Parasites are increasingly being recognised as important players affecting individuals, populations, communities, and even ecosystems. Some parasites change their host's behaviour to aid transmission to the next host in their life cycle. Parasite-induced behaviour modification may both drive and be driven by changes in host energy metabolism. Here, we examined the gregarious estuarine fish species, the California killifish (Fundulus parvipinnis) and its brain-infecting, behaviour-manipulating trematode parasite (Euhaplorchis californiensis). Killifish were reared in shoals from hatching in either a control (uninfected) or twice-weekly infection (infected) treatment for 12 months. Standard metabolic rate (SMR), maximum metabolic rate (MMR), and acute metabolic response to infectious propagules (MRacute) were then measured using respirometry chambers that allowed these social fish to smell and see their shoal-mates to prevent isolation stress. Brain, gill, and white muscle samples were extracted to assess the way infection influences citrate synthase (CS) and lactate dehydrogenase (LDH) enzymatic activities as indicators of aerobic and anaerobic metabolism, respectively. While SMR and MMR were unaffected by infection status, both uninfected and infected fish exhibited spikes in MRacute. Intriguingly, infected fish mounted a stronger response to exposure than naïve (control) hosts, implying a learned 'fear' response to parasite exposure. Measures of enzyme activity suggested that only the brain (the site of the infection) was impacted by the parasites, with infected individuals exhibiting lower LDH activity than uninfected fish. Given the importance of lactate in brain function, these results could suggest a mechanism for parasite-induced behavioural modification

S8: FISH DISTRIBUTION IN THE SHALLOW MARINE NEARSHORE AND ESTUARINE SEASCAPES: NURSERY AREAS AND THE EFFECT OF ENVIRONMENTAL DRIVERS

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Assessing fish distribution across estuarine and marine nearshore habitats is important to identify ecologically important habitats. Yet, only a few studies, particularly in southern Africa, have focused on fish community patterns across an estuary and marine nearshore gradient concurrently. The aim was to determine the settlement and nursery value of shallow marine nearshore and estuarine habitats and to examine whether these two coastal environments have distinct fish assemblages in relation to physical factors. This was achieved by determining fish abundance, species composition and patterns of habitat use, by life stage across the estuary-ocean gradient in Algoa Bay. The marine nearshore sites were dominated by species which spawn in the marine environment and are not dependent on estuaries (marine species and marine estuary-opportunists), whilst the estuaries were dominated by estuarine spawners or marine spawners dependent on estuaries to some degree. The differences observed between the marine nearshore and estuary were mostly driven by the salinity, turbidity, silt and organic content of the sediment. In addition, soft-bottom habitats in both the estuaries and the nearshore were dominated by early-life stages (postflexion larvae, settlement stage and young-of-the-year fishes), but a significantly greater abundance of early-life stage fishes was found in the estuarine environment, highlighting the importance of estuarine habitats for demersal fishes within the Algoa Bay. Examining estuarine and nearshore marine habitats is important in order to identify ecologically important habitats, which has important implications for the development of effective management strategies for coastal fish populations, particularly in the light of anthropogenic change.

O40: FRESHWATER FISHES AND MICROPLASTICS IN AN ERA OF MULTIPLE STRESSORS

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The contamination of freshwater fishes by microplastics (plastics < 5 mm) can result in negative ecological, physiological and reproductive impacts on affected biota with important implications for conservation and management. However, freshwater fishes are subject to a range of stressors simultaneously, for example warming, emerging contaminants and parasites. While stressors typically cause negative effects in isolation, less is known about the potential interactive effects of microplastic contamination with additional stressors. Synthesising data from a literature review, several field studies, an interaction experiment and a metanalysis this presentation will present: 1) the factors impacting the ingestion and effects of microplastics, 2) the interactive effects of microplastics and parasite exposure on feeding and growth and 3) factors impacting the interactions between microplastic and additional stressors. Microplastic loadings in several species of wild fish were highly consistent, unrelated to biological and environmental features and did not support the bioaccumulation or biomagnification of particles. Parasite exposure reduced feeding and growth in a freshwater fish final host, however microplastic exposure had no single or interactive effect. Finally, microplastic interactions were typically additive across numerous stressors, measured responses and fish species with studies using environmentally unrealistic exposures often overestimating multiplicative effects. The data suggest that current baseline microplastic loadings in fishes are consistent and likely causing relatively minor impacts compared to those of other stressors.

S9: SMALL BOTTOM FISH DISTRIBUTION IN THE DUTCH EEZ.

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Small bottom fish, such as juveniles of commercial species like sole (Solea solea) and plaice (Pleuronectes platessa), as well as non-commercial small species like gobies (Gobiidae), solonettes (Buglossidium luteum), and sandeels (Ammodytidae), play a significant role in the North Sea food web as prey items for many predatory fish, bird, and marine mammal species. Much is unknown about the abundances and/or distribution of these small bottom fish as a result of their low representation in the common demersal fish surveys. However, for our study a deep digging dredge was used, which appeared to be particularly suitable gear for quantitively collecting (small) bottom fish, including sandeel burrowed in the sediment. This catch data was used to fit habitat distribution predictions by using R-INLA. Bottom fish biomasses up to 5 times higher than previously reported based on the standard surveys (IBTS, BTS, DFS), were found. This will affect the carrying capacity of the Dutch part of the North Sea as well as the bottom-up and top-down interactions between prey and predator species.

S17: REHABILITATION AND MANAGEMENT OF PONDS FOR CONSERVATION, WITH EMPHASIS ON SELF-SUSTAINING POPULATIONS OF FISHES OF CULTURAL HERITAGE CONCERN

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Ponds have long been a crucial component of agricultural landscapes in Europe, acting as a source of food (fish), water (for livestock) and both a home and/or stepping stone for a range of aquatic and terrestrial plants and animals. Fish species typically found in English ponds are crucian carp Carassius carassius, tench Tinca tinca, threespine stickleback Gasteosteus aculeatus and European eel Anguilla anguilla, with crucians and eels currently threatened species. To combat the decline of crucian carp, which is considered a fish of angling cultural-heritage in England, the Norfolk Pond Project (NPP) has been rehabilitating existing and fully-terrestrialised pond habitat and re-stocking the restored ponds with genetically-pure crucian carp. As a result, self-sustaining crucian populations are now established in many of the rehabilitated ponds in Norfolk, thereby reversing the species' decline in Norfolk over the last four decades. Key to the restoration of crucian populations is an understanding of crucian environmental biology in the East of England, which 30 years of research has revealed to be particularly favourable for crucian growth and reproduction. This presentation will summarise recent fish surveys of the rehabilitated ponds to identify fish species composition (in particular the aforementioned species) and assess growth and fitness patterns of restored crucian populations to identify which type(s) of rehabilitated ponds (formerly ghost, near-terrestrialised, over-shaded, etc.) are most effective for crucian conservation.

S15: KNOWLEDGE OF SPAWNING PHENOLOGY MAY ENHANCE SELECTIVE BARRIER PASSAGE FOR WETLAND OBLIGATE FISHES

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Within the Laurentian Great Lakes, many native fishes use wetlands for spawning; however, these areas are also used by non-native common carp (Cyprinus carpio) that impart negative ecological impacts. There is interest to manage common carp using barriers to decrease passage to specific habitats (e.g., spawning sites), but these barriers could also exclude native wetland obligate spawners such as largemouth bass (Micropterus salmoides) and northern pike (Esox lucius). Our objective was to determine if differences in phenologies, specifically, spawning movements could be exploited to operate seasonal barriers that are opened and closed to promote selective fragmentation. Using a long-term dataset from the Cootes Paradise Marsh fishway (Hamilton, Ontario), we generated predictive models based on cumulative growing degree day (CGDD) for all three fishes. These models successfully predicted earlier arrival by all species in a warmer year and delayed movements during a cold year, supporting the role of temperature as a driver of interannual variation in phenology. We then compared the fishway model predictions to movements to spawning habitat within nearby Toronto Harbour derived from acoustic telemetry data. We found that the models performed well in that the predictions were correlated with the acoustic telemetry data for all three species, but performance was weakest for northern pike. It is our hope that managers could use these predictive models to assist in the operation of seasonal barriers to optimize control of non-native common carp, while minimizing negative impacts for native species that require access to coastal wetlands.

S12: FISHING IN THE AMAZON: EXPLORING THE POTENTIAL FOR FISHING-INDUCED EVOLUTION IN THE AQUARIUM INDUSTRY

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Intense fishing represents one of the strongest, selective anthropogenic pressures exerted on natural populations. In commercial food fisheries, there is increasing evidence that physiological and behavioural traits are associated with vulnerability to capture by fishing gears. However, the selective impact of fishing has been completely overlooked within the context of the ornamental fishing industry. This is surprising as it is a highly selective fishery that is becoming increasingly popular. Here, we examine what traits determine vulnerability to capture using lab-based simulations as well as findings from field surveys and underwater trapping data in the Amazon. Findings from these studies provide a basis for understanding if selection on traits follows a pattern or if the impact is context specific. Results from this study will provide one of the first examples of fisheries selection within the ornamental fishing industry and will further our understanding of the potential impacts of this growing fishery.

O1: FUTURE PROJECTIONS OF SUITABLE HABITAT FOR 49 COMMERCIAL FISH SPECIES: HOW WILL FISHERIES ALLOCATION AND CONSERVATION OBJECTIVES BE AFFECTED?

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Climate change is anticipated to result in shifts to distributions of marine organisms, including commercial fish. We describe projections from models, showing the future suitable habitat for 49 commercially valuable fish in the Exclusive Economic Zone (EEZ) of the United Kingdom (UK). We employed an ensemble of species distribution models together with downscaled climate projections assuming three different climate change scenarios (RCP4.5, RCP8.5 and A1B). Habitat suitability and latitudinal shifts were quantified in the recent past (1997-2016) and for two futures (2030-2050; 2050-2070). Of the species examined, around half were predicted to have consistently more suitable habitat in the future within the UK EEZ, including black seabream, seabass, sardine, surmullet (red mullet), anchovy and pouting (bib). Conversely, it is suggested that the seas will become significantly less suitable for other species including saithe, Atlantic wolffish, starry ray, halibut, ling, megrim and lemon sole. Results show that while there are differences in the magnitude of change, and that the models perform better for certain species compared with others, overall the general trends in habitat suitability and abundance are robust across models and climate scenarios. Commercial fisheries will need to adapt to these changes by: (1) changing the location where fleets operate, and/or (2) changing the gear used and species targeted. There may be financial or regulatory barriers to successful adaptation and these will need to be overcome if the UK fishing industry is to remain profitable and sustainable in the years to come.

O8: HOOK AND LINE FISHING REDUCES THE POTENTIAL FOR PHYSIOLOGICAL ADAPTATION TO THE IMPACTS OF CLIMATE CHANGE

Potts, Warren M. [1,2], Muller, Cuen [1], Bailey, Lauren [1], Skeeles, Michael [1], Duncan, Murray I. [1,2], Winkler, Alexander C. [1], Nabani, Xolani [1], Mlotshwa, Nonhle [1], James Nicola [2], Childs, Amber-Robyn [1]

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This presentation summarizes our research on the impacts of hook and line fishing on the physiology of fish populations using the heavily exploited, resident Chrysoblephus laticeps, as a model species. We compared the metabolic physiology of two exploited and two unexploited populations and found that unexploited populations had a significantly higher aerobic scope at extreme temperatures. We then used acoustic accelerometry in the wild and found that acceleration was constrained at thermal extremes in the exploited population. While this may suggest that individuals that maintain their metabolic rate at extreme temperatures are more susceptible to hook and line fishing, we also assessed the relationship between boldness and physiology to better understand the selective removal of high performing physiological phenotypes. We found a significant correlation between physiology and boldness, with the high physiological performance phenotypes not only the boldest, but also outcompeting their conspecifics in feeding duals at normal and warm temperatures. We field spawned C. laticeps from exploited and unexploited populations and reared them in contemporary and predicted pH conditions to determine if high physiological performance traits were heritable. We found that preflexion larvae from the exploited population went into metabolic depression in pH conditions expected for 2100. Our findings suggest that hook and line fisheries selectively remove high performance physiological phenotypes because they are more active (and bold) and since their removal reduces the resilience of offspring to environmental stress, will reduce the resilience of fish populations to the impacts of climate change.

S13: A TEMPORAL ASSESSMENT OF FISH DIVERSITY AND ABUNDANCE WITHIN THE UNIQUE HYPER-SALINE ENVIRONMENT OF HAMELIN POOL, SHARK BAY UNESCO WORLD HERITAGE AREA, WESTERN AUSTRALIA

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Shark Bay UNESCO World Heritage Area in Western Australia is dominated by the world's most extensive seagrass beds (4,800km2), extreme salinity gradients (36PSU - >65PSU) and globally important stromatolites. The region has experienced recent marine heatwaves (MHWs) (2010/11 & 2022) and has therefore received the highest rating of vulnerability of UNESCO's Climate Change Vulnerability Index. During the 2010/11 MHW, 36% of critical seagrass beds were damaged on the Faure Sill, risking collapse and potential subsequent increased water exchange into the extreme hyper-saline environment of Hamelin Pool, threatening the world's largest population of actively accreting stromatolites. There is a paucity of information on the composition and stability of fish fauna within Hamelin Pool. This research deployed 639 stereo Baited Remote Underwater Video systems over 4 years (167 in 2016, 115 in 2018, 196 in 2020 & 161 in 2022) in order to comprehensively assess and describe the patterns and temporal dynamics in fish composition across the unique environment of Hamelin Pool.

O7: THE RETURN OF ATLANTIC BLUEFIN TUNA (THUNNUS THYNNUS)TO UK WATERS: OBSERVATIONS AND INTERPRETATIONS

Righton, David *[1], Binney, Francis [2], Birch, Samantha [1], Block, Barbara A. [3], Brereton, Tom [4], Creach, Veronique [1], Davison, Phil [1], Hawkes, Lucy A. [5], Horton, Thomas W. [1,5,6], Howlett, Peter [4], Hyder, Kieran [1], Lamb, Phil [1], Pinnegar, John [1], Plaster, Alex [2], van der Kooij, Jeroen [1], Wright, Serena [1] & Witt, Matthew J. [5,6]

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Over the last decade, Atlantic bluefin tuna (Thunnus thynnus, BFT) have been documented more frequently in waters of the north-east Atlantic, including those of the UK and the Channel Islands. We used multiple techniques (direct observations, fisheries bycatch, eDNA surveys and tagging) to track the return of this apex predator to the south-west of the UK and to assess its distribution and residency. The data reveal a sustained increase in sightings and bycatch of tuna in waters to the south-west of the UK since 2014, which is corroborated over a wider geographic range by strandings and other ad-hoc observations. eDNA surveys confirmed the presence of bluefin in the south-west approaches and Celtic Deep in 2018 to 2022. Data from electronic tagging reveal that BFT typically occupy UK waters between June and December, when small pelagic fish are also abundant. After December, BFT disperse to foraging areas in the eastern Atlantic and the Bay of Biscay before larger individuals migrate to the Mediterranean to spawn in May and June, and smaller individuals move to the Bay of Biscay. All individuals at liberty with an electronic tag for a full migratory cycle demonstrated philopatry, often returning to within 50 km of their tagging location. The results of our study are consistent with habitat models that show the increasing suitability of the UK's pelagic environment as a foraging area for juvenile and adult BFT, and provide clues as to the drivers of their return to, and their future within, the NE Atlantic.

O19: RIVER RESTORATION IN ACTION: RECOVERING ENDANGERED ATLANTIC SALMON AND AQUATIC ECOSYSTEMS ONE NATIONAL PARK AT A TIME

Robinson, John W.*[1,2], Whitelaw, John M. [1], Samways, Kurt M. [2]

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For decades, Atlantic salmon in Eastern North America have precipitously declined. Reduced to less than 250 wild adults, the Inner Bay of Fundy (iBoF) Atlantic salmon population was listed as endangered under the Canadian Species at Risk Act in 2003. In conjunction with Fundy Salmon Recovery (FSR), Fundy National Park deploys an innovative salmon recovery strategy, where out-migrating smolts are collected, reared to maturity in modified sea cages at the world's first Wild Salmon Marine Conservation Farm on the island of Grand Manan, New Brunswick, and subsequently reintroduced back to their natal rivers to spawn naturally. Passive Integrated Transponder (PIT) telemetry demonstrated that 2021 was the highest returning abundance in over 30 years with 114 returning adults, followed by 2022 where Fundy National Park represented over 70% of the entire iBoF population with 102 adults, while most other iBoF rivers continue to decline. Using a Bayesian hierarchical model to estimate juvenile salmon abundance, numbers have increased from 0.4/100m2 to 8.2/100m2 and 0/100m2 to 16.9/100m2 in the Upper Salmon and Point Wolfe Rivers, respectively, since the restoration program began in 2015. In addition, freshwater productivity and ecosystem function have increased as a result of restoring salmon back in the rivers. FSR is a true collaboration of Federal and Provincial governments, industry, First Nations, and academia leading salmon and ecosystem recovery. Applying this model to various restoration strategies across Kouchibouguac, Cape Breton Highlands, Gros Morne, and Terra Nova National Parks could inform when and how best to apply salmon restoration initiatives.

