24th International Pectinid Workshop

New Bedford, Massachusetts, USA

April 22nd–28th, 2026

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Welcome to the 24th International Pectinid Workshop
New Bedford, Massachusetts, USA
April 22-27, 2026

The IPW Organizing Committee is delighted to welcome you to New Bedford, Massachusetts, USA, for the 24th International Pectinid Workshop

As we celebrate 50 years of Scallop Workshops, we hope you will enjoy your time with friends and colleagues. There are three full days of presentations coupled with a dedicated day for industry presentations and discussions. The scallop fishery in New Bedford is the largest in the world, and 1 in every 10 scallops sold worldwide is processed here! There are several social functions on the agenda to encourage informal discussions, and we hope you take advantage of this historical site as you engage in all things 'scallop'!

Thanks to all of the helpers, especially Eric Heupel, artist and web master, Noreen Blaschik for a myriad of tasks, and the generous sponsors who have made this IPW possible.

Kevin Stokesbury, Sandy Shumway, and Jay Parsons

HISTORY OF THE INTERNATIONAL PECTINID WORKSHOP

Celebrating 50 years of International Pectinid Workshops

The International Pectinid Workshop (IPW) has been a biennial event for researchers, students, managers, fishermen, shell collectors, and all others interested in scallops. It began as a small gathering and has grown over the past 50 years to include delegates from more than 30 countries. The biennial pattern was disrupted by Covid, hence only 24 workshops representing 50 years. It remains a traditional symposium with a single main session to facilitate dissemination of research, best practices, and future recommendations. The relaxed atmosphere and social interactions promote interactions between old friends and new, and the themes reflect the main areas of research at the time of the workshops.

1st	1976	Baltimore, Ireland	Dan Minchin
2nd	1978	Brest, France	Jean Claude Dao
3rd	1980	Port Erin, Isle of Man	Andrew Brand
4th	1983	Aberdeen, Scotland	Jim Mason
5th	1985	La Coruna, Spain	Guillermo Roman
6th	1987	Menai Bridge, Wales	Andy Beaumont
7th	1989	Portland, Maine, USA	Sandra Shumway
8th	1991	Cherbourg, France	Pierre Lubet
9th	1993	Nanaimo, Canada	Neil Bourne
10th	1995	Cork, Ireland	Gavin Burnell
11th	1997	La Paz, Mexico	Esteban Felix-Pico
12th	1999	Bergen, Norway	Sissel Andersen/Thorolf Magnesen
13th	2001	Coquimbo, Chile	Elizabeth von Brand/Juan Enrique Illanes
14th	2003	St. Petersburg, Florida, USA	Norm Blake/Don Sweat
15th	2005	Mooloolaba, Australia	Michael Dredge/Peter Duncan
16th	2007	Halifax, Canada	Jay Parsons
17th	2009	Santiago de Compostela, Spain	Luz Perez-Paralle/Jose Luis Sanchez
18th	2011	Qingdao, China	Guofan Zhang
19th	2013	Florianopolis, Brazil	Guilherme Rupp
20th	2015	Galway, Ireland	Julie Maguire/Ellen-Sofie Grefsrud
21st	2017	Portland, Maine, USA	Kevin Stokesbury/Jay Parsons/Sandra Shumway
22nd	2019	Santiago de Compostela, Spain	Luz Perez-Paralle/Jose Sanchez/Antonio Pazos
23rd	2024	Douglas, Isle of Man	Peter Duncan/Isobel Bloor/Andy Brand/ Bryce Stewart
24th	2026	New Bedford, USA	Kevin Stokesbury/Sandra Shumway/Jay Parsons

PROGRAM

THURSDAY April 23, 2026		
8:40-9:20 AM	Mike Dredge (Australia)	**Recruitment variation and climate change - a journey to the unknown**
9:20-9:40 AM	Zhengchen (John) Zang (USA)	**Spatially variable growth responses of Atlantic sea scallops to warming: integrating observational data and dynamic energy budget modeling**
9:40-10:00 AM	Rubao Ji (USA)	**Energy balance controls on Atlantic sea scallop growth**
10:00-10:20 AM	**MORNING BREAK**	
10:20-10:40 AM	Jonathan H. Grabowski (USA)	**Investigating the links between environmental conditions and scallop biology on Georges Bank**
10:40-11:20 AM	Roger Mann (USA)	**Exploring temporal and spatial variation in age structure and growth rates of the scallop, *Placopecten magellanicus***
11:20-11:40 AM	Aisha Abdallah* (UK)	**Seasonality of scallop meat yield and its implications for sustainable scallop fisheries management in the United Kingdom**
11:40 AM -12:00 PM	Alanna Mnich (USA)	**Atlantic sea scallop (*Placopecten magellanicus*) shell oxygen isotope signatures ($\delta^{18}O$) as a proxy for benthic temperature and seasonal growth rates across fishing areas**
12:00-1:30 PM	**LUNCH**	
1:30-1:50 PM	Jessica Harvey (UK)	**Evaluating age-reading agreement of king scallop (*Pecten maximus*) shells collected during stock assessment surveys**
1:50-2:10 PM	Changsheng Chen (USA)	**Cumulative impact of offshore wind energy development on sea scallop larval dispersal and settlement over the U.S. northeast shelf**
2:10-2:30 PM	Esteban Fernando Félix-Pico (Mexico)	**Status of scallop fishery and aquaculture of Baja California Sur, México**
2:30-2:50 PM	Nathan Shivers (USA)	**Utilizing Loggerhead turtle (*Caretta caretta*) foraging patterns to characterize Atlantic sea scallop (*Placopecten magellanicus*) range changes through the Mid-Atlantic Bright**
2:50-3:10 PM	Ellen Sofie Grefsrud (Norway)	**Towards transition from diver harvesting of scallop (*Pecten maximus*) in Norway**
3:10-3:30 PM	**AFTERNOON BREAK**	
3:30-5:00 PM	**New Bedford Fishing Heritage Museum**	

(indicates student)*

FRIDAY April 24, 2026		
8:30-9:10 AM	Deborah R. Hart (USA)	**Long-term history of the US sea scallop fishery and science**
9:10-9:30 AM	Silvia Malagoli (UK)	**A length-based stock assessment of king scallop (*Pecten maximus*) in Cardigan Bay**
9:30-9:50 AM	Tom Leven* (UK)	**Developing spatio-temporal models to derive standardized abundance indices from Welsh scallop fisheries data**
9:50-10:10 AM	Leander Harlow (UK)	**King scallop stock status: bridging the gap between assessments and fisher observations**
10:10-10:30 AM	Andrew D. Corso (USA)	**Evaluating the use of electronic monitoring in the United States Atlantic sea scallop (*Placopecten magellanicus*) fishery**
10:30-11:00 AM	**MORNING BREAK**	
11:00-11:20 AM	Roger Mann (USA)	**A large-scale A.I. benchmark for optical benthic survey automation**
11:20-11:40 AM	Liese A. Siemann (USA)	**Using machine learning to study Atlantic sea scallop distributions and swimming behavior with large optical datasets**
11:40 AM -12:00 PM	Chris Rillahan (USA)	**Survey dredges do not sample well in high-density scallop grounds: new evidence from high-definition cameras**
12:00-1:30 PM	**LUNCH**	
1:30-1:50 PM	Sally A. Roman (USA)	**Development of a GRTS survey approach for the VIMS sea scallop dredge survey**
1:50-2:10 PM	Adam J. Delargy (USA)	**Identification and recruitment success of aggregations of juvenile Atlantic sea scallops**
2:10-2:30 PM	Farrell Davis (USA)	**Demonstrating the long-term efficacy and detectability of large-scale scallop transplanting in southern New England**
2:30-2:50 PM	Stephen P. Geiger (USA)	**Restoration of bay scallops (*Argopecten irradians*) in Florida has allowed maintenance of recreational stocks**
2:50-3:10 PM	Phoebe Jekielek (USA)	**Spat happens: linking wild scallops and aquaculture futures**
3:10-3:30 PM	Dana Morse (USA)	**The Cecil B. DeMille method of building a scallop farming industry in Maine**
3:30-3:50 PM	**AFTERNOON BREAK**	
3:50-5:00 PM	**POSTER SESSION**	
5:00-7:00 PM	**HAPPY HOUR – MOBY DICK BREWING**	