O39: FISHERIES-INDUCED EVOLUTION DRIVE GENOMIC SHIFTS EVEN AFTER A PERIOD OF RECOVERY

Sadler, Daniel E.*[1], Sävilammi, Tiina [1], van Dijk, Stephan [1], Watts, Phillip C. [1], Uusi-Heikkilä, Silva [1]

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Overfishing can cause drastic alterations in fish populations, not only causing population declines, but also phenotypic and associated genotypic divergence. One solution to tackle the effects of over-exploitation is to set a moratorium and cease fishing activities. However, the applied recovery time may not be long enough to allow population to fully recover phenotypically and genetically. We study this important question experimentally and use whole genome sequencing to assess potential shifts in genomic structure after multiple generations of harvesting. We use three selection lines where 75% of individuals were harvested according to body size: small-selected (smallest individuals remain in the spawning stock; simulating typical fisheries), large-selected (largest individuals remain in the spawning stock) and random-selected (individuals were chosen at random to remain in the spawning stock, acting as a control). After five generations of harvesting, we allowed populations to recover for ten generations. We demonstrated phenotypic and genetic shifts in the small-selected populations compared to the large- and random-selected fish. During the recovery period, the size-selected lines (both small- and large-selected) further diverged away from the control line having a more similar genetic structure with each other and had lower genetic diversity. Our results highlight the importance of understanding the underlying genetic changes as a result of harvesting and assessing whether recovery periods are substantial enough to allow populations to recover genetically.

O44: HOW MUCH GENE FLOW IN CHIONODRACO RASTROSPINOSUS AMONG THE ANTARCTIC PENINSULA AND THE WEDDELL SEA?

Schiavon, Luca [1], Ceballos, Santiago [2], Matschiner, Michael [3], Trucchi, Emiliano [4], Lucassen, Magnus [5], Mark, Felix C. [5], Riginella, Emilio [6], La Mesa, Mario [7], Zane, Lorenzo [1], Papetti, Chiara*[1]

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The presence of the icefish species Chionodraco rastrospinosus, endemic to the Antarctic Peninsula only, in the Weddell Sea was documented very recently bringing up the question as how and what factors underpin its geographic distribution. To investigate this, we have analysed genome-wide SNP markers and used Lagrangian simulations. Our results show that populations of C. rastrospinosus from the Antarctic Peninsula and the Weddell Sea are genetically similar, but the main circulation does not explain this connectivity. Recent examples have been proposed that show how Antarctic fish distributed in a similar environmental context, between the Antarctic Peninsula and the Weddell Sea and exposed to the strong homogenizing power of the Circum-Antarctic Current, show different patterns of genetic connectivity suggesting that also ecology and behaviour are crucial in shaping population genetic structure in fish of the Southern Ocean.

S22: USING DIAZEPAM TO INVESTIGATE THE EFFECT OF STRESS ON THE FACULTATIVE MIGRATION OF EUROPEAN GLASS EEL (ANGUILLA ANGUILLA)

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The European eel (Anguilla anguilla) has received considerable attention in recent decades due to its significant decline. This catadromous species presents a large panel of estuarine migratory tactics, ranging from residency in marine water, to various degrees of upstream colonization through estuarine and freshwater ecosystems. These different migratory behaviors may have strong effects on the sex ratio of the local stock and it is therefore crucial to understand both the drivers and constraints on glass eels to settle in or migrate up the estuary.

Recent results suggest that non-migrant (NM) glass eels may be more stressed or sensitive to stress than migrant individuals (M). Estuaries are considered stressful environments and represent a major sink for various contaminants usually considered as powerful stressors. Among these chemicals, benzodiazepines can induce a number of neuroendocrine alterations in fish but paradoxically, they also may counteract the stress responses due to their potential anxiolytic effect.

To investigate the effect of stress on the migratory behavior of glass eels, we first determined their behavioral phenotype (M or NM) in an experimental device that mimics the reversal of the tidal current. Thereafter, 25 individuals of each phenotype were exposed to an environmental dose of diazepam for 7 days. To address the level of stress and the effect of diazepam in M and NM, stress hormones were analyzed in 10 individuals of each treatment. The sensitivity to stress was investigated using oxygen consumption after a mechanical stress.

S20: ENVIRONMENTAL DRIVERS OF NORTHERN ATLANTIC MARINE TROPHIC INTERACTIONS.

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Global environmental change is predicted to alter the dynamics of marine ecosystems with major implications for the sustainability of their functioning and value. Commercially important fish stocks have showed a major decline and sea surface temperatures have increased by approximately 0.5 °C in the past 150 years within the northern Atlantic, affecting species biodiversity and distributions. Here, we use a novel database of fish stomach contents, spanning >30 years and >400 thousand predator-prey body mass measurements, to show that both commercial fishing and sea surface temperature are key environmental drivers of spatiotemporal changes in food web dynamics. As trophic interactions are largely dependent on allometric scaling, the predator prey body mass ratio is a key indicator that provides valuable insight into food webs. The predator-prey body mass ratios of three important commercial fish species were found to increase with commercial fishing pressure and sea surface temperature across the northern Atlantic. This result is most likely due to the selection of smaller prey by predators and the removal of key predator species. By highlighting key environmental drivers of food web dynamics, this research has the potential to highlight vulnerable species and communities across large spatiotemporal scales. Furthermore, enhancing the understanding of what drives trophic interactions could enable the prediction of changes within marine food webs, from local sites to ICES rectangles and the global scale, which is currently not achievable based on observed interactions alone.

S29: PINK SALMON (ONCORHYNCHUS GORBUSCHA) INVASION IN THE NORTH ATLANTIC

Skóra, Michał E.*[1,2], Jones, J. Iwan [1], Townhill, Bryony [3], Berntsen, Henrik H. [4], Couce, Elena [3], Davies, Gareth D. [5], Eliasen, Kirstin [6], Guðbergsson, Guðni [7], Hopper, Paul [8], Lauridsen, Rasmus B. [9], Marshall, Shona [10], Millane, Michael [11], Nielsen, Julius [12], Robertson, Sean [13], Sivebæk, Finn [14], Skaala, Øystein [15], Söderberg, Linda [16], Thorstand, Eva B. [4], Trueman, Clive [17], Urquhart, Jamie [18], Wells, Alan [19], Youngson, Alan F. [20, 21], and the late Copp, Gordon H. [3,22,23,24]

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23. Trent University, Canada
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Pink salmon (Oncorhynchus gorbuscha) are the smallest, yet most abundant salmon in the North Pacific. The species was deliberately introduced into Russian White Sea tributaries in the second half of the 20 century. In 2017, they suddenly and unexpectedly appeared in large numbers in rivers across the North Atlantic, including in the UK and Ireland. In 2022, pink salmon smolts were caught in Scotland and Iceland, providing evidence of the extent to which the invasion has spread and successful completion of the freshwater life cycle of this anadromous fish. Stable isotopes have been used to assess the feeding grounds and trophic position of pink salmon in the North Atlantic.

O3: CLIMATE-DRIVEN SYNCHRONY IN MARINE AND TERRESTRIAL ECOSYSTEMS FROM THE MID-ATLANTIC RIDGE TO SOUTHERN EUROPE

Tanner, Susanne E. *[1,2], Campelo, Filipe [3], Cunha, Jorge [4], Eiras-Dias, José E. [4], Giacomello, Eva [5], Nabais, Cristina [3], Neves, Verónica [5], Ramos, Jaime A. [6], Reis-Santos, Patrick [7], Silva, Mónica [5], Vasconcelos, Rita P. [8], Vieira, Joana [3], Morrongiello, John R. [9]

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Ecological impacts of climate change are detectable in a wide variety of phenomena, ranging from shifts in species distribution to changes in phenology and redistribution in ecosystem productivity. However, less attention has been given to climate-driven synchrony of population dynamics in multiple taxa and ecosystems. Exploring common patterns among life-history traits of fish and other taxa from marine and terrestrial ecosystems at large spatial scales and linking them to potential drivers may provide insights into key mechanisms of population dynamics. Here, we use multidecadal time-series of otolith growth of five fish species (Trachurus trachurus, Merluccius merluccius, Helicolenus dactylopterus, Pontinus kuhlii, Pagellus bogaraveo), collected along the Portuguese mainland, Madeira and Azores islands, and combine them with time-series of tree growth, grape vine flowering phenology, indices of seabird reproduction and dolphin sighting rates to investigate common trends in variation and synchrony among taxa. The time-series are analyzed using rolling correlation and dynamic factor analyses (DFA). Relationships of the obtained common trends in population dynamics with large-scale environmental processes acting in the North Atlantic region are examined. Using DFA, three common trends are identified and relationships of the identified trends with East Atlantic Pattern and Atlantic Multidecadal Oscillation show varying direction and magnitude. Future changes in frequency or amplitude of these large-scale processes are likely to have major consequences for both marine and terrestrial taxa. Furthermore, high similarities in growth patterns of fish and trees offer the possibility of extending fish chronologies up to multi-centennial scales potentially providing better insights into historical and future responses of fish populations to climate variation.

O27: EXPLORING THE ROLE OF THE WADDEN SEA AND OTHER NURSERY AREAS IN THE DECLINE OF MARINE JUVENILE GUILD FISH POPULATIONS

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Fish often rely on shallow coastal habitats during their early life stages before switching to offshore habitats as adults. The marine juvenile guild refers to a group of fish species that follow this life history pattern. The Wadden Sea, which borders the North Sea, is an important nursery ground for many of these species. However, fish densities in the Wadden Sea have declined dramatically since the 1980s, with the most significant reductions observed in the marine juvenile guild.

To understand the mechanisms responsible for this decline, it is essential to consider the full life-cycle of these fish, since these fish depend not only on the Wadden Sea, but also on the North Sea. Additionally, other nursery areas may serve as a source population and compensate for reduced habitat quality in the Wadden Sea.

We developed size-structured population models that capture the entire life history of individual fish and explicitly account for the role of the Wadden Sea relative to the North Sea and other nursery areas. In these models, individual growth and development depend on food availability, which allows us to understand how changes in food availability and habitat quality impact population dynamics.

By examining the models, we have identified counterintuitive stage- and habitat-specific bottlenecks that depend on how the Wadden Sea functions in relation to other nursery areas. These insights will help us to better understand the decline of the marine juvenile guild and guide efforts to restore their populations in the Wadden Sea and beyond.

O29: ACHIEVING “GOOD ENVIRONMENTAL STATUS” IN THE NORTH SEA FOR FOODWEBS: A NEW WAY OF THINKING?

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Ecosystem-based management is mandated by international legislation, including the Marine Strategy Framework Directive (MSFD) in the EU. This introduces a requirement for marine environments to achieve “Good Environmental Status” or GES, implying that the ecosystem is in a healthy and biodiverse state which does not limit the management options of future generations. Indicators of GES typically refer to the current or past state; however, Rossberg et al. (2017) have suggested an alternative approach that defines GES in terms of being able to recover to the appropriate reference unperturbed state within 30 years if human activities cease. In this study we evaluate Rossberg et al.’s “recovery timescales” approach using the StrathE2E2 “big picture” model, an end-to-end ecosystem model designed to evaluate both top-down and bottom-up effects at an ecosystem level. We ask whether the approach is enough to prevent severe depletion as well as ensuring recovery at some future time. We also ask whether implementation is practical given uncertainties in defining appropriate baselines for recovery, defining what recovery looks like relative to this baseline, and taking account of natural variability. We find that the main issues with implementation are a) defining the appropriate baseline for recovery in a changing environment, and b) ensuring that there is stakeholder acceptance of any recommended actions in the event that they differ substantially from current policy. Subject to these two issues, we conclude that a “recovery timescales” method is a valuable addition to ecosystem management in support of achieving GES.

O25: THE INFLUENCE OF HABITAT CHARACTERISTICS AND DENSITY-DEPENDENCE ON SPATIAL DISTRIBUTIONS OF SPAWNING SOCKEYE SALMON (ONCORHYNCHUS NERKA)

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The selection of habitats by individuals under different environmental conditions and population densities is a relatively understudied area of research. This study examines how spawning sockeye salmon choose among habitats that vary in reproductive habitat quality and protection from predators. A Bayesian generalized linear mixed model is applied to 15 years of annual tagging data from two distinct populations of sockeye salmon spawning in streams with different geomorphic conditions. The study finds that certain stream-scape characteristics influence the spatial distribution and population densities of spawning sockeye salmon, which can impact reproductive success. The results have important implications for habitat occupancy predictions, especially in light of proposed human development that threatens freshwater habitats worldwide, and can inform management decisions across a range of systems.

O6: THERMAL SENSITIVITY OF FIELD METABOLIC RATE IN MARINE TELEOSTS

Trueman, Clive N*[1], Jones, Joseph[1]

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Water temperature controls the physiological performance of ectothermic fishes and is the main predictor for species distributions in current and future climate conditions.

However, the thermodynamic effect of temperature on enzyme relation rates is only one part of an animal's realised energy requirements, and the thermal sensitivity of organism-level metabolic rate is expected to vary according to a wide range of interacting contextual variables such as resource availability, parasite loading, phenotypic variability and predator density. This begs the question, to what extent, and under what conditions is the total energy requirements of a wild fish sensitive to variation in the experienced external temperature?

We set about answering this question using stable isotope proxies for external temperature and field metabolic rate. Drawing on data from 30 marine teleost species across life stages, habitat types and functional groups, we show that, within species, field metabolic rates are frequently only weakly related to external temperature, implying that temperature will be a relatively poor predictor for individual physiological traits in wild conditions. Increased thermal sensitivity of FMR is seen at species' range edges, in juvenile life stages and in more territorial functional groups.

We build on these observations to refine operational descriptions of thermal niches of fishes based on the thermal sensitivity of field metabolic rate. This framework creates testable hypotheses, and can inform predictions of species' metabolic performance under multiple stressor conditions.

O28: DECLINING FOOD AVAILABILITY FOR FORAGE FISH LARVAE IN THE NORTHEAST ATLANTIC: AN INDICATOR FOR ATLANTIC SALMON MARINE SURVIVAL

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Marine return rates of Atlantic salmon (Salmo salar) to European rivers have declined in recent decades. A high and variable rate of natural mortality is thought to occur during the first few months at sea when small, post-smolt stage salmon are migrating towards their main feeding grounds in the Norwegian Sea. Recent evidence suggests that food available to post-smolts has declined. This study uses Continuous Plankton Recorder data to derive a measure of the zooplankton prey energy available to the forage fish comprising the bulk of the salmon post-smolt diet. This is found to have declined steeply across the Northeast Atlantic including within regions used during post-smolt migration. Long-term trends and interannual variability in marine survival of post-smolts from a set of southern European rivers are found to be correlated with this prey energy on a range of scales. Adult body size in the River Bush is also correlated with prey energy averaged over the region of ocean relevant to that river. Comparison with environmental indicators derived from biophysical ocean model hindcasts suggests that prey energy is regulated by a combination of climate forcing impacts on ecosystem productivity and multi-decadal variability in water masses along the migration routes. Prey energy has a more direct and consistent relationship with survival than indicators based on sea temperature and primary productivity. This study provides evidence of degraded feeding conditions in post-smolt food web and presents forage fish prey energy as a potential marine indicator for salmon management.

S7: NORTHEAST ATLANTIC MACKEREL; AN INDIVIDUAL BASED MODEL TO AID SPATIAL MANAGEMENT.

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Mackerel (Scomber scombrus) in the Northeast Atlantic (NEAM) are highly migratory with a wide distribution that varies annually. The NEAM stock is covered by surveys throughout many parts of the year, however the full spatial dynamics of NEAM outside these periods is still uncertain. Here we present a spatially explicit Individual Based Model (IBM) that incorporates information from the mackerel literature, relevant survey and biological/physical datasets to fill in some of the spatial distribution gaps for this stock. The current model covers the Northeast Atlantic and Nordic Seas and contains a full linked life cycle. The model uses an energy budget model driven by sea surface temperature and chlorophyll-a concentration remote sensing data to produce emergent stock dynamic outputs, including Spawning Stock Biomass and weight at age. The IBM has a fully emergent feeding, and partially constrained emergent spawning sub model that can be used to explore distribution dynamics. Ongoing work will relax the remaining spatial constraints and add connectivity matrices from a particle tracking model to model pelagic drift from spawning grounds to mackerel nursery areas. Further development includes using tagging data to inform the timing and speed of movement between spawning and feeding areas. The intention is to use this model to inform and advise management on Northeast Atlantic mackerel distribution beyond current spatial and temporal survey boundaries.

S27: COMBINED ENVIRONMENTAL STRESSORS REDUCE CORAL REEF RESIDENCY IN GREY REEF SHARKS (CARCHARHINUS AMBLYRHYNCHOS)

Williamson, Michael J. [1, 2, 3], Tebbs, Emma J. [2], Dawson, Terence P. [2], Curnick, David J. [1], Ferretti, Francesco [4], Carlisle, Aaron B. [5], Chapple, Taylor K. [6], Schallert, Robert J. [7], Tickler, David M. [8], Block, Barbara A. [7] and Jacoby, David M.P. *[9,1]

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Coral reef ecosystems are highly threatened and can be extremely sensitive to the effects of climate change. As central place foragers that move predictably to and from a core area, grey reef sharks (Carcharhinus amblyrhynchos), are intrinsically linked to reef ecosystems, providing substantial pelagic nutrient subsidies to coral reefs in the process. How environmental stress, increasing in both frequency and intensity, impact routine site-attached reef shark behaviour however, remains relatively unexplored, despite the potential implications for reef ecosystem functioning and connectivity. We utilise multi-year acoustic tracking of grey reef sharks resident to the remote coral reefs of the Chagos Archipelago in the Central Indian Ocean. We combine tracking data with a bespoke index of coral reef stress exposure using a suite of remotely sensed products available within Google Earth Engine (GEE) geospatial processing platform. Our data encapsulate the environmental conditions and shark behaviour prior to, during and after the 2015-16 El Niño event which led to mass coral bleaching in the region. We show that increased environmental stress exposure to localised areas of reef habitat reduced residency behaviour in grey reef sharks and explore the temporal signature of environmental stress on shark behaviour. As climate change is predicted to increase environmental stress on coral reef ecosystems, leading to annual bleaching events by 2043, understanding how site-attached predators respond to stress, will be crucial for forecasting the functional significance of altering predator behaviour. Our study represents a very early, but important step towards this pressing goal.

S27: THE ENVIRONMENTAL DRIVERS OF MOVEMENT AND BEHAVIOUR OF EUROPEAN EELS IN UK RESERVOIRS

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Increasing human demands for freshwater drive the construction of large water storage reservoirs. Such disconnected waterbodies frequently hold significant stocks of European eel but there is rarely a feasible route by which adult eels can escape to undertake their seaward spawning migration. The Eels (England and Wales) Regulations 2009 provide strong drivers to develop effective means to enhance escapement of reservoir eels to the sea. However, little is currently known about the movement and aggregation patterns of adult eels in reservoirs. With its high population of eel, and minimal recreational activity, Abberton reservoir provides a rare opportunity to investigate the fine-scale behaviour of European eel. Acoustic telemetry positioning techniques will be used to determine the distribution, aggregation, and movement characteristics of adult eels. Tracking data will be analysed in relation to concurrent environmental data to quantify the key drivers of eel movement and responses to environmental change, and used to develop predictive models to enable forecasting of behaviour under a range of management and environmental scenarios. The findings will provide an evidence base to inform decision-making around the potential for future fish pass design and/or trap and transport schemes.

O26: OTOLITHS REVEAL THE HIDDEN DIVERSITY OF THREATENED CALIFORNIAN SALMON ACROSS THE AGES

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Chinook Salmon (Oncorhynchus tshawytscha) are critical to the ecology, culture, and economy in their native range. The once-abundant spring-run Chinook Salmon in California have declined due to habitat loss and water diversions. Understanding the life history plasticity of the few remaining populations is essential for their effective management and conservation.

We used otolith (ear stone) sclerochronology and geochemistry to reconstruct key life history metrics (age, growth, size at migration, habitat use) of spring-run Chinook Salmon populations across watersheds across a range of time periods (~1850 and 2002-2019) from the Central Valley, California. We find that spring-run Chinook Salmon populations vary in their life history traits depending on the physical and biological characteristics of their watershed, as well as the level of anthropogenic alteration and restoration efforts. The Butte Creek watershed has the most abundant remaining spring-run population, which predominantly expresses a single life history characterized by fast early growth and floodplain rearing. In contrast, populations in Mill and Deer Creek, with access to cold water refugia, show much greater variability in juvenile migration modes, including the now-rare 'yearling' life history being their lifeline during drought years. The Yuba River spring-run population is threatened by introgression from nearby hatcheries but still shows a variety of life history traits. Finally, samples from archaeological sites from the mid-1800s show that significant changes in habitat use have occurred since the region has been transformed by mining, dams, and industrial fisheries.

Collectively, these findings reveal large variation in habitat use within and among populations both past and present, and that maintaining connected and complex habitat mosaics is key to the persistence of remnant spring-run populations in the future.

O35: OVEREXPLOITATION AND DECLINE IN KELP FORESTS INFLATE THE BIOENERGETIC COSTS OF FISHERIES

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Fisheries ecosystems are subject to long-term shifts in food web structure as a result of exploitation and environmental change. Our study aimed to determine long-term legacy effects of overexploitation and changes to the composition of basal organic matter sources on trophic structure of marine food webs. We used whole tissue (delta13C and delta15N) and amino acids specific (delta15NAA) stable isotope analyses of bone collagen and muscle tissue from five fishes spanning the period of human occupation of New Zealand to resolve the bioenergetic consequences of long term shifts in food web structure. Our analyses indicate declines in contribution of organic matter derived from kelps in four species, and intraspecific increases in TLs in three species of the five fishes between European colonisation (1650-1800AD) to the present day regime of industrialised fishing and environmental change (1953-2018AD), but little change during the prehistoric time period spanning early Māori colonisation (1250-1450AD) to European colonisation. Analysis of the bioenergetic costs of the observed shifts in food web structure indicate a 179% increase in basal organic matter requirements to support mesopredatory fish. These data provide a rare case study on the consequences of legacy effects of exploitation and environmental change for bioenergetics of fish communities.

O14: RECOLONISATION OF THE RIVER CLYDE BY ATLANTIC SALMON (SALMO SALAR), A 40 YEAR CASE STUDY

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This year represents the 40th anniversary of the return of an Atlantic salmon run to the River Clyde in west-central Scotland. Formerly locally extinct, this recolonisation is one of the great 'good news' stories in fisheries biology and was initially made possible by gradual improvements in water quality in the estuary and lower freshwater river. Subsequent de-industrialisation of the system and improvements to fish passage have increased the accessible river length and the availability of spawning habitat to the extent that the Clyde is now a significant recreational salmon fishery. The origin of the stock remains enigmatic but here we will review the specific interventions which have encouraged this iconic species (there are three salmon on the Glasgow coat of arms) back to a significant proportion of its former range. Much of the insight we bring is based upon 20 consecutive field seasons of spatial and temporal monitoring and we will identify the constraints to complete recolonisation and threats to the persistence of Atlantic salmon in what may be its most urban fishery.

POSTERS

Ordered alphabetically by last author name.

PREVALENCE OF MICROPLASTICS IN OYSTERS FROM DEEP BAY AND YUNG SHUE O, HONG KONG.

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Microplastics (MPs) are ubiquitous in the marine environment and are present in the water column, sediment, flora and fauna. Monitoring and assessing the prevalence of MPs is crucial for assessing both marine health and the possibility of uptake into marine organisms and trophic transfer through the food chain. MPs can be accidentally ingested from the environment by filter-feeding organisms such as mussels while foraging, making them particularly vulnerable to MPs pollution. As filter feeders, oysters are especially vulnerable to MPs pollution. In this study we assessed MPs abundance in the oysters from Deep Bay and Yung Shue O, Hong Kong sites which differ in proximity to aquaculture and anthropogenic activity. Seawater and sediment samples were collected in order to quantify environmental microplastics (EMPs) in the surrounding environment. EMPs were extracted using standard protocols for digestion, filtration and density separation, and were analysed using FTIR-ATR spectroscopy. EMPs were present in the oysters from both Deep Bay (10.01 ± 1.415 MP g-1) (average ± SD) and Yung Shue O (24.01 ± 1.688 MP g-1) (average ± SD). These findings will be discussed in relation to uptake from the environment and the possibility of trophic transfer from oysters to humans.

INVESTIGATING THE ORIGIN AND LIFETIME HABITAT USE OF ATLANTIC SALMON ACROSS THE BRITISH ISLES USING CHEMICAL MARKERS ARCHIVED IN THEIR EYES AND EARS

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Atlantic salmon (Salmo salar) are particularly vulnerable to climate change and habitat loss given their reliance on multiple habitats across their life cycle, and today their populations are in widespread decline. In order to target conservation management actions more effectively we need a more complete picture of the migratory behaviours expressed within and among populations, and whether particular strategies contribute disproportionately towards lifetime success under particular environmental conditions. The analysis of chemical records from archival body tissues extracted from post-spawned adult salmon allow us to reconstruct their previous habitat use and juvenile behaviours to obtain novel information on successful strategies in a given year. Here, we measured otolith element concentrations (Mg/Ca, K/Ca, Mn/Ca, Zn/Ca, Sr/Ca, Ba/Ca, Pb/Ca) and eye lens stable isotope ratios (δ13C, δ15N, δ34S) in salmon sampled in 2020 and 2021 from six salmon populations around the British Isles (Rivers Frome, Tweed, Deveron, Shin, Oykel, Burrishoole) alongside samples obtained from a commercial aquaculture stock. We estimated the size at which wild individuals had emigrated from freshwater to marine environments, their diversity of movements within freshwater, and whether the different natal sources exhibited unique chemical fingerprints that could be used to identify their origin. Results indicated diverse habitat use and emigration size, both within and among populations, and significant differences in natal chemical signatures. Overall, this study demonstrates the potential for these approaches to reveal life history patterns in Atlantic salmon and carryover effects between fresh and marine environments. These tools also show great promise for identifying farmed escapees and discriminating among populations that are genetically similar, providing new options for provenance tracing and reconstructing population-specific migration pathways at sea.

EVOLUTION OF FUNCTIONAL MORPHOLOGY IN A RADIATION OF NEOTROPICAL CATFISHES (LORICARIIDAE)

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Loricariidae is the largest family of catfishes, Siluriformes represented by 1041 currently described species within 115 genera endemic to neotropical freshwaters. The family is diagnosed by a ventrally facing oral disc, laterally flattened body shape and dermal plating. A high number of species have been described in sympatry regardless of displaying a similar body plan and benthic niche.

A high amount of morphological variation is displayed in their trophic morphology that they utilize to obtain food via a rasping motion. The trophic morphology has previously been linked to diet. While the majority are algivores/detritivores a diversity of trophic niches are utilized by Loricariids for example Panaque who are specialized to rasp into wood, invertivores such as Scobinancistrus and, substrate dwelling Loricariinae which displays ornate barbels while feeding amongst sandy substrates.

The aims are to study the diversification of trophic morphology within large diversifications, to what extent is this linked to diet and habitat use, is trophic morphology functional and are different morphologies under selection?

Morphological analyses using microcomputed tomography using ~150 species from the Natural History Museum, London allows for comparison of craniofacial morphology. Differences will be summarized by Principle Component Analyses. In addition to the morphological data, using a species level comprehensive phylogeny from molecular data obtained from Genbank and BOLD a phylogenomic constraint tree can be created. This will enable identification of divergent and convergent evolution across Loricariidae.

RECONSTRUCTING HABITAT USE THROUGHOUT THE LIFE HISTORY OF BROWN TROUT IN A COMPLEX NORWEGIAN LAKE SYSTEM.

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Brown trout have great cultural value and are a key species for connecting marine and freshwater environments. However, anthropogenic stressors have led to population declines in many rivers over the last two decades. Knowledge of their habitat use and how it changes in response to environmental factors is key to successfully managing the species and its many different phenotypes. The partially anadromous life history of brown trout can make it particularly difficult to track their movements between habitats without expensive and invasive tagging methods. Here, we used eye lens stable isotopes and otolith elemental concentrations to characterise the movements of brown trout between two connected lakes and to and from the sea. We then used otolith microstructure to determine how growth rates vary between regions, to reconstruct the duration spent in freshwater and marine habitats, and to quantify the contribution of different strategies and habitats to the adult population. These methods can be applied to identify critical habitats supporting both resident and anadromous trout populations, and how their importance may change over time, providing managers with a powerful tool to preserve this important species.

MICROPLASTIC CONTAMINATION IN INVERTEBRATES IN AN URBAN RIVER SYSTEM (RIVER TAME, MANCHESTER)

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Urban rivers are highly contaminated with microplastics, due to input from local activity and outflow from waste water treatment plants. The River Tame in Manchester is especially susceptible, being one of the most contaminated water bodies in the world. Invertebrates are an important part of the food web in river ecosystems, due to their roles as primary consumers and prey for fish species. In five sites across the River Tame, invertebrates were captured using river kick sampling, with each site chosen due to their proximity to a waste water outflow valve or residential areas. Samples of 10-15 individuals were chemically digested using 30% hydrogen peroxide then chitinase and examined for microplastics. Preliminary data indicates a significant level of contamination of microplastic particles less than 250µm in samples when compared to blanks, mainly consisting of blue, pink and purple fragments. Higher levels of microplastics are expected in invertebrates captured closest to the waste water outflow valve, with annelid species predicted to be the most contaminated. This study will demonstrate the effects of a high urban population and proximity to waste water treatment plants on microplastic content of invertebrates. The effects on the invertebrates' functioning remains unclear and should be explored through future study. These findings demonstrate the need for action to clear the current contamination and to prevent future input. Invertebrate contamination data collected in this study contributes to a larger study of the transfer of microplastics through an urban river ecosystem, also analysing microplastic content of sediment, water, and fish.

MEASURING THE QUALITY OF HABITATS FOR JUVENILE FISHES AND INVERTEBRATES: PERSPECTIVES FROM FIFTY YEARS OF RESEARCH

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Identification of the areas that sustain fish populations, through robust measurement of juvenile habitat quality, is necessary to focus conservation priorities, improve recruitment forecasts and implement effective ecosystem-based fisheries management. There remains widespread agreement with the suggestion by Beck and coauthors (2001) that the best metric of quality is the contribution that a juvenile habitat makes to the adult population (“juvenile-adult linkage”), which is determined in part by juvenile abundance, growth and survival in that habitat. Through a systematic review of the application of these four metrics (abundance, growth, survival and juvenile-habitat linkage) in 885 studies over the past 50 years, we evaluated the development and current status of methods to measure juvenile habitat quality. We found that juvenile habitat studies have been overwhelmingly based on metrics of abundance and to a lesser extent growth, employing the most widely used and easily applied methods. More limited and declining attention has been paid to survival, with few existing or emerging methods available. Juvenile-adult linkage has also been measured rarely, and while promising methods are available these are not necessarily combined with other metrics or applicable at the spatiotemporal scales necessary to resolve the processes influencing juvenile habitat quality. Restrictions in the diversity of taxa, geographical locations and habitats of previous research further limits knowledge to a relatively narrow set of well-studied systems. We provide recommendations for building on existing approaches and harnessing new technology towards future advances in our ability to identify the juvenile habitats required by fish and invertebrate populations.

HOW HAS SHARK FUNCTIONAL DIVERSITY CHANGED THROUGH GEOLOGICAL TIME?

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Modern sharks have a long evolutionary history (>250 million years), during which they have persisted through numerous environmental changes and played key ecological roles. Today, many shark species control prey populations via predation, with their decline negatively affecting food webs worldwide. Here, we assess how shark ecological functions have changed over time by quantifying changes in their functional diversity from the geological past to the present. Because ecological traits like body size and diet are hard to measure directly from their bodies, which are rarely preserved in the fossil record, we rely on their well-preserved and abundant teeth. Accordingly, we compiled a dataset of over 5,000 shark teeth from museum collections spanning the entire Cenozoic (66 Ma-present) and took different tooth measurements which have been demonstrated to be good proxies of ecological traits. Our results show that functional richness (FRic; volume of functional space; which represents the range or extent of ecological functions) – increased from the Palaeocene (~61 Ma) to the Eocene (~45 Ma), when it reached maximum levels (FRic = 51% of functional space). From then onwards, despite some fluctuations, functional richness generally declined to as low as 15% in the Pleistocene (~1.3 Ma). Although functional richness seemed to have recovered in the present, it remained 35% lower than its past peak. Taken together, our results demonstrate a general reduction in functional diversity from the past to the present, suggesting that some of the extent of shark ecological roles has been lost over time.

RECRUITMENT OF EUROPEAN SEABASS (DICENTRARCHUS LABRAX) IN NORTHERLY UK ESTUARIES: PRESENTING A MISMATCH BETWEEN SPAWNING AND FISHERIES CLOSURES.