WELCOME TO INDUSTRY DAY

at the

24th International Pectinid Workshop

Whaling Museum, New Bedford, Massachusetts, USA

Saturday, April 25, 2026

International Perspectives on Dwindling Stocks and Growing Management

8:00 AM	**Welcome and Coffee**
8:30 AM	**Introduction** **Scott Lang** (former New Bedford mayor)
8:45-9:30 AM	**New England Perspective** **Kevin Stokesbury** (SMAST/UMASSD)
9:30-10:15 AM	**Australian Perspective** **Michael Dredge** (retired, Queensland Department of Primary Industries)
10:15-10:45 AM	**COFFEE BREAK**
10:45-11:30 AM	**Canadian Perspective** **David Keith** (Department of Fisheries and Oceans)
11:30 AM-12:15 PM	**European Perspective** **Luz Pérez-Parallé** (Universidad de Santiago de Compostela)
12:15-12:45 PM	**PANEL DISCUSSION & GENERAL QUESTIONS**

MONDAY April 27, 2026		
8:30-8:50 AM	Aline Blanchet-Aurigny (France)	**Biological traits, habitat limitations and restoration perspectives of the black scallop (*Mimachlamys varia*) in the Bay of Brest (Finistère, France)**
8:50-9:10 AM	J.A. Sameoto (Canada)	**Quantifying the habitat preference of a scallop dredge fishery: implications for marine spatial planning**
9:10-9:30 AM	Chandler Nelson (USA)	**Predation, natural mortality, and implications for Atlantic sea scallop management**
9:30-9:50 AM	C. Huntsberger (USA)	**What happened to the juvenile scallops? Fishery and population dynamics of the sea scallop fishery in Cobscook Bay, Maine**
9:50-10:10 AM	Max Zavell (USA)	**Carbonate buffering reduces the CO_2 footprint of the U.S. sea scallop fishery**
10:10-10:30 AM	Halle Berger* (USA)	**Shell shock: investigating four decades of ocean acidification and warming on Atlantic sea scallop shells**
10:30-11:00 AM	**MORNING BREAK**	
11:00-11:20 AM	Halle Berger* (USA)	**Modeling the spatiotemporal effects of ocean acidification and warming on Atlantic sea scallop growth to guide adaptive fisheries management**
11:20-11:40 AM	Connor Buckley (USA)	**Adapting to a new paradigm: Atlantic sea scallop management under climate change**
11:40 AM -12:00 PM	Paxton Easton* (USA)	**Assessing the thermal tolerance of Atlantic sea scallop (*Placopecten magellanicus*) early life stages**
12:00-1:30 PM	**LUNCH**	
1:30-1:50 PM	Rebecca Smoak (USA)	**Operationalizing *ScallApp*: A tool to engage the fishing industry in tracking scallop health and reproduction**
1:50-2:10 PM	Bassem Allam (USA)	**Climate change, disease, and the demise of an iconic fishery**
2:10-2:30 PM	Liam Miller* (USA)	**Describing the identity and impacts of shell blister in Atlantic sea scallops**
2:30-2:50 PM	Kyle Brennan (USA)	**The use of probiotics to mitigate Atlantic sea scallop (*Placopecten magellanicus*) mortality following challenge with pathogenic *Vibrio* species**
2:50-3:10 PM	E. Pales Espinosa (USA)	**Evidence for direct transmission of bay scallop Marosporida in *Argopecten irradians***
3:10-3:30 PM	Farrell Davis (USA)	**Fishermen-led injury prevention strategy: ergonomic intervention for scallopers**
3:30-5:00 PM	**CLOSING COMMENTS & AFTERNOON BREAK**	
6:00-7:00 PM	**HAPPY HOUR**	
7:00-11:00 PM	**LOBSTER BANQUET**	

(indicates student)*

ABSTRACTS

(* indicates student)

Seasonality of scallop meat yield and its implications for sustainable scallop fisheries management in the United Kingdom

Aisha Abdallah*[1], Marija Sciberras[1], Karen Alexander[1], Lynda Rodwell[2], and Gwladys Lambert[3]

[1]The Lyell Centre, Heriot-Watt University, Edinburgh, United Kingdom; [2]University of Plymouth, Plymouth, United Kingdom; [3]Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, United Kingdom
aa2354@hw.ac.uk

Seasonal variation in king scallop (*Pecten maximus*) meat yield has implications for harvest timing and the economic returns of fishing operations, yet the drivers and consistency of these patterns across years remain inadequately understood in UK waters. Here, five years (2019–2023) of commercial processor data, integrated with environmental variables, are used to characterise the seasonal and interannual variations in king scallop meat yield across two major UK scallop fishing grounds in the English Channel (ICES areas 7d (east) and 7e (west)).