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Globally, coastal habitats play an important role ecologically, economically and culturally, but are concomitantly under threat from habitat degradation and biodiversity loss. Despite this, estuaries and coastlines remain important nursery habitats for many juvenile fishes and play a critical role in determining recruitment rates and fisheries productivity. This work examined the settlement timing, condition and growth rates of juvenile European seabass (Dicentrarchus labrax) in two north Wales estuaries (Dwyryd, Y Foryd), at the northern edge of the species range. Seabass recruitment in the UK is highly variable, and management actions to protect spawning stocks include annual fisheries closures over a two-month February-March window. Whether these closures are having the desired outcome for this data-poor species remains unclear. Here, we used otolith microstructural analysis (counts and widths of daily growth rings) to estimate spawning, hatching and settlement timing and juvenile growth rates. Here we report a significant mismatch between the timing of fishery closures and the spawning date of this cohort (back-calculated median spawn date = May 5th ± 17 days SD), suggesting that the closure may be too early to be protective of these particular stocks. We also report significant differences in condition factor between the two closely located estuaries, suggesting variation in habitat quality. Finally, we present the first estimates of pelagic larval duration for seabass recruits settling in UK habitats. Our results suggest that the timing of current fisheries closures may not be preventing the harvesting of spawning adults supplying these northernmost estuaries, of whom are likely to become increasingly important as seabass distributions and phenology shift in our climate future.

FEEDING ECOLOGY OF A COMMON SHARK MESOPREDATOR FROM A MEDITERRANEAN MARINE PROTECTED AREA

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Many coastal sharks are considered as mesopredators which makes them occupy a potentially influential trophic niche within coastal food webs. These kind of mesopredators feed opportunistically and their diets reflect the resource availability in the environment. The smooth-hound shark (Mustelus mustelus) is a commonly caught elasmobranch, and according to the red list of the IUCN is considered as vulnerable in the Mediterranean Sea. Understanding how its feeding habits change through time and space is crucial to improve management plans and thus their conservation status. We study the feeding habits of M. mustelus caught around the Marine Protected Area Egadi Islands, Sicily, through stomach content analysis. We aimed to analyse how diets vary by sex, season, and size. Our results indicate that the diet of this mesopredators is mainly composed of crustaceans and teleost fishes. Crustaceans from the family Paguridae and teleost from the family Clupeidae were commonly found in the stomach contents. Our results suggest that this species feeds opportunistically in benthic-demersal waters. However, it may also forage pelagic preys close to the surface in shallow waters. Male individuals fed in higher quantity of bony fish relative to females. This could suggest that this species have a spatial segregation in the feeding behaviour. Further studies are needed to understand how the MPA could potentially provide an important feeding and/or nursery area to coastal mesopredators.

ASSESSING THE ECONOMIC IMPACT OF CHARTER BOAT CATCH AND RELEASE ATLANTIC BLUEFIN TUNA FISHERY FROM ANGLER EXPENDITURE

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In recent years, the number of sightings of Atlantic Bluefin Tuna (BFT) in UK waters has been increasing. This has led to growing interest in the recreational fishing community and the potential socio-economic benefits it would bring to coastal communities. A pilot catch and release tagging programme for BFT was conducted from August to November 2021 across 15 vessels in the Southwest of England. This study estimated the socio-economic impact generated directly by the anglers that took part in the pilot programme. We identified the general profile of anglers, their opinions and personal benefits generated from the programme as well as the overall economic impact generated from the spend by anglers. A survey was done of anglers engaging in pilot programme to assess the economic impact in 2021. 111 of the 1069 that fished completed the survey, generating data for 80 out of the 407 trips with paying anglers onboard. Anglers responding to the survey were between mostly 50-60 years old with high household income and had positive opinions about the program. Expenditure was estimated for each trip and raised to the total number of trips. Removing taxes and imports provided the direct impact, with total economic impact and jobs supported calculated using an input-output methods Using information on what anglers would do if the fishery was not available, it was possible to determine the proportion of angler spend that could be directly attributed to the fishery (counterfactual). As a pilot study, it provides insight into the economic impact of future programmes.

COMBINING MONITORING AND ECO-PHYSIOLOGY TO UNDERSTAND THE RESPONSE OF A COASTAL FISH TO OCEAN ACIDIFICATION: INSIGHTS FOR OCEAN ACIDIFICATION REFUGIA

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Ocean acidification (OA) is occurring as a result of increasing anthropogenic CO2 emissions. Experimental studies to assess coastal species responses to OA have historically used open ocean averages and projections to infer treatment conditions. However, the conditions predicted for the open ocean by the end of the century may not reflect what is going to happen in coastal regions as these environments show greater pH variability than the more stable open ocean. Variability in pH and associated carbonate chemistry parameters were monitored along the shoreline and offshore waters (30 m depth contour) of Algoa Bay to inform an experimental study which assessed the physiological response of larval stage Diplodus capensis (Sparidae) to a range of pH treatments representative of local variability as well as future coastal acidification scenarios. pH ranges of up to ~0.5 - 0.6 units were recorded over relatively small spatial (10 km) and temporal (daily) scales. Higher average pH (and high diel variability 8.35-7.79) was recorded around a macroalgal-dominated reef in the bay. Diplodus capensis collected around the macroalgal reef, showed behavioural and physiological tolerance to pH treatments as low as 7.3 in their later larval stages. Macroalgae and seagrass can raise pH on a local scale by taking up carbon through photosynthesis. This highlights the need for local data to inform experimental OA research and role that macroalgae and seagrass, that serve as nursery habitats for many marine fish species, may play in providing a refuge from acidification by offering higher average (> 8.2) pH levels.

SEASONALITY AND THE EFFECT OF WINTER ON THE FISH COMMUNITY AND DIFFERENT FISH SPECIES – SPECIES COMPOSITION, SIZE, ACTIVITY AND HABITAT USE IN A BOREAL LAKE

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Seasonal changes in temperature, light and oxygen are pronounced in boreal lakes. Large boreal lakes are inhabited by various fish species with different thermal, light and oxygen optimums, but we know little about year-round activity and habitat selection. We asked how the catch proportion of different fish species varies throughout the year, how the catch per unit effort (CPUE) and biomass per unit effort (BPUE) change on a community and species level between different months and habitats, and how does the size and condition factor change in different months? The research was done in mesotrophic Lake Pääjärvi, a deep and humic lake in southern Finland. Fish were sampled with gillnets from three main lake habitats for one year. Additional samplings were done in the following years in August and March. Roach (Rutilus rutilus) was the most abundant fish, followed by perch (Perca fluviatilis). The proportions of species in catches changed from cyprinid dominance in spring, early summer, and autumn to percid dominance in late summer and winter. CPUE was the lowest during winter and the highest in summer. Littoral catches were highest year-round. Perch and pikeperch (Sander lucioperca) utilized the pelagic zone more in the summer than in other months. Condition of fish peaked in summer. Caught fish were mainly larger in winter and smaller in summer. August has commonly been the prime month of fish community monitoring, but it might not provide a whole year view of species composition, CPUE, size and habitat selection.

CHARACTERISING FISH BIODIVERSITY ON ONE OF THE WORLD'S MOST REMOTE INHABITED ISLANDS (TRISTAN DA CUNHA): A BIODIVERSITY CRADLE, MUSEUM, OR GRAVE?

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Oceanic Islands are well documented sources of global biodiversity (Whittaker and Fernández-Palacios 2007; Kier et al. 2009; Friedlander et al. 2013). However, islands are threatened by anthropogenic impacts, making them sites of species extinctions and declines (Kueffer and Kinney 2017). Conserving island ecosystems is environmentally and socioeconomically important, as islands harbour valuable resources for both local communities and global economies (Friedlander et al. 2013; Kueffer and Kinney 2017). Tristan da Cunha is one such oceanic island chain, situated in the South Atlantic Ocean, 2000km from continental land. Tristan's nearshore environment is a vital resource to the local community, who rely on fish, cephalopod, and crustacean species for nutrition and income. Despite its importance, Tristan's fish community is understudied, lacking baseline genetic data.

The present project addresses the lack of molecular data for Nemodactylus monodactylus, Sebastes capensis, and Helicolenus mouchezi, three dominant Tristanian fish species (Caselle et al. 2018), by describing evolutionary history and contemporary population dynamics, informing robust taxonomic designation, providing insights into species origins and broader biogeographical processes across the southern Atlantic Ocean, and assessing stock structuring across the islands. This work places Tristan's fish biodiversity into a global spatial and historical framework, and provides information to support the organisation of resources and management regarding the island fauna.

MAPPING MIGRATIONS: TOPE SHARKS (GALEORHINUS GALEUS) AND UK COMMERCIAL FISHERIES

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Tope sharks (Galeorhinus galeus) are a protected migratory species in UK legislation and listed under the Convention for Migratory Species as needing international cooperation to monitor and boost their populations. Currently, any tope sharks caught in commercial fisheries around the UK which cannot legally be retained (forming part of the bycatch, incidental capture), must be discarded back to sea. The efficacy of discarding as a management practice is both gear- and species-specific and information on effectiveness on tope stocks is currently limited.

Using data from the Cefas Observer Programme (2002-2020), the discard-retention patterns and catch-per-unit-effort (CPUE) of tope sharks have been mapped against commercial fisheries identifying seasonal spatial occurrence and gear interactions split further by sex and age (inferred from length). Predominantly taken in set nets and bottom trawlers, ~65% of individuals were discarded from both gear types. For bottom trawlers, mean CPUE has been declining since 2008, lowest 2016-2020 (2.0kg.h-1) whilst seasonally, males peaked January-March (4.2kg.h-1) and females July-September (7.5kg.h-1; the same as mature females: ≥150cm TL). These findings and their implications are discussed against the future management needs of tope sharks in UK commercial fisheries.

ASSESSING THE VULNERABILITY OF POPULATIONS OF ARCTIC CHARR ACROSS SCOTLAND

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Arctic charr (Salvelinus alpinus) has been described as the most variable known vertebrate species in the world with high levels of phenotypic and genetic diversity seen across its Holarctic range. This diversity gives the species high conservation value and makes it an invaluable example for studying the nature of adaptive radiation. Climate change, anthropogenic factors and predation by other fish are all notable and increasing threats to the species and its diversity. To understand which populations may require more immediate attention than others, we need insight into the vulnerability of different populations across Scotland.

To explore this, we constructed a national-scale genetic dataset of populations found across Scotland. We used two contrasting but complimentary approaches to assessing vulnerability. First, we used the genomic vulnerability framework, using GradientForest, to make predictions about the fitness of populations using climate-associated SNPs and predicted changes to climate under different RCP scenarios. Secondly, we used information on bathymetry, fish communities, and anthropogenic factors affecting the lakes to create a sensitivity score system to assess the vulnerability of populations based on these factors. We then combined these different approaches to investigate any correlating or contrasting patterns between them and illustrate how we can use this combined data to make inferences on other populations not in our dataset.

TROPHIC ECOLOGY OF JUVENILE SWORDFISH (XIPHIAS GLADIUS) IN THE MEDITERRANEAN SEA: THE ROLE OF CEPHALOPODS AND GELATINOUS PLANKTON

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Understanding the interactions between fish and the wider food web is essential for effective marine ecosystem management. The study of the diet of large pelagic fish that perform long vertical migrations and contribute to the demersal-pelagic coupling of the ecosystem, such as swordfish (Xiphias gladius), provides an opportunity to document the structure and functioning of marine ecosystems through characterizing diversity, distribution, and availability of prey. Here, we examined the diet of juvenile swordfish in the north-western Mediterranean Sea in 2012 and 2020, using two complementary methods: stomach content analysis (SCA) and mass-balance isotopic mixing models, which allowed us to explore the consumption of organisms that are not usually detected in SCA due to fast degradation. SCA showed an increase in cephalopod consumption between the two periods, and an increase in the relative importance of bathypelagic fish with size. This was supported by the mixing models' results. Although gelatinous prey were only found in one stomach, the models pointed to higher consumption in 2012, when several gelatinous blooms were reported. Further studies are needed to inform whether the consumption of low-energetic prey may affect the physiology of this species. By using SCA results as informative priors in the stable isotope mixing models, our study highlights the importance of combining multiple and complementary approaches to better reconstruct the diet of generalist species. Our findings suggest that swordfish in the Mediterranean may have an opportunistic diet that is responding to changes in the ecosystem, being useful indicators for monitoring marine ecosystems.

ASSESSING THE COMPLEMENTARITY OF OTOLITH MICROCHEMISTRY AND MORPHOMETRY TO PREDICT ATLANTIC SALMON (SALMO SALAR) ORIGIN

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Since the beginning of the 20th century, otolith microchemistry has been broadly used around the world to reconstruct fish life history patterns, especially for migratory species such as Atlantic salmon (Salmo salar). However, the use of these natural biomarkers may sometimes be limited as the chemical signatures among habitats may be too similar. Alternatively, otolith shape has also experienced a significant expansion in scientific community but mainly for species identification and stock assessment of marine fish. Yet, morphometric analyses could provide additional or complementary information since it has been demonstrated that otolith shape was influenced by genetics, the environment but also the interaction between these two variables. Nevertheless, scientific literature evaluating the potential of combined otolith microchemistry and morphometry in order to reconstruct geographic origin of migratory fish species remains scarce. In our study, we sampled otoliths from Atlantic salmon returning to spawning grounds from 2009 to 2018 in the Adour and the Garonne-Dordogne basins, in addition to individuals from six basins or hydrographical regions along the Bay of Biscay (from North to South: South Britany, Allier, Nivelle, Bidasoa, Asturias and Galicia). For each individual, we characterized otolith shape using the elliptic Fourier analysis (EFA) and the microchemical profile using a femto-laser ablation linked to an inductively coupled plasma mass spectrometry (fs-LA-ICP-MS). The objectives of our study are (i) to compare the results obtained via otolith shape and microchemistry in order to predict a natal (i.e. wild or hatchery) and a geographic origin of salmon, (ii) to investigate the complementarity of shape analysis when microchemistry is limiting and (iii) to study the relevance of combining the two methods within the same dataset to assign an individual origin.

CONTRASTING TEMPORAL TRENDS IN TROPICAL FRESHWATER BIODIVERSITY REVEALED BY A MULTI-DIMENSIONAL ANALYSIS

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Freshwater ecosystems are experiencing rapid biodiversity degradation in what scientists have named “The Freshwater Biodiversity Crisis”. However, our knowledge of temporal biodiversity change in these systems is not equal across the globe since long-term trends in tropical freshwater assemblages remain relatively understudied. Here, we take a multi-dimensional approach to assess how the diversity of fish, invertebrate and diatom assemblages monitored in disturbed and undisturbed streams in the Northern Range, Trinidad (Trinidad & Tobago), changed over a time period of five years. To do so, we compare the changes that occur when biodiversity is computed giving equal weight to all species (i.e. species richness) and when the abundance of dominant taxa in the assemblage is given increasing weight in the computations. We use this approach to investigate the alpha and beta components of diversity, i.e. the change within assemblages and the turnover relative to the start of the temporal series, using linear and polynomial models. Our results show that different abundance weighting of species reveals different signatures of temporal change across the assemblages in the Northern Range, and unveil contrasting trends across groups and disturbed vs undisturbed locations. These results illustrate the complexity of biodiversity change over time and are discussed in light of their implications for the conservation of the freshwater communities investigated.

IDENTIFYING BIOLOGICALLY RELEVANT MANAGEMENT UNITS BASED ON GENETIC POPULATION STRUCTURE IN A MULTI SPECIES TROPICAL COASTAL FISHERIES OF INDIA

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The management of coastal fisheries operations is decentralised in India. Individual coastal states (provinces) manage the territorial waters adjoining their coastline autonomously and without coordinating with their neighbours. The underlying assumption of such management is that the fish populations are static and distributed according to these political boundaries. This biologically inaccurate assumption can cause massive mismatch between management rationale and biological realities. Neighbouring states may share the same population of fish while having contrasting harvest policies. This mismatch can lead to inaccurate stock assessments, isolated and ineffective fisheries regulations and eventually overfishing. Unfortunately, the information about geographical extent of genetically distinct populations for most marine fish is missing. We attempted to address this knowledge gap for nine ecologically and commercially important fish species along the west coast of India. We used genome wide Single Nucleotide Polymorphism (SNP) markers to identify genetically distinct fish populations. Our results show that for abundant and highly fecund fish like Indian Mackerel, Japanese threadfin bream and Ribbonfish, different states are fishing from a single west-coast-wide population. Conversely, slow swimmers (Silver pomfret), habitat specialists (Silver sillago) and viviparous (Spadenose shark) fish show multiple genetically distinct populations along the coastline. Our results suggest a need for a more nuanced and ecological approach to manage coastal fisheries. They also highlight the need for collaboration and coordination between neighbouring states while formulating their individual fisheries policies. This is the first attempt in a multi-species fishery of India to recommend management units based on genetic population structure.

GROUP COMPOSITON AND BENEFITS OF CLOWNFISH AMPHIPRION OCELLARIS LIVING WITH THEIR HOST ANEMONE STICHODACTYLA GIGANTEA IN CAPTIVITY

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Animal groups are often composed of relatives, which can facilitate cooperation and improve group performance. The group of clownfish living with their hosts anemones, which consists of up to 6 individuals with a well-defined size hierarchy. Although some aspects of the fish-anemone relationship are well-known, in-depth studies of the group composition are rare. In this study, we followed movement of clownfish Amphiprion ocellaris siblings as newly settling juveniles during their settlement with their natural anemone host Stichodactyla gigantea. The growth and size differentiation of clownfish living with their natural host was also compared to those without the host. The sibling newly settling juveniles A.ocellaris did not go together during their host search, and individuals switched several times before settling down. During the search, the fish tended to move toward and then settle down together with the largest individual. The fish living with the natural host S. gigantea showed higher weight and growth rate than those without the host. The analysis of fish otoliths (otolith radius and increments) from embryonic to juvenile stages indicated size differences of the fish at early stage. Symbiosis with their natural host likely enhanced the size differentiation within clownfish population.

These findings contribute to understanding the social behavior within the symbiotic relationship of clownfish and anemones. These results also suggest baselines for assessments in the context of marine climate change and over exploitation that dramatically decrease the clownfish population.

SEA ANEMONE – ANEMONEFISH: BEHAVIOUR AND MUCUS PROTEIN PROFILING

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Fish species of the genus Amphiprion (Perciformes: Pomacentridae) seek protection from predators among the tentacles of sea anemones, where they live essentially unharmed from stinging by the host's nematocysts. The skin mucus of these anemone fish has been suggested as a protective mechanism that prevents the discharge of the nematocysts upon contact. Whereas some anemonefish species seem to produce their own protective mucus coating, others may acquire mucus (or biomolecules within) from the sea anemone during an acclimation period. In controlled experiments, we show that Amphiprion ocellaris acclimated successfully to their natural host anemone species Stichodactyla gigantea, and also to Stichodactyla haddoni, and in some cases Heteractis crispa, neither of which are natural host species. No symbiosis was observed for three other anemone species tested, Entacmaea quadricolor, Macrodactyla doreensis and Heteractis malu. We explored the skin mucus protein profile from naïve and experienced A. ocellaris during their acclimation to natural and unnatural host anemones. We confidently report the presence of metabolic and structural proteins in the skin mucus of all samples, likely involved in the immunologic defence, molecular transport, stress response, and signal transduction. For those anemonefish who established symbiosis, there was a clear increase in ribosomal-type proteins. We additionally provide evidence for the presence of anemone proteins only in the skin mucus of individuals that established symbiosis. This study provides the potential role of skin mucus-associated proteins in anemonefish – anemone symbiosis. Further exploration of these mucosal proteins could reveal the mechanism of anemonefish acclimation to host anemones.

REPRODUCTIVE BIOLOGY AND GROWTH ASSESSMENT OF GREY MULLET SPECIES (LIZA AURATA, LIZA RAMADA, AND CHELON LABROSUS) IN UNITED KINGDOM

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Liza aurata, Liza ramada, and Chelon labrosus are the three grey mullet species of the Mugilidae that are commonly found in United Kingdom (UK) waters. The three mullet species have no size limitations with regards to fishing and are categorised as one species, the grey mullet, by commercial fisheries in the UK. As a result of this generalisation, little research has been carried out to elucidate the key aspects of the grey mullet's reproductive biology and behaviour such as their spawning period. Consequently, the primary aim of this research was to determine the spawning period of this species through morphological indices. The secondary target was to identify the fecundity of the grey mullet and to develop a novel system for defining the stages of grey mullet gonads, based on histological and macroscopic examination to understand their reproductive biology. The final objective was to reconstruct the growth history of grey mullets by measuring fish scales. The spawning period of L. ramada and L. aurata was during summer (June, July, and August); C. labrosus was recorded to spawn twice a year, once in April and once in November. Their absolute fecundity range was found between 112,800 and 1,224,324 eggs for the grey mullets. A new system for establishing the stages of grey mullet gonads based on histology and macroscopic examination was proposed. Von Bertalanffy growth parameters were determined for L. ramada ($L\infty$ = 636.588, K = 0.4193, t0 = -2.05534) and L. aurata ($L\infty$ = 831.3313, K = 0.161338, t0 = -4.85765).

THE IMPACT OF ARTIFICIAL LIGHT AT NIGHT ON THE ACTIVITY BEHAVIOUR AND PHYSIOLOGY OF FRESHWATER FISH

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With rapid and widespread urbanisation, the world has experienced unprecedented population growth over the last century, with urban areas predicted to house up to 68% of the global population by 2050. Whilst providing modern society with the means to be active during the night-time, artificial light at night (ALAN) has become a fast-growing, serious, and ongoing pollution event. Considering the dependence of numerous biological phenomena on natural light regimes, it is unsurprising that ALAN constitutes substantial anthropogenic pressure on natural biological systems. Recent decades have seen considerable growth of interest into light pollution. However, most research focusses on terrestrial organisms and, comparatively, aquatic organisms and environments have been understudied. Therefore, this study investigated the influence of low intensity ALAN on the physiology and activity behaviour of two co-occurring and contrasting freshwater fish, brown trout (Salmo trutta) and European eel (Anguilla anguilla). Initial results indicate impacts of ALAN on population-level activity for both species. For brown trout, daytime activity following exposure to ALAN was approximately 50% lower compared to those in the control tank. For eel, a species generally considered active at night, early indications suggest increased activity across the entire 24-hour period after exposure to ALAN, but data analyses are ongoing. Although behavioural impacts were observed, effects on fish physiology appear less obvious. This talk will present these results and discuss their implications within the context of experimental studies aimed at identifying ecological impacts of ALAN and the need to better understand and mitigate this major form of environmental change.

MONITORING CRITICAL HABITAT ACROSS JUVENILE ATLANTIC SALMON LIFE-STAGES USING REMOTE SENSING

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Successful management of Atlantic salmon stocks requires evaluation of the distribution of critical habitat across the salmon life-stages, from fry, through parr, to pre-smolts. Obtaining this habitat information may be challenging due to difficulties inherent in sampling large watercourses. Here, we show how readily accessible remote sensing data – whether from UAVs, aerial photography or LiDAR – can be used to monitor changes in the habitat of juvenile Atlantic salmon at different life-stages within rivers. We examine how habitat changes spatially and temporally within selected Atlantic salmon rivers in Norway, including the Orkla and Nidelva in mid-Norway and the Alta in the Norwegian sub-Arctic. We apply a range of remote sensing approaches (from velocimetry to deep learning) to identify the spatial hierarchy of controls on habitat, focusing on how temporal changes in habitat can impact on the success of spawning and rearing grounds. We identify local-scale habitat properties (flow velocity, depth and substrate type) using UAVs, identify meso-scale habitat properties (hydromorphological units) using aerial photographs, and identify riverscape properties (such as reaches and sedimentary links) using LiDAR. We present recommendations for optimizing the methodology, including selecting the best windows for imaging. The advantage of this approach is that it allows for efficient monitoring of temporal changes in the scale-dependent controls on habitat availability at different life-stages, allowing for an overall assessment of the potential of the river for supporting salmon populations.

DISCOVERY OF CORALLIGENOUS REEFS AS ESSENTIAL FISH HABITAT IN THE AEGEAN SEA, EASTERN MEDITERRANEAN

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The Mediterranean is known to host high biodiversity and many important habitats, including those of the mesophotic zone. This research focuses on an understudied area of the Mediterranean, in the eastern Aegean Sea. An exploratory expedition of the mesophotic zone around the island complex Fourni was undertaken using remotely operated vehicles (ROVs) at depths of 30 to 100 meters. Coralligenous reefs were discovered, along with three other key habitat types: black coral forest, maerl/rhodolith beds, and algal-dominated substrata. Coralligenous reefs are fundamentally important mesophotic habitats but remain largely unknown in this eastern region. These reefs produce complex ecosystems formed by red coralline algae (Rhodophyta) as the primary carbonate producer, are biodiversity hotspots and act as crucial spawning grounds for commercially important fish and invertebrates. A total of 98 benthic organisms were identified belonging to 13 different Phyla. Coralligenous reefs were the most species rich habitat with 56 species recorded, with the main Phyla as Porifera. Associated fish species were quantified at various depths and across habitats. Forty-three species of fish were recorded as well as nesting grounds and egg cases. Despite their great conservation value and biodiversity, these key ecosystems are poorly studied and not actively protected, whilst facing increasing anthropogenic threats. This study provides data which is being used to inform policy and support the expansion of no trawling zones in the Aegean Sea.

DETERMINING THE ONTOGENETIC CHANGE OF TROPHIC LEVELS ASSOCIATED WITH MIGRATION IN MARINE FISH

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Fishes play an important role in marine food webs and energy transfers through trophic levels. However, the interaction between fish growth, movement, and trophic level is complex in the natural environment, so determining ontogenetic trophic levels of marine fishes associated with migration is challenging. Over the past decades, stable isotope values recorded in calcified structures provide a way towards understanding fish movement and trophic ecology. We propose an integrated approach to comprehensively evaluate the trophic position during fish growth. First, we established ocean isoscapes around Taiwan by analysing seawater δ18O values and particulate organic matter (POM) δ15N values to provide the environmental baseline. Second, we conducted a case study on dolphin fish (Coryphaena hippurus), a commercially important and highly migratory species. The migration routes of individual dolphin fish throughout their lifetime were reconstructed by analysing δ18O of otolith carbonates in comparison to the seawater δ18O baseline. Moreover, the trophic levels at different life stages were determined by analysing δ15N of bone organic matter in comparison to the POM δ15N baseline. Owing to a prior determination of ontogenetic habitat shift, we could more precisely calculate the trophic levels based on the difference between bone and baseline δ15N values, minimising the bias of spatial variation in baseline values. Combining these data, we detailed the individual life history of dolphin fish and demonstrated a comprehensive method using multiple isotope systems with various calcified structures to study the ontogenetic trophic positions of fishes in the marine food web.

DEVELOPMENT OF A UNIVERSAL ISOTOPE PROXY TO STUDY THE METABOLISM OF MARINE FISHES

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Metabolic rate, in terms of energy use, is associated with individual fitness, including growth, reproduction, and life history responses to environmental pressure. The studies of metabolic ecology reveal how marine organisms respond to environmental changes, such as ocean warming, ice melting, acidification, hypoxia, and so on. Thus, a fundamental measure of metabolic rate facilitates precisely predicting the biogeography of marine organisms impacted by climate change and other anthropogenic disturbances. However, capturing the field metabolic rate of free-living fishes in the natural environment is a challenge. To overcome the challenge, previous studies demonstrated using the δ13C values recorded in biogenic carbonates as a potential metabolic proxy. To step forward, our research tries to develop an alternative approach to analysing δ13C values in vertebrae, which is mainly composed of organic matter and hydroxyapatite, but with a minor amount of carbonates in crystal structures. By estimating δ13C metabolic proxy from vertebral carbonate, we establish the relationship between the proxy and metabolic traits and evaluate the metabolic levels varied among functional groups. This method also holds great potential to assess the adjustment of metabolic rate during ontogeny and could be applied to a broader range of marine animal taxonomy. The acquired information is important for fisheries management in the changing future.

INVESTIGATING FINE-SCALE DRIVERS OF VARIATION ON PELAGIC FISH MIGRATION ROUTES IN THE NORTH SEA

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Spatial and temporal variations in fish and migration routes, especially important pelagic, zooplankton-eating species (e.g., Atlantic herring Clupea harengus), are driven by weekly, seasonal and annual changes in the timing and locations of where new primary production is created in shelf seas. There are a number of fine-scale oceanographic features that have been identified as important locations with very high and predictable primary production (i.e., foraging opportunities), including fronts with high gradients of density change (tidal and shelf edge fronts) and bank/trough areas where internal waves are created. In collaboration with the University of Aberdeen, Ørsted, and the Environmental Research Institute at the University of the Highlands and Islands, the PREDICT project aims to investigate these temporally ephemeral but predictable fine-scale features to predict mechanisms of variability in pelagic fish migration patterns in the North Sea. Using a Bayesian modelling approach, we bring together multiple datasets (e.g., ICES age-at-length and NEODAAS satellite frontal data) to identify years, regions and finer-scale features to recreate fish migration patterns. This has enabled us to generate seasonal maps of overlap for multiple species to elucidate spatio-temporal trends in growth rates and track annual cohorts with a greater degree of precision. The creation of individual migration maps will help us to identify where planned locations of future windfarms may overlap with high use areas in the annual cycle of fish movement during their migration, enabling the most accurate predictions of likely changes to migration routes.

ASSESSING THE ECONOMIC IMPACT OF RECREATIONAL SEA ANGLING IN THE UK

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Sea angling in the UK is an important activity that may impact fish stocks, but it also has important economic and social benefits. Economic data are needed to support the development of MRF, assess the impact on coastal communities, and support decisions on the allocation of fisheries resources. Here, we assess the total economic impact of sea angling in the UK. The total economic impact, Gross Value Added (GVA), and employment supported by sea angling in the UK in 2016, 2017, and 2021 were estimated using an Input-Output method. Expenditure on trips and major items (capital) was collected from a sample of sea anglers and raised to the total population using information from a national survey of sea angling participation. Taxes were removed, and expenditure partitioned between industrial sectors accounting for imports. Modelling approaches were used to assess the drivers of economic impact and reduce uncertainty in the estimates. The importance of the economic impact generated by sea angling in the UK will be discussed in the context of fisheries management and government levelling up agenda.

USING NATURAL CAPITAL INFORMATION TO SUPPORT FISHERIES MANAGEMENT: THE CASE OF THE EUROPEAN SEA BASS

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Natural capital concepts are becoming more widely understood, and there is growing interest in use of the approach in a range of marine policy and management contexts from local byelaws and protected areas to marine plans and fisheries strategies. However, each context has different needs, opportunities and challenges that vary with factors including the specific objectives, temporal and spatial scales, the data and resources available, the existing legislative framework, and the capacity of stakeholders and partnerships. It is essential, therefore, that a range of different applications are considered when developing methods, guidance and tools for the practical application of the natural capital approach, to ensure that these are robust and fit for purpose. In this study, the full suite of services and benefits provided by the commercial and recreational sea bass fisheries was mapped using a natural capital framework, particularly in terms of how these can provide an uplift to coastal communities, and quantitative and qualitative evidence on the scale of the associated values were compiled. A systems model has been extended to provide information that can be included in the framework alongside semi-quantitative information on wider cultural and health and well-being benefits. Different policy measure that change future stock sizes as well as the accrued benefits from harvesting the stock by commercial and recreational sea bass fisheries were assessed. The outputs of this work will be discussed in the context of the development of UK Fisheries Management Plans and efforts to conserve natural capital.

VISUAL SCIENCE OUTPUTS ARE USEFUL FOR STRENGTHENING COMMUNICATION AND KNOWLEDGE SHARING ACROSS POLICY MAKERS, INDUSTRY AND BEYOND.

Kirsty Bradley (Cefas, UK) , other authors will be listed on individual slides as examples and important considerations for communicating with different audiences will be the subject of the talk

Scientists are often specialists in their subject and deeply involved in technical data collection and analysis that many are not exposed to in the same level of detail, even within the same team/company/sector. Communication of science is an important output for increasing knowledge across other scientists, industry stakeholders, policy makers and public makers all of whom support implementation of our science.

Peer review papers have been the main way of communicating our science outputs. The use of eloquent, technical wording can create a unwanted barrier between scientists and their audiences. Scientists want people excited about what, why and how they do research and how it can benefit everyone.

The utility of visual outputs/infographics in communicating has always been valuable in some sectors and it is becoming more prevalent in science. While scientists have used visualisations to understand complex data, through graphs and maps in scientific papers, the increase in popularity of infographics shows that science communication is evolving. Thinking visually can improve your communication, by helping to break down your message for more audiences, structure plans and proposals, simplify your results into tangible outcomes, inform policy makers more succinctly and improve stakeholder engagement. The use of eye catching, and well-structured standalone infographics can make a lasting impression on your audience. I will present examples of visual science outputs I have been involved with in Fisheries science workstreams which have been used to strengthen communication and share knowledge sharing with a variety of audiences.

SEE-SCAPES: A FRAMEWORK FOR STUDYING ECOLOGICAL ENERGY IN THE CONTEMPORARY MARINE ENVIRONMENT.

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Historic limitations have resulted in marine ecological studies usually overlooking some well-established concepts from behavioral ecology. This is likely because the methods available were easily overwhelmed by the scale of ecological processes and sampling resolution in the marine environment. Innovations in technology, data management, and statistical modelling, have built up over the past two decades, and the timing is right for marine ecological research to embrace the concepts of behavioral research, and measure the marine environment from a more holistic perspective. Towards facilitating this holistic vision for the future of marine ecological research with special attention towards predicting fish distributions, we propose a novel perspective and workflow for the contemporary marine environment: the Seascape of Ecological Energy framework (SEE-scapes). SEE-scapes contextualizes the research and knowledge gained from decades of marine biological and behavioral literature and provides a guide for marine ecologists interested in grounding their research in behavioral first principles. SEE-scapes describes what we consider to be the relevant considerations in a contemporary marine seascape when considering distributions and demography. It is uniquely formulated to help account for differences in marine vertebrates' somatic experiences and offers solutions for modelling the eco-evolutionary drivers of behaviour across the dynamic and hierarchical levels of the seascape. In doing so, we provide an important framework for a new era of marine research. Simply put, the SEE-scapes perspective and workflow provides the guidance and context to translate a dynamic study system and reveal the abundance of opportunity for collaborative and integrative research in the marine environment.