A pronounced seasonal cycle in meat yield was observed in Area 7d, characterised by spring peaks (April–May) and a prolonged yield decline (July–November). The yield pattern identified July-November as the probable spawning period in Area 7d. In Area 7e, where commercial data were limited to May–September, meat yield peaked in June–July. While meat yield decreased with depth and salinity in Area 7d, current velocity and salinity were significant predictors in Area 7e. There was no suggestion that seasonal closures had a direct influence on yield, as they did not produce significant measurable changes in post-reopening meat yield. Economic analyses which related yield to market prices and fuel consumption as indicators of operational efficiency revealed a weak link between market prices and biological condition, with fuel efficiency declining during low-yield periods. Catch efficiency, however, did not coincide with periods of high meat yield in the English Channel (Area 7d) but instead peaked during the low-yield season, highlighting the role of seasonal closures in reducing fishing pressure when scallops are possibly spawning.

These findings demonstrate that commercial processor data offers a practical approach for monitoring scallop condition at management-relevant scales. The spatiotemporal relationships identified provide an empirical basis for optimising harvest timing around periods of peak meat yield, simultaneously enhancing profitability, reducing fishing pressure during low-yield periods, and supporting the sustainable exploitation of the UK king scallop fisheries.

Climate change, disease, and the demise of an iconic fishery

Bassem Allam[1], Kristen Savastano[1], Sivanna Trainer[1], Guillaume Cacot[1], Harrison Tobi[2], Stephen Tettelbach[2], Emma Green-Beach[3], Debra Barnes[4], Denis Grouzdev[1], and Emmanuelle Pales Espinosa[1]

[1]Stony Brook University, Stony Brook, NY, USA; [2]Cornell Cooperative Extension of Suffolk County, Southold, NY, USA; [3]Martha's Vineyard Shellfish Group, Inc., Martha's Vineyard, MA, USA; [4]Bureau of Shellfisheries, New York State Department of Environmental Conservation, Kings Park, NY, USA
Bassem.Allam@stonybrook.edu

Since 2019, catastrophic mortalities of adult bay scallops (*Argopecten irradians*) have occurred annually throughout the Peconic Bays (east end of Long Island, New York), leading the U.S. Department of Commerce to declare the bay scallop in NY a fishery disaster. These mortality events were associated with annual outbreaks of an apicomplexan parasite dubbed bay scallop *Marosporida* (BSM). The parasite appears to be acquired by juveniles during their first summer and fall but at low intensity, and the disease worsens dramatically during the following summer with significant increase in parasite numbers and activity (cell division), disrupting scallop tissues and decimating adults before they enter the fishery that fall. Field observations showed that disease outbreaks occurred in years consistently displaying positive temperature anomalies (i.e., warmer than average) during spring and early summer.

Laboratory experiments were designed to expose scallops to chronic mild alterations of temperatures simulating slightly warmer (+2.5 ºC) or cooler (-2.5 ºC) than normal spring and summer. Results showed faster development of disease and higher mortality among scallops exposed to the warmer spring, while a 2.5 ºC reduction of temperature yielded nearly 50% less mortality. In parallel, field experiments further underlined the role of temperature in disease dynamics, even though disease development and scallop mortality were relatively low in field sites exposed to most elevated summer temperatures. Altogether, these findings underline the role of temperature alterations in disease development and scallop mortalities, but temperature impact seems to involve complex host-parasite interactions. Specifically, warmer springs appear to induce an early development of the disease and yield higher mortality levels, while summer temperature peaks appear to limit further disease development and, interestingly, ultimately yield reduced mortality levels. On the other hand, scallop genetic background seems to play a major role in scallop resistance to the infection.