HECKLED BY HEAT AND HYPOXIA: TEMPORARY HABITAT LOSS DURING SUMMER EXPERIENCED BY WESTERN BALTIC COD

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Adverse changes in ecological bottlenecks can have severe effects on stock health, productivity and natural mortality (M). The poor status of the Western Baltic cod stock raised concerns about the usefulness of the estimated natural mortality and fishing mortality, which seems severely overestimated despite massively reduced fishing pressure. Continuous oceanographic data (seafloor temperature, oxygen, salinity) were recorded at 12 positions covering a typical slope area from shallow to deeper waters (5-25 m) for 2 years , supplemented by regular CTD casts. 3D mapping of environmental changes over time combined with physiological thresholds of Atlantic cod (Gadus morhua) were used to assess the spatio-temporal windows in habitat suitability of cod. Water temperatures >15°C down to around 15 m water depth occurred from July to October. Oxygen saturations <60% from the deeper basin up to around 15 m water depth occurred from June to November. Hence, during summer cod are trapped between a heated surface layer and hypoxic bottom water. This likely resulted in habitat exclusion or extreme habitat compression of cod during one third of the year (July-October. Use of inferior habitats in summer likely coincide with adverse metabolic conditions, poor food supply and increased exposure of cod to predators. Moreover, wind-induced rapid upwelling of hypoxic waters in early autumn may lead to local fish kills, largely invisible, difficult to quantify and presently unaccounted in M. We show that such data are crucial to properly understand reasons for poor environmental conditions and poor status of affected demersal fish stocks.

TEMPERATURE-INDUCED CARDIAC REMODELLING OF CORAL REEF FISHES FROM THE WORLD'S HOTTEST REEFS

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The Arabian Gulf (AG) experiences summer maxima >35°C, making it the hottest reef environment on earth, and creating a present-day example of end-of-century predictions. Here, we use AG reefs as a natural proxy for climate change to investigate temperature induced cardiac remodeling as an adaptive strategy in meeting increased oxygen demands in several common coral reef fish species. Furthermore, by investigating the same species from the neighboring Gulf of Oman (GO) where temperatures are less extreme (annual SST 22-32°C), we are able to explore adaptive / acclimation strategies.

Heart structure was extensively analysed in individuals from AG and GO at five temperatures representing the existing seasonal AG thermal range (18, 22, 27, 31.5, 35.5°C). Specifically, we investigated elastin, collagen and glycogen content, as well as cardiomyocyte size within the spongey ventricular tissue. Fishes were collected throughout the year when SST matched those of investigation, allowing an accurate representation of naturally occurring remodeling. As conditions in GO do not reach the same seasonal extremes, fishes from this region were acclimated for >3 weeks to 18°C and 35.5°C.

We found species specific responses across temperatures within both populations (AG and GO), consistent with previous respirometry performance work on the same individuals, suggesting that aspects of cardiac remodeling are assisting in meeting greater oxygen demands at high temperatures. Importantly, there were population differences between AG and GO individuals, representative of adaptation / acclimation to their extreme environment. This is the first study to investigate cardiac remodeling in fishes within the Arabian Gulf.

SPATIOTEMPORAL CHANGES IN CRITICAL VEGETATED MARINE HABITATS, AND THE CONSEQUENCES FOR BIODIVERSITY

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Catastrophic losses of seagrass habitats have been observed globally, prompting scientists and other stakeholders to form a collaborative push for seagrass research, conservation and restoration. Interest in seagrass as a nature-based solution for both mitigating climate change and the biodiversity crisis has grown significantly, following these observed habitat losses.

Historically, seagrass beds were widely distributed along the coastline of the UK. Yet, in the past century, pollution, coastal development, and industrial expansion has caused serious declines. In the south-east of England, recent estimates have suggested a loss of up to 97% seagrass cover across two estuaries, the River Stour and River Orwell. The potential for natural recovery and persistence of seagrass meadows in the region has prompted interest in restoration of these habitats, their biodiversity and ecosystem function, such as a fish nursery habitat.

Results on contemporary changes to Zostera noltei seagrass distribution will be presented, from areas where seagrass has been lost and retained, as well as newly recorded locations. Seagrass-associated biodiversity will be examined and the role of intertidal seagrass as a critical nursery habitat will be discussed, including the potential for restoration in a southern-North Sea estuary complex.

DEVELOPING A CONSERVATION AND RECOVERY STRATEGY FOR THE UK'S LOST "DINOSAUR FISH" SPECIES, THE EUROPEAN STURGEON (ACIPENSER STURIO) AND ATLANTIC STURGEON (ACIPENSER OXYRINCHUS)

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The UK’s two native sturgeon species, the critically endangered European sturgeon (Acipenser sturio) and the vulnerable Atlantic (aka Baltic) sturgeon (Acipenser oxyrinchus), were once commonly found in UK rivers and coastal waters. This talk will give an overview of the reasons for declines in their populations across Europe, and outline what is being done to aid their recovery both across Europe and in the UK. Recent UK sturgeon recovery efforts include: 1) development of a UK Sturgeon Action Plan, and 2) using decision analysis processes to determine which conservation interventions, such as reintroductions, would be most beneficial for the recovery of UK sturgeon.

TRACKING ESTUARINE ORIGIN OF THE EUROPEAN EEL (ANGUILLA ANGUILLA): USE OF OTOLITH MICROCHEMISTRY TO IDENTIFY STOCKED EELS MIGRATING AS SILVER EEL FROM LOUGH NEAGH, NORTHERN IRELAND

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Recruitment levels of the European eel (Anguilla anguilla) have declined since the early 1980s subsequently resulting in the species being listed as critically endangered. This prompted EU action and the creation of an EU Eel Recovery Plan instructing member states to create Eel Management Plans to aid in the recovery of eel stocks. A considered management action within Eel Management Plans (EMP) is stocking of juvenile eels, as seen within Lough Neagh, the largest wild eel fishery in Europe. Formerly a widely applied action, there is much contention over the validity of this method, culminating in ICES listing the efficacy of eel stocking as the number one research need in their 2022 working group report. The use of otolith microchemistry can provide a robust approach for identifying the origin of individual eels, providing empirical evidence for the value of stocking by identifying the prevalence of stocked individuals within the out-migrating spawners. Using the elemental composition within glass eel otoliths, measured by laser ablation-inductively coupled plasma mass spectrometry (LA-ICPMS), microchemical "fingerprints" have been derived, showing differences among estuarine sources. This project aims to reassess the robustness of these multi-elemental fingerprints within the zero-band of a larger library of glass eels, and then quantify their frequency within adults (silver eels) caught on their outmigration from Lough Neagh 12-18 years after stocking. Elemental fingerprints in juveniles and adults will be cohort matched using otolith-derived age estimates and the known stocking history of the Lough Neagh fishery, allowing us to assess the contribution of stocked eels to this important population.

SEAGRASS SECURITY: ASSESSING THE ROLE OF FISHERIES SUPPORTING AND PROVISIONING SERVICES IN UK'S TEMPERATE SEAGRASS MEADOWS (ZOSTERA MARINA)

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Coastal habitats e.g., seagrass meadows, provide vital coastal and ecological connectivity, ecosystem services and key provision habitats that support fisheries, particularly as a nursery habitat for commercially fished species. Seagrass presence and extent (Zostera noltii and Zoster marina) are in significant decline, being altered by human pressures and a changing climate, with consequential impacts to commercial fish stock biomass, economic losses, and a changing seascape. Associated ecosystem and fishery complexities and limited understanding within these habitats means commercial valuation and natural capital assessments are often overlooked during ecosystem service review as lack of meaningful data and methodologies makes it difficult to quantify and value.

Using a Seagrass Residency Index (SRI) approach, the economic value of seagrass habitat and commercial fisheries value of supporting and provisioning services can be quantified. This ensures that targeted climate-focused conservation and restoration of seagrass habitats can support and improve these fish stocks effectively whilst simultaneously informing targeted governmental policies and practices and awareness of this vital coastal resource.

This study assesses the role of temperate seagrass meadows (Zostera marina) in supporting fisheries and quantifying its commercial value using SRI method approach in a UK context. Seven UK seagrass meadow case study sites were studied across varying environmental gradients, seagrass biotopes, spatial scales, and stages of restoration. This research presents a contemporary picture of the economic value of seagrass meadow provisioning services for commercial fish species in the largest assessment of its kind in the UK.

USING A MULTIMARKER APPROACH TO QUANTIFY THE CONTRIBUTION RATES OF ANCHOVY NURSERY AREAS IN THE GULF OF CADIZ (SOUTHWESTERN IBERIAN PENINSULA) TO THE ADULT STOCK

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Estuarine systems are recognized worldwide for providing critical nursery grounds for the juveniles of numerous fish species. However, little is known about the contribution rates of these areas to the adult stock due to the methodological difficulties associated with tracking fish across life stages and habitats. Chemical tracers in archival tissues can provide unique information about the lifetime habitat use and environmental history of individual fish, providing insight into natal origin and nursery grounds used by adult fish.

To explore nursery area promotional contribution and the factors underpinning differential survival patterns, post-larval anchovies (Engraulis encrasicolus) were sampled in the main estuaries of the Gulf of Cadiz, Spain, during three consecutive years (2016, 2017, 2018). Significant differences in size and abundance were observed suggesting differences in habitat quality, however the extent to which these differences reflect their relative contribution rates forms the second part of the study. To characterise the chemistry of fish from each estuary, the elemental and isotopic fingerprints of the juvenile portions of otoliths and eye lenses were quantified. Finally, adult anchovies were sampled from the Gulf of Cadiz fishing grounds in 2018, representing the cohorts sampled on the nursery grounds in 2016 and 2017, to explore the extent to which natural tracers were effective at resolving promotional contributions of different estuaries to that population.

The information generated in this study could help to determine the importance of the different nursery areas in terms of contribution to the adult stock, providing a useful tool for fishery managers and policymakers to identify the critical habitats supporting this important species.

A SEASCAPE-SCALE ASSESSMENT OF FISH CONNECTIVITY ACROSS BIOGENIC HABITATS IN THE SOLENT, UK

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The Solent estuarine strait, situated between mainland England and the Isle of Wight, is facing degradation due to human activities and climate change. To address this, the Solent Seascape Project (SSP) was launched in January 2023, the first of its kind in the UK, aimed at initiating seascape scale restoration. The long-term objective is to restore and safeguard 30% of the Solent's seascape to transition it from a degraded state to a productive, naturally expanding, and interconnected ecosystem.

The SSP involves actively restoring 8 hectares of saltmarsh, 7 hectares of seagrass, 4 hectares of native oyster reefs, and 10 breeding seabird nesting sites to increase habitat extent and promote recovery across the seascape. It will also evaluate ecosystem function and assess seascape-scale connectivity by using different techniques to determine fish habitat use and movement across different life stages, using multiple environmental DNA (eDNA) markers (COI, 12S & 18S) to assess biodiversity and fish utilisation, combined with carbon and nitrogen stable-isotope analysis.

The data collected will be ground-truthed using fish surveys, tagging, underwater visual surveys, and acoustic monitoring to understand the function and importance of temperate biogenic coastal habitats for fish and mobile fauna and how distance, size, and quality impact connectivity between habitats. The project will also assess ecosystem service benefits, including carbon sequestration, biodiversity, and nutrient removal.

The SSP will set a precedent for future restoration efforts and provide policymakers with an evidence-based record of the benefits of seascape restoration. By delivering nature-based solutions, the project will not only benefit the ecosystem but also the communities that depend on it. The project's restorative actions will improve ecological connectivity and ecosystem services, making it a model for future restoration effort.

SPATIAL PATTERNS OF DISTRIBUTION, ABUNDANCE AND GROWTH OF LIFE STAGES OF PARACHANNA OBSCURA (GUNTHER 1861) IN A MAN-MADE LAKE

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Poor environmental conditions have the capacity to alter the ecology and density of some fishes in a man-made lake. This study investigates the spatial patterns of distribution, abundance and growth of life stages of Parachanna obscura in a man-made lake in order to provide information for management of life stages of P. obscura that has high commercial value in Nigeria. Sampling was carried out between March 2018 and March 2020 using local fishing traps, cast and gill nets. Length weight relationship, condition factor, growth parameters, fishing mortality, sex ratio, gonad development and water quality were measured. Results indicated that length frequency distribution of P. obscura class interval range was 8-11.9cm to 36.39.9cm. Four stages of gonad development observed were stage 2,3,4 and 5 which were resting, maturation, maturity and reproduction. The highest value of oocyte counts recorded were 5, 503 eggs per sample. The water quality results at spatial levels showed that temperature range (25.8-27 ° C), pH (7.77 – 8.08), conductivity (85.7-120µScm-1) and dissolved oxygen (4.4-4.6mg/ L) were obtained in station1.The water quality parameters of station 1 impacted the distribution and abundance of P. obscura in the lake as station1 recorded least catch of fish, while the other stations recorded high abundance of P. obscura. The study concluded that activities that alter ecosystem should be reduced because of their effects on the water quality which impacts negatively on the fisheries potentials of the lake.

Keywords: Parachanna obscura, spatial distribution, water quality, gonad, growth

OBSTACLE AVOIDANCE: HOW A CORAL REEF FISH, RHINECANTHUS ACULEATUS, USES VISUAL CUES TO NEGOTIATE THROUGH A CLUTTERED ENVIRONMENT

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Structural complexity within aquatic habitats is highly varied; while some habitats are characterised by wide open spaces, others such as coral reefs, are cluttered with biotic and abiotic structures. In cluttered environments, the movement of fish within the space is necessarily influenced by the structures within it, but little is known about how fish select their routes around obstacles. Using laboratory experiments, we investigated the routes of fish when crossing a field of 12-20 white cylindrical obstacles to reach a food reward. The reward could appear in one of three positions, dividing the task into an initial search phase aimed at locating the goal, followed by a directed phase in which the fish had to detour around obstacles to reach its goal. In order to analyse the movements of the fish relative to obstacles, we developed tools to automatically detect experimental stimuli (e.g. cylinders) and track fish within the boundaries of the aquarium. Resulting trajectories were analysed to answer three broad questions: 1. How do fish select a gap (e.g. largest, most direct to goal)? 2. Does gap selection behaviour differ when fish are searching compared to when they are moving towards a detected goal? 3. How far ahead do fish look when planning a route? These results are not only of interest to those studying the movement and navigation behaviour of wild fish but may also be of import to aquaculture and the design of containment systems.

EXAMINING THE RELATIONSHIP BETWEEN MARINE MICROPLASTIC POLLUTION AND PROXIMITY TO URBANISED AND EFFLUENT ZONES IN WATERS SURROUNDING THE ISLE OF CUMBRAE, SCOTLAND.

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Microplastics (MPs) are ubiquitous in the marine environment and have been shown to be present in the water column, sediment, flora and fauna of oceans globally. Benthic invertebrates play a vital role in maintaining sediment and water quality, and benthic communities are widely used in the monitoring of marine pollution. Environmental and biological samples collected across four sites around the Isle of Cumbrae, Scotland, were analysed for MP presence and abundance. Sites differ in proximity to industrial and domestic wastewater treatment (WWT) outflows - known transport pathways for MP release into the marine environment. We examined how this proximity relates to MP pollution and the associated impacts on benthic biodiversity within and between sites. MPs were analysed using FTIR-ATR spectroscopy. MPs were present in seawater and sediment samples from all sampling locations; the current analysis indicates significant differences in MP fibre type between sites for sediment ($p<0.0001$) but not for seawater samples. There were no significant differences between sites for MP abundance in water or sediment samples. Average MP particle concentrations ranged between 5.07–20.40 particles L-1 and 0.1-1.78 particles g-1 dry weight (DW) for seawater and sediment samples respectively. Kilchattan had highest phylum-level diversity according to Shannon's Index ($H=1.214$) and was the site furthest from any WWT. Balloch Martin ($H=0.965$) and Fairlie ($H=1.017$) had lowest phylum-level diversity and high proximity to Largs WWT. This is one of the first comprehensive studies to examine the relationship between abiotic and biotic MP pollution and proximity to WWT sites, in benthic environments surrounding Great Cumbrae.

EXAMINING MICRO-NANOPLASTICS (MNPS) UPTAKE, PRESENCE AND DISTRIBUTION IN THE BLUE MUSSELS (MYTILUS EDULIS) FROM ISLE OF CUMBRAE, SCOTLAND.

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Plastic litter has become the most common type of marine debris because of rising plastic consumption and poor waste management. Micro/nanoplastics (MNPs) resulting from plastic litter fragmentation upon weathering have raised particular concerns due to their size. The latter allow them to move easily in the marine ecosystem, across trophic levels within the food web and across different tissues within contaminated animals. Indeed, MNPs can be accidentally ingested from the environment by filter-feeding organisms such as mussels while foraging, making them particularly vulnerable to MNP pollution. Here, the effects of different concentrations of reference MNPs (i.e., Polystyrene nanobeads, PSN) on blue mussels (Mytilus edulis) were investigated. The mussels were exposed to PSN under laboratory-controlled condition for 7 days and then investigated after the exposure ended. The presence and abundance of MNPs in different vital organs of mussels (gill, gut, gonad, mantle) were assessed. All MNPs (PSNs and environmental microplastics (EMPs) were extracted using the standard protocols for digestion, filtration and were analysed using FTIR-ATR spectroscopy. MNPs were detected across all organs investigated; unusually, gonad tissue had the highest average number of MNP particles at (39.371 ± 22.749 MP g-1) (average ± SEM) (Two-way ANOVA, $p = 0.0009$), with EMPs fibre type being the most abundant with average of (84.630 ± 24.305) (average ± SEM). These findings will be discussed in relation to uptake from the environment and the possibility of trophic transfer from mussels to humans.

ESTIMATING BASELINE ISOSCAPES SPATIAL VARIABILITY FROM FISH ISOTOPIC SIGNATURES AT THE COMMUNITY LEVEL

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One of the main limitations in the application of stable isotopes to marine trophic ecology is obtaining a reliable baseline upon which to calculate isotopic enrichment. Isotopic baselines are variable in space and time, influenced by several factors such as terrestrial runoff, oceanic currents or primary production, and thus, investigating their patterns of variability is essential to gain confidence in any estimate of trophic position based on isotopic signatures. In this study we propose a multispecies and multitrophic approach to study baseline isoscapes for nitrogen (δ15N) and carbon (δ13C) in the Northwestern Iberian Peninsula. Using a set of 372 isotopic data of 11 demersal fish species sampled during autumn, we modelled the spatial variability of the isotopic baseline (for δ15N and δ13C separately) by removing the biological effect of species identity and individual length. Using the residuals of these models, we investigated the effect of environmental variables in driving the observed spatial patterns. Our results indicate that the δ15N baseline is not as variable as that of δ13C. Attending to δ13C, the baseline values strongly differed spatially between the westernmost area of Galician coast, with the lowest δ13C residuals, and the easternmost Cantabrian Sea, with the highest residuals. This variability reflects differences between these biogeographic areas regarding environmental variables such as upwelling intensity and primary production. Our study brings forward the potential of multispecies isotopic data for approximating the environmental isotopic baselines for the whole ecosystem.

LINKING VGLL3 GENOTYPE AND AGGRESSIVE BEHAVIOUR IN JUVENILE ATLANTIC SALMON (SALMO SALAR)

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Aggressiveness can affect social hierarchies and result in the unequal distribution of resources, with aggressive individuals monopolizing access to food influencing growth. In Atlantic salmon, aggression has been found to have a genetic component, and growth also influences maturation timing. Maturation timing associates with a large-effect locus around vgll3, which is also linked to growth and condition, with vgll3*EE (early maturation) individuals having higher condition factor than vgll3*LL (late maturation). Here, we examine the possibility that aggressiveness may play a role in juvenile vgll3*EE individuals having higher condition factor by having increased food intake due to higher aggression promoting increased food access. This prediction was tested under a social context: aggressiveness and feeding activity in four size-matched individual salmon, two from each genotype, were observed over 95 trials. Contrary to our prediction, vgll3*LL individuals, not vgll3*EE, were more aggressive. Increased aggression of vgll3*LL individuals was independent of their sex and size, and genotypes did not differ in their condition factor nor feeding activity. These results imply that aggressiveness may have an energetic cost impairing growth and condition, especially when food cannot be monopolized. This may have critical implications for individual fitness and aquaculture practices.

DOES PARENTAL CONDITION MEDIATE OFFSPRING DEVELOPMENTAL PLASTICITY?

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The environment a parent experiences can shape investment into reproduction and per offspring energy allocation and alter the response of offspring to their environment. For example, when reared under low food conditions, life-history theory predicts that mothers will change their per offspring investment: either increasing offspring size to help buffer offspring from stressful conditions or reducing offspring size to divert their finite reproductive reserves to increase fecundity or future reproductive effort. Low food availability in one generation may also elicit a response in the subsequent generation. For example, offspring from mothers exposed to low food may suppress or elevate their metabolic rate, or alter energy allocation towards maintenance or growth, to compensate for lower energy acquisition from the mother. The implications of transgenerational and developmental plasticity are likely to be context-dependent, where warmer temperatures may exacerbate the fitness consequences of variation in energy acquisition and allocation under low resource environments. Food availability and temperature in the parental generation are likely to alter maternal energy allocation (e.g., offspring size and composition and/or number) towards offspring and the physiology of offspring, yet whether this is an adaptive response, i.e., as a strategy to maximise fitness, or whether it is due to a direct constraint (and is likely maladaptive), is difficult to resolve. Here we manipulate parental food availability and temperature in zebrafish to test the effect of parental environment on offspring investment and its implications for offspring phenotypes and survival.

LONG-TERM SUSTAINED SWIMMING IMPROVES SWIMMING PERFORMANCE IN CHINOOK SALMON ONCORHYNCHUS TSHAWYTSCHA WITH AND WITHOUT SPINAL SCOLIOSIS

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Exercise training during early production is becoming a key component in salmon hatcheries as exercise enhances several production-related traits in salmonids. Exercise conditions for rearing salmonids are continually being optimised and now that the salmonid industry is developing offshore, training is being considered as a tool to prepare stocks for high energy environments. It is unknown if exercise can enhance traits in other understudied salmonid species and in individuals with spinal curvature, which is a common issue within some salmon farms. Here we exposed Chinook salmon to low (0.3 bl s-1) and moderate (0.8 bl s-1) tank velocities for ten to eleven months and quantified respiratory and swimming performance in individuals with and without mild scoliosis. Further, we investigated compositional and morphological responses at cellular and whole-body levels. Raising Chinook salmon under moderate velocities improved swimming performance in individuals with and without spinal curvature, but recovery processes in individuals with spinal curvature were greater. Fat content was reduced in fish raised under moderate velocities, while protein content was higher in individuals with spinal curvature. Together, the results of this study shows benefits for integrating exercise training into hatchery settings (i.e., pre- and post-smolts) to prepare stocks for offshore farming and provides evidence that some exercise-enhanced traits can be translated into individuals with spinal curvature, but concerns remain for individuals with more severe cases. Additionally, this study reveals that the product quality of fish farmed may change in offshore locations, and that optimising nutrient profiles for offshore feeds should be considered.

TOP-DOWN EFFECT HIDES THE IMPACT OF WARMING ON AN AQUATIC FOOD WEB

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Global warming is altering the composition and functioning of both terrestrial and aquatic ecosystems. Most research has focussed on the direct effects of warming on species and their population dynamics, while less is known about the indirect effects through species interactions. Trophic cascades are especially likely to influence the impact of warming given that trophic levels differ in their response to warming because of differences in metabolism and vital rates. We investigated if the top-down effect of a common mesopredator, the three-spined stickleback, alters the impact of warming on a Baltic Sea food web. We manipulated both temperature and the presence of stickleback in mesocosms, and found the stickleback to counteract the impact of warming on lower trophic levels. This was through increased consumption of herbivores, which exceeded the rate at which the herbivore population could grow, which in turn promoted the growth of algae biomass, which warming otherwise reduced. Thus, the top-down effect of the stickleback hid the impact that warming had on the food web. This highlights the importance of considering the impact of warming on multiple trophic levels and their interactions. Failing to consider differences in responses among trophic levels and the impact this has on their interactions can result in faulty conclusions about the impact of warming on ecosystems.

ECOTYPE DIVERSIFICATION AS MECHANISM FOR COEXISTENCE IN EXTREME ENVIRONMENTS – THE CASE OF NORTHERN PIKE (ESOX LUCIUS) IN BRACKISH LAGOONS

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Competition for resources fosters the evolution of diverse and often specialized phenotypes, particularly in extreme environments. Brackish environments offer challenging conditions for freshwater species, which may respond to the osmoregulatory conditions by developing different habitat use strategies along a gradient between residency in freshwater tributaries, over anadromy to brackish residency. We used high-resolution intra-otolith δ18O isotope ratios and trace elemental concentrations to reconstruct the lifelong thermosaline niche of northern pike (Esox lucius) inhabiting brackish lagoons of the southern Baltic Sea at the edge of the species´ salinity tolerance. Age-specific and life-time growth were used as a fitness surrogate. The individual environments experienced were classified into ecotypes with a dynamic time warping approach. In a sample of 130 pike collected from lagoons and adjacent tributaries, we detected four ecotypes, a brackish resident, an anadromous type, a freshwater resident and an unexpected fourth ecotype characterized by freshwater or oligohaline estuarine spawning and subsequent movements into mesohaline conditions (cross-habitat type). 68% of the pike captured in the lagoon ecosystem were brackish residents, suggesting they have undergone evolution to complete the life cycle under mesohaline conditions. 24% were of the cross-habitat type and 8% of were classified as anadromous. Growth of the ecotypes varied significantly between age classes, but life-time growth was similar, suggesting that all ecotypes achieved similar fitness. Pike have responded to the brackish environment by developing a diversity of ecotypes representing a range of adaptations able to complete a life cycle in an environment offering extreme physiological challenges.

A CLASS OF THEIR OWN? WATER-SOLUBLE POLYMER POLLUTION IMPACTING A FRESHWATER HOST-PATHOGEN SYSTEM

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Microplastic pollution is a major ecological threat for aquatic ecosystems, fuelling the debate on whether 'intentionally added microplastics' or primary microplastics (MPs) should be banned under UK and EU REACH chemical regulation and restriction. Primary MPs, often added to personal care products (PCPs), are beginning to see restrictions on their uses, but water-soluble polymers (WSPs) have so far slipped through the net of global chemical regulation. Despite the widespread occurrence of WSPs in the cosmetic and food industries, there are no regulations for their use. In addition to their high prevalence in PCPs, the predominant use of WSPs is attributed to wastewater treatment itself, where they are applied directly to aid removal of contaminants. As a result, reports of WWTP effluents with high WSP concentrations (up to 7 mg/L) are emerging, yet the environmental implications of these chemicals are largely unknown. Defining the interaction of these chemicals with other biological stressors is imperative to determine the potential risk of WSP for freshwater ecosystems, moreover their long-term impacts need to be well defined to ensure their feasible use as decontaminants in WWTPs.

Utilising a host-pathogen model system, this study assesses the impact of WSPs on fish welfare, specifically host growth, metabolic rate and disease susceptibility; thereby defining the interaction of this emerging contaminant class with a second stressor (i.e., the pathogen). Analytical methods will be applied to further examine the fate of these chemicals in vivo, achieving an interdisciplinary into their effects on this freshwater ecological model.

ECOPHYSIOLOGICAL EFFECTS OF MERCURY BIOACCUMULATION AND BIOCHEMICAL STRESS IN THE DEEP-WATER MESOPREDATOR ETMOPTERUS SPINAX (ELASMOBRANCHII; ETMOPTERIDAE)

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Mercury (Hg) presents high toxicity to biota as it has no biological function, it is bioaccumulated with age and biomagnified to higher trophic levels. Few studies have assessed oxidative stress and neurotoxicity in deep-water species. Therefore, this work evaluated early ontogenetic changes and physiological effects (antioxidant defences, oxidative damage, aerobic metabolism and neurotransmission functions) of Hg accumulation in the white muscle and brain tissues of the velvet belly lantern shark Etmopterus spinax from the southern Iberian coast (NE Atlantic). We observed that the low Hg concentrations observed may induce acute effects in E. spinax before they reach sexual maturity. Different Hg concentrations were observed in E. spinax: [Hg] males > [Hg] females; [Hg] muscle > [Hg] brain. The higher activities and levels of antioxidant defences in females than in males suggest that females have higher redox capability. However, higher levels of oxidative damage were also observed in females. Whilst the mechanisms underlying these effects remain unknown, these results suggest differences in Hg accumulation between tissues and sex, and potentially deleterious impacts on oxidative stress status and neurophysiology of E. spinax, potentially impairing swimming performance and reproduction, which could consequently impact the health of both individuals and population.

INVESTIGATING BY-CATCH UNCERTAINTIES TO IMPROVE ANTARCTIC KRILL FISHERY MANAGEMENT

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The increased commercial interest in Antarctic krill (Euphausia superba) over the past two decades has driven significant increases in catches in Area 48 (southwest Atlantic sector, Southern Ocean), where E. superba is actively fished over three statistical subareas (48.1 to 48.3). Annual catches of E. superba have attained more than 300,000 tonnes over the last decade, making this the largest volume fishery in the Southern Ocean. Larval and juvenile fish are frequently taken as bycatch in the krill fishery. Concerns as to the extend and detrimental impacts on fish populations call for sound management tools supported by fisheries-independent scientific research.

Utilising the comprehensive archive at British Antarctic Survey (BAS), spanning over three decades of ichthyoplankton research, we are employing morphological and molecular methods to develop enhanced identification guides to improve reporting on by catch for the krill's fishery, which in turn will support CCAMLR efforts to safeguard Antarctic marine resources through an ecosystem-based approach.

A NEW BASELINE FOR THE POPULATION STRUCTURE OF ATLANTIC HERRING (CLUPEA HARENGUS) IN NORWEGIAN WATERS

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The herring fishery is one of the most important fisheries conducted in Norwegian waters. Throughout the year, herring is present and fished both along the Norwegian coast as well as throughout much of the waters of the Norwegian Exclusive Economic Zone. In a fisheries management perspective, knowing which population one is catching is of utmost importance, as failure to take this into account can lead to fishing based upon the wrong fisheries quota and as a result a wrongful and unbalanced harvest. Using modern population genetics methods, we conducted a study of Atlantic herring throughout Norwegian waters, in order to get a new updated view of the population structure of the species present in Norwegian waters. These results were used to build up a population baseline to be used in assignments studies of fisheries samples from the Norwegian herring fisheries. For the future, this baseline will be available for studies both on the population composition of fisheries catches, as well as help in monitoring the potential changes in herring population distributions.

OTOLITH DEFORMITIES IN CHINOOK SALMON: INFLUENCE OF CLIMATE CHANGE AND HATCHERY MANAGEMENT

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Pacific salmon have been severely impacted by anthropogenic disturbance resulting in habitat loss, overharvest, and obstruction of migratory routes. This is especially true of Chinook salmon (Oncorhynchus tshawytscha) native to the California Central Valley (CCV), where declines in wild populations and high levels of hatchery supplementation have occurred. Aberrant otoliths, where the typical aragonite crystal structure is replaced by vaterite crystals, are common among salmonids and have been associated with reduced hearing and escape efficiency. However, the mechanisms causing the crystal type to switch remain elusive. We used Generalized Additive Models to investigate the drivers of vaterite replacement in CCV juvenile salmon sampled during their emigration from freshwater in 2014-2018 (n = 2823). Overall, hatchery origin fish had ~7 times higher vaterite incidence than wild origin fish. Furthermore, vaterite incidence was positively related to fish size, suggesting a link to higher metabolic and growth rate, as has been shown in previous studies. Vaterite incidence was higher during drought, suggesting some influence of environmental conditions such as temperature, although temperature itself was only weakly correlated. Importantly, vaterite replacement varied among populations, with the highest incidence rates observed in fish originating from the hatchery with the oldest broodstock in the system. This suggests a the potential for a heritable component to vaterite replacement, which is troubling given the interbreeding that occurs between hatchery and wild populations. Further studies are required to fully understand the mechanisms underpinning vaterite formation in salmonids, although its incidence in CCV Chinook salmon is predicted to increase in the face of more frequent and intense droughts and continued hatchery supplementation.

THE USE OF MEAN LIFE SPAN INDEX AS INDICATOR OF ECOLOGICAL STATUS IN TRAWLED AREAS

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The development and monitoring of ecological indicators play a prominent role for supporting the implementation of an ecosystem approach to fisheries by assessing ecosystem status. Different approaches have been used to build indices on the impact of fishing, in particular for bottom trawling. In this study the Mean Life Span index was used in two areas on historical series of trawl survey data aiming at understanding pros and cons of the use of this index and his applicability in a Mediterranean context. The study was carried out in the Gulf of Castellammare, an area subject to trawl ban since 1990 and in a portion of the Strait of Sicily, an extremely important area for trawl fisheries. The Mean Life Span index was applied at the two Mediterranean historical data-set and the values ranged from 6.1 to 11.01. Its applicability depends on the availability of data on the life cycle of the species, in particular on maximum age. If this data are scanty, its application is poorly indicated. Results obtained in the two study areas showed a slightly increasing trend across years. This could be related to the trawl ban in the Gulf Castellammare and to a decrease of fishing pressure in the Strait of Sicily.s

DEVELOPING NEW BIOMARKERS TO QUANTIFY THE ROLE OF KELP DETRITUS IN MARINE FOOD WEBS WITHIN THE PARC NATUREL MARIN D'IROISE

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In coastal areas, kelp forests support complex food webs with many marine consumers relying on kelp as their basal organic matter source. The kelp forests and fish in the Molène archipelago (Brittany, France) have been exploited since the Bronze Age. The decline of kelp forest habitat and changes in availability of organic matter sources can directly affect the trophic dynamics of marine ecosystems. Recently, it has become evident that kelp detritus may be a significant resource and enhance secondary production within and around kelp forests. Understanding the contribution of detritus to marine food webs is particularly important in the current changing ocean scenario, where climate change related stressors are driving large scale changes in kelp abundance and distribution, with consequences for productivity. Using complementary biochemical analyses (lipid analysis, stable isotopes and compound-specific stable isotopes) of fish tissues, kelp and detritus, this project aims to better understand the trophic links between exploited fishes and their primary organic matter sources and to resolve long-term changes in the trophic structure of fish species historically exploited in the region. By combining biochemical analyses, we will identify biomarkers allowing us to differentiate between species of macroalgae, as well as differentiating fresh and detrital algae to track the fate of both within local food webs of the associated community in the Iroise Sea. Here, we are presenting first results of using n-alkanes in combination with fatty acids and stable isotopes to differentiate between seven species of macroalgae and detritus from three sites along the Brittany coast.