Warming in the Gulf of Maine and changes in epibiont assemblages on *Placopecten magellanicus* in Salem Sound, Massachusetts, USA

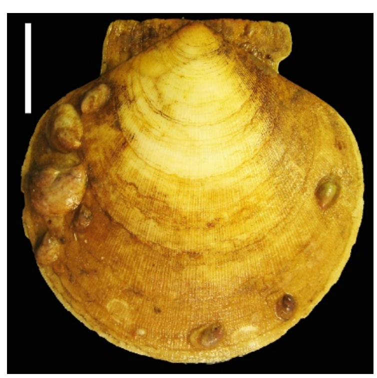
Richard H. Bailey

Northeastern University, Department of Marine and Environmental Sciences, Boston MA, USA
r.bailey@northeastern.edu

Well documented warming of the Gulf of Maine (GOM) over the past several decades has been accompanied by expansion of ranges and growth in numbers of some species. Significant increase of sedentary slipper limpet (*Crepidula fornicata*) and sessile bivalve (*Anomia simplex*) populations on rocky hardgrounds, cobbles, and shells in the southern GOM is attributed to this warming. While *C. fornicata* was always present, its abundance has increased to the point where some subtidal rock substrata are extensively covered to the exclusion of other epifauna, and motile benthic taxa such as *Placopecten magellanicus* increasingly serve as attractive settlement surfaces.

To assess these changes, collections of living *P. magellanicus* were made by SCUBA diving in 2009, 2013, 2016, 2017, and 2019 at the same location in Salem Sound. At depths of 15 -18 m (50 – 60 ft) all scallops observed were collected from cobble and sand bottoms, placed in individual sample bags, and stored on ice. Images of the of the upper (left) and lower (right) valves were taken in the lab on the day of collection. Counts and measurements of attached *C. fornicata* and dimensions of *P. magellanicus* were made on the digital images. From 2009 to 2019 the mean number of *C. fornicata* on *P. magellanicus* individuals increased from 5.6 to 24.5 on valves greater than 80 mm in height; one individual in 2019 had 78 *C. fornicata* attached on right and left valves.

Regession of *P. magellanicus* height vs. *C. fornicata* number for each collection demonstrates similar increase during growth stages. Increased mass of epibionts likely had a detrimental effect on locomotion and feeding efficiency. Interestingly, *C. fornicata* are often more abundant on lower valves, probably due to the lack of algae, sponges, and barnacles typically covering much of the upper valves. Should this infestation of *C. fornicata* expand, it could affect the quality and quantity of harvestable sea scallops at inshore localities. Scallops at offshore sites do not seem to be similarly affected.



Lower (right valves) with *C. fornicata* from 2009 (left) and 2019 (right) illustrating *C. fornicata* increase.

Scale bar = 3 cm.

Modeling the spatiotemporal effects of ocean acidification and warming on Atlantic sea scallop growth to guide adaptive fisheries management

Halle Berger*[1], Samantha Siedlecki[1], Shannon Meseck[2], Emilien Pousse[3], Dvora Hart[4], Felipe Soares[1], Antonie Chute[4], and Catherine Matassa[1]

[1]University of Connecticut, Department of Marine Sciences, Groton, CT, USA; [2]NOAA Northeast Fisheries Science Center Milford Laboratory, Milford, CT, USA; [3]Océanopolis, Brest, France; [4]NOAA Northeast Fisheries Science Center Woods Hole Laboratory, Woods Hole, MA, USA
halle.berger@uconn.edu

Adaptive fisheries management requires reliable predictions of species responses to changing conditions across large-scale environmental gradients. Bioenergetic frameworks, such as Dynamic Energy Budget (DEB) models, link physiological processes to environmental conditions, enabling predictions of organismal growth under changing conditions. This study presents the first large-scale coupling of a DEB model to downscaled regional oceanographic simulations to reveal how environmental stressors emerge at relevant biogeographic, economic, and oceanographic scales. A DEB model was calibrated for the Atlantic sea scallop (*Placopecten magellanicus)* with forcing from a realistic regional ocean model to predict the effects of ocean acidification (OA) and warming on individual growth historically and over the next century. The model reproduced observed historical patterns in scallop age at harvest size and maximum size. At mid-century (2035–2050), scallop growth was projected to increase in most areas except the southern Mid-Atlantic, and OA effects were limited to the deep Gulf of Maine. By the end of the century (2080–2095) under a high emissions scenario, scallops were predicted to grow faster but reach smaller maximum sizes. These results highlight that warming stress is more acute than previously accounted for, particularly in the southern Mid-Atlantic, whereas OA stress preceded warming stress in the north. Together, these emerging stressors compress the spatial range for optimal growth. These findings demonstrate the value of spatially coupled DEB models for informing adaptive fisheries management and provide a foundation for developing short-term forecasting tools to support proactive responses to environmental stress.