NOVEL 'DANCING RODS' BEHAVIOURAL BARRIER FOR DOWNSTREAM MIGRATING SALMONIDS.

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The global decline in the populations of freshwater migratory fish species has been strongly linked to the absence of free-flowing rivers due to hydropower and adjacent infrastructure. The present energy and climate crises make reliance on hydropower even more prevalent with new hydro energy consumption records being set every year. To mediate the ongoing freshwater biodiversity loss it is imperative to restore longitudinal river connectivity by allowing downstream migration in addition to the upstream efforts. Out-migrating fish follows the main flow, which typically ends in the intake area, so a guidance system is needed to direct the fish toward the bypass. Current solutions involve physical barriers, which can cause fish impingement and injury and can be difficult to upscale for larger hydropower facilities due to high costs associated with building, maintenance, retrofitting and head loss. Alternative guidance barriers based on fish behaviour do exist and are often preferred by companies due to the lower costs and maintenance efforts, however, these are often limited by higher water velocities. It is essential to find guidance systems that can be implemented easily. Novel behavioural ‘dancing rods’ guidance barrier was tested with one- and two-year-old Atlantic salmon smolts in large experimental flume. The guidance efficiency was significantly higher than the no guidance barrier control, presenting a good base design for future passage solutions.

VALIDATING SCALE GROWTH PATTERNS IN TROUT THROUGH MARK-RECAPTURE

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Analysis of growth marks in fish scales is a widely used approach for deriving age estimates and high-resolution growth histories from salmonids. This study aims (1) to validate scale reading for partially-anadromous brown trout (Salmo trutta L.) using a mark-recapture experiment and (2) to investigate the influence of temperature history on fish and scale growth patterns. Scales were sampled from 101 PIT-tagged trout during initial tagging and again when the fish were recaptured (4-44 months later). Age estimates and annual growth measurements were obtained from the scales for each sampling event to validate the annual periodicity of scale annuli formed during the release period and sources of variability in growth rates (age, time at liberty, temperature history) were examined. In 72% of cases, the number of annuli formed in the scale during the release period was consistent with annual periodicity. In 21% of cases the rate of annulus formation was less than expected and in the remaining 7% of cases, more than one annulus per year was formed. Deviation from annual periodicity was more likely in older fish and in fish at liberty for two years or more. Changes in scale size and circuli number were proportional to changes in body size during the release period (correlation coefficient = 0.74 and 0.77 respectively). Growing degree day was the best predictor of scale growth during the release period while body growth was best explained by time at liberty. Implications for the use of scale measurements to reconstruct age and growth patterns in trout are discussed.

MICROPLASTIC OCCURRENCE IN THE GASTROINTESTINAL TRACTS AND GILLS OF THE COMMON MINNOW (PHOXINUS PHOXINUS) AND THREE-SPINED STICKLEBACK (GASTEROSTEUS ACULEATUS) FROM THE RIVER TAME, GREATER MANCHESTER, UK.

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Untreated wastewater has been identified as a major source of microplastic input to urban rivers and can contribute to the formation of microplastic hotspots on river channel beds. In this study, the occurrence of microplastic bioaccumulation was assessed in two mid-consumer fish species collected from the River Tame, Greater Manchester, UK, where multiple microplastic hotspots have been reported. A total of 93 individual fish (minnow, n=41; stickleback, n=52) were collected from 5 sites within the Dukinfield and Reddish Vale reaches. The gills and gastrointestinal tract were isolated and digested in 10% potassium hydroxide followed by vacuum filtration on a 47 mm glass fibre filter with 1.2 µm pore size (Whatman, GF-C). Identification and quantification of suspected microplastic particles were performed at up to 90x magnification on a brightfield stereomicroscope, which can resolve particles down to 30 µm. Suspected plastic particles were then re-suspended in ultrapure water (Milli-Q) and filtered onto an aluminium oxide filter (Whatman, Anodisc), followed by polymer confirmation using µ-FTIR spectroscopy (Perkin-Elmer Spotlight 400). Preliminary findings show that microplastic occurrence is widespread albeit low in numbers for both species, suggesting frequent uptake and effective elimination for the particles within the detectable range of this study (>30 µm). In addition, the composition of the channel bed microplastic assemblages may have influenced the frequency and types of plastic particles found in both organs. Further studies focusing on smaller microplastic particles (<30 µm) and their presence in remote organs are recommended to gain a clearer insight into the prevalence of organism-wide microplastic bioaccumulation.

SUBTLE TRANSCRIPTOMIC RESPONSE OF EURASIAN PERCH (PERCA FLUVIATILIS) IN RELATION TO TRIAENOPHORUS NODULOSUS PLEROCERCOID INFECTION

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Determining the physiological effects of parasite infection and host immune response are essential to improving our understanding of host-parasite interactions and their ecological and evolutionary consequences. Here, we evaluated the impact of the widespread and antagonistic helminth Triaenophorus nodulosus on it's second intermediate host, the Eurasian perch (Perca fluviatilis), by analyzing liver and spleen transcriptomes of the host via RNA-Seq. A greater number of total differentially expressed (DE) genes were uncovered in spleen samples, with DE genes involved primarily in immune response, while DE genes in the liver showed metabolic function. Thus, our transcriptomic analysis revealed only weak host response indicating that plerocercoid infections of the liver do not evoke extensive physiological and immune response from the host. This study demonstrates that transcriptomic analyses can provide valuable information about the physiological effect of infection and its potential costs to the host.

OCEANIC PROCESSES AFFECT BLUE SHARK DENSITIES IN UK WATERS

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The highly migratory Blue Shark, Prionace glauca is a seasonal migrant to waters to the south-west of England, where it can be locally abundant. The Pat Smith database, representing a collaboration between recreational anglers and scientists, currently records 99,511 P. glauca catch and release captures by recreational anglers from 1953 to 2019. The Catch per Unit Effort (CPUE) derived from these records shows variability on decadal scales, with maxima in the 1950s and 2010s. We examine whether change in CPUE through time is related to large-scale oceanic environmental variability, as indicated by the North Atlantic Oscillation, the Atlantic Multidecadal Variability and freshening events in the eastern subpolar North Atlantic. Generalized Additive Modelling of the catch data indicated that multi-year changes in salinity and the AMV contributed 24.52% to the overall variance in P. glauca captures, demonstrating a previously unrecognised connection between the migrations of an apex predator with abiotic interactions between atmospheric forcing and ocean circulation.

These findings illustrate how complex abiotic interactions affect the migrations of an apex predator and suggest that these links should be accounted for in fisheries models.

IDENTIFYING NURSERY HABITATS IN SUPPORT OF SUSTAINABLE FISHERIES: A CASE STUDY OF THE EUROPEAN SEABASS (DICENTRARCHUS LABRAX)

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Fish nursery habitats are areas of juvenile habitat that are of particularly high quality, and it is important to identify these areas to facilitate more efficient allocation of conservation resources. Four key metrics of habitat quality are density, growth, survival, and contribution to the adult population, yet these are often difficult to measure and are not always used effectively to identify nursery habitats.

A key example of a species which has received Nursery Habitat protection is the European seabass (Dicentrarchus labrax). D. labrax is a slow growing, late maturing fish with a complex life cycle, and an economically important recreational fishery in the British Isles. Since 1990, fishing for bass within selected “nursery” habitats in the UK has been restricted, but the relative quality of these habitats is poorly understood.

This poster will assess how past decisions on nursery closures were made historically and evaluate these decisions in light of existing data. We will consider our current capacity to identify important habitats for juvenile D. labrax in the British Isles, identifying key knowledge gaps and future approaches to better quantify habitat quality through measurements of growth and mortality.

An improved understanding of D. labrax habitat quality will allow more directed data collection for better informed, science-led management that is responsive to natural environmental variability and the impacts of climate change in coastal areas.

METABOLIC STRATEGIES OF ACANTHOPAGRUS SCHLEGELII UNDER THE ACIDIFIED SEAWATER

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Metabolic rate (MR) reflects the total energy used on growth, reproduction, activity, and reaction to environmental changes within a specific period, and is usually measured in calorie consumption or oxygen consumption per unit of time, revealing individual fitness. Resting metabolic rate (RMR) represents the minimum requirement of an animal's energy cost and is one of the measures to evaluate metabolic strategies under various environmental conditions. In responding to climate change, like ocean acidification, marine organisms might adjust their RMR for adaptation or acclimation. To explore the underpinning mechanism, this study reared seabream (Acanthopagrus schlegelii) in a CO2-induced acidified environment and monitored fish's metabolic performance during both short-term (few days) and long-term (months) periods. We found no difference in the RMR under acute CO2 exposition but different trends between control and acidified groups in long-term observation. In either acute or long-term CO2 expositions, seabream maintained a low ammonium excretion rate the same as the control group but raised an acid excretion rate. Based on these results, the CO2 exposure time might be the key to determining the seabream's adjustment of physiological strategies. We demonstrate that RMR could be used as an ecological indicator for acidified environmental issues but a long-term observation of RMR changes is highly recommended. With a better understanding of fish metabolic performance, we could predict the biogeography of marine fishes more accurately in the changing ocean.

MARINE LANDSCAPE COMPOSITION AND BIODIVERSITY DRIVE DISTRIBUTIONS AND GROWTH OF JUVENILE GADOIDS

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The juvenile stages of fish development have a large influence on recruitment success of fish populations. To maximise the benefits to a fish population, nursery habitat needs to support juveniles immediately after settlement and promote growth. These connected patches of habitat form the "nursery seascape”. The study aim was to increase understanding of juvenile gadoid uses of the landscape and its influence on juveniles post-settlement through marine landscape mapping, distribution modelling, and growth calculations for cod (Gadus morhua), haddock (Melanogrammus aeglefinus), and whiting (Merlangius merlangus).

Detailed predictions of marine landscape composition were undertaken using video imagery within the South Arran Marine Protected Area (MPA) in the Clyde estuary on the west of Scotland, from 2013 to 2019. Substratum coverage data were used to produce distribution predictions for the three gadoids. Fish trap surveys were conducted to collect otoliths, age the fish, and estimate growth rates. Marine landscape data were then employed to see how the proportion of substratum coverage affected growth.

Four areas of high demersal and epibenthic biodiversity were identified within the MPA. Despite variations in habitat preference between species, all three species showed a positive relationship with increased biodiversity. Additionally the marine landscape composition influenced juvenile distribution, with the boundaries of substrata patches influencing distribution. Otolith analysis showed cod and whiting growth was influenced by differing substrata, with cod showing a positive relationship to substrata patches with a higher perimeter to area ratio indicating a more complex boundary. This provides important data to inform future management strategies.

CORTISOL IN WILD CAUGHT MARINE FISH

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Understanding the difference in cortisol concentration between different fish varying in life strategies such as benthic, pelagic or flat fish in the natural environment is difficult. Currently, the main way to quantify the effect a stressor has on individuals is through the measurement of cortisol in the blood. However, cortisol concentrations can increase rapidly in as little as 15 minutes due to stress, including handling and transport. Due to the necessity to capture wild fish to measure cortisol baseline levels have not been recorded in wild marine fish. We have employed a novel technique of using muscle samples to determine if we could differentiate underlying cortisol levels between different species of marine fish. Five specimens of 13 species of fish were sampled through trawling in the Celtic Sea. By analyzing cortisol in muscle samples, we reduced some of the problems associated with collecting samples from wild fish, mainly dramatic increases of cortisol in the blood during capture. We hypothesized that species would show different levels of cortisol, depending on the fish's life strategies. Our results suggest that baseline cortisol concentrations may be able to be measured in wild fish using muscle samples, with significant differences in cortisol concentrations being recorded between species.

ECOLOGICAL AND BEHAVIOURAL CONSEQUENCES OF ANTHROPOGENIC NOISE IN SHARK NURSERIES

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Sharks have been shown to display several behavioural responses to sound, suggesting that sound is used in multiple ecological contexts. While our understanding of their hearing ability is limited, it is believed that they are sensitive to low-frequency sounds (<1500 Hz) in the particle motion domain. This overlaps with the characteristics of many anthropogenic noise sources, including motorboats, which have consistent negative effects on many marine taxa. Sharks, however, are yet to have been studied in this capacity. Considering that shark-boat interactions occur in a variety of circumstances, including commercial fishing, provisioning for tourism and depredation, developing this understanding could be used in conservation management. This is particularly true for coastal areas, which sharks use as nursery sites and where human disturbance is concentrated. The Biscayne Bay (Miami, FL) has high levels of boating activity while simultaneously providing nursery habitat for at least three species of shark. Here, we characterise the local soundscape within the parameters of known shark hearing sensitivities and describe temporal trends in biophony and anthrophony. We then integrate these local sound recordings into playback studies, deploying underwater speakers alongside baited remote underwater video systems (BRUVS) to expose sharks in-situ to multiple boat noise treatments. Our results provide an initial insight into if and how sharks detect and respond to boat noise, and are used to develop discussions on why deepening our understanding of shark sensory ecology should be considered in their conservation.

HOW DO FISH MODULATE THEIR SWIMMING TRAJECTORIES WHEN SWIMMING THROUGH CRITICAL FLOW?

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River fragmentation and channelization reduce aquatic biodiversity and impede fish migration. Understanding the behavioural response of specific fish species to hydraulics in critical flow fields is required to adapt river restoration measures to the needs of the fish community. We observed three fish species showing distinct swimming patterns when swimming across the same flow field in a vertical slot fish pass. The analysis of the swimming trajectories using modern machine learning approaches indicated that water discharge, spatial course of the trajectory and trajectory length were the most important variables for discrimination between species trajectories. These insights suggest that fish might choose swimming routes across critical flow corresponding to their individual hydraulic needs when swimming across the vertical slot. Our present study aims to develop a deeper understanding of the relationship between flow conditions and the swimming trajectories of fish. With combining state of the art Particle Image Velocimetry, video tracking, and machine learning, we aim to describe the swimming patterns of rainbow trout (Oncorhynchus mykiss (Walbaum 1792)) in critical flow (i), describe the relationship of the trajectories and the present flow conditions (ii) and predict preferred swimming routes on the flow conditions (iii). This approach will create the basics for evidence-based river restoration accounting for the individual impact of flowing water on the target fish species and provide evidence on how fish adapt their behaviour to critical flow fields.

SALINITY AND THE ATLANTIC WHITEFISH: OSMOREGULATORY PHYSIOLOGY, METABOLISM AND SWIMMING PERFORMANCE

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3. Dalhousie University Aquatron, Canada

4. Fisheries and Oceans Canada

The Atlantic Whitefish (Coregonus huntsmani) is an anadromous fish endemic to Nova Scotia, Canada. Only a single population remains, and it has been effectively isolated from the sea for the past 100 years. Following listing on the Species at Risk Act (SARA) in 2006, Fisheries and Oceans Canada put forward a three-part recovery plan to (1) achieve stability in the current population, (2) expand its current range, and (3) re-establish the anadromous form. To date, none of these goals has been achieved. Restoring anadromy for the Atlantic Whitefish could provide substantial benefits such as increased habitat and food availability. However, much remains unknown about their biology, and anadromy may no longer be a viable life history strategy for the species. The migration model states that it is advantageous for fishes to migrate if the growth and survivorship advantages of utilizing a second habitat, minus the costs of moving between the habitats exceed the advantages of staying in one habitat for the same period. For re-establishment of the anadromous form to be successful, an understanding of how whitefish from the Petite Rivière grow and perform aerobically under conditions that may be experienced during a migration, including salinity change and exhaustive swimming, is necessary. The overarching goal of this study is to assess the effect of osmoregulation and aerobic exercise in saltwater on a land-locked population of Atlantic Whitefish. I will do this by comparing aerobic scope and blood parameters (plasma Na+, K+, Cl+; lactate, glucose, cortisol) across treatment groups of juvenile Atlantic Whitefish acclimated to different salinities.