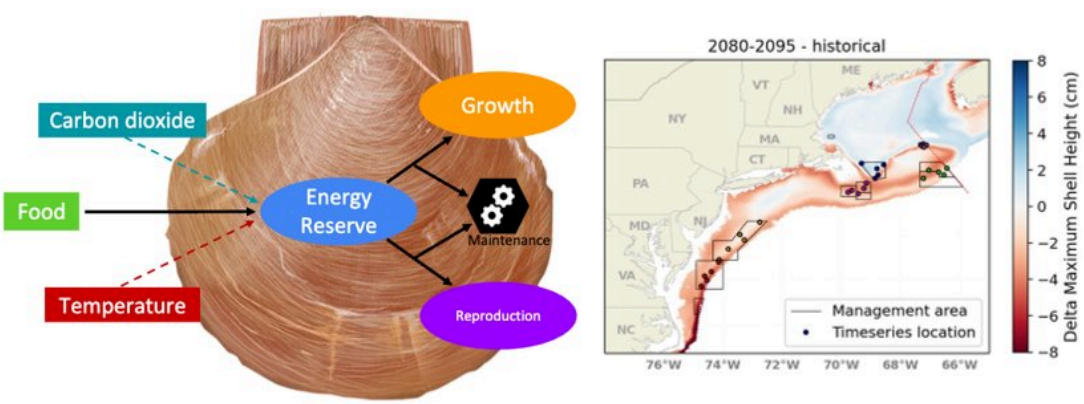


Figure 1 : A simplified schematic of the scallop DEB model (left) and mapped comparison of simulated end-of-century maximum shell height compared to historical (1980-1995; right).

Shell shock: investigating four decades of ocean acidification and warming on Atlantic sea scallop shells

Halle Berger*[1], Samantha Siedlecki[1], Shannon Meseck[2], Dvora Hart[3], Antonie Chute[3], Sarah Roberts[1], Felipe Soares[1], N. David Bethoney[4], and Catherine Matassa[1]

[1]University of Connecticut, Department of Marine Sciences, Groton, CT, USA; [2]NOAA Northeast Fisheries Science Center Milford Laboratory, Milford, CT, USA; [3]NOAA Northeast Fisheries Science Center Woods Hole Laboratory, Woods Hole, MA, USA; [4]Commercial Fisheries Research Foundation, Kingston, RI, USA
halle.berger@uconn.edu

The U.S. Atlantic sea scallop (*Placopecten magellanicus*) fishery is valued at over $350 million annually, making it one of the most valuable fisheries in the country and the largest wild scallop fishery globally; however, managers and industry stakeholders are concerned that changing ocean conditions, including ocean acidification (OA) and warming, will cause future declines in scallop populations and harvest. Like all bivalves, scallops produce hard calcium carbonate shells that protect soft internal tissues. OA hinders calcification by reducing seawater pH and the availability of carbonate ions and can also cause shell dissolution at low calcium carbonate saturation states. Because shells serve as a critical line of defense, the effects of OA on shell production can reduce bivalve growth and survival. These effects may be exacerbated by additional physiological impacts of OA, warming, and other stressors (e.g., predation and shell-boring parasites). To investigate if these stressors have already affected the physical properties of scallop shells, shell thickness was measured for 3,900 archived specimens collected during annual dredge surveys across Georges Bank and the Mid-Atlantic since 1980. Spatiotemporal changes in shell thickness were evaluated, and potential environmental drivers were examined using existing habitat datasets (e.g., substrate type) and output from a high-resolution regional ocean model (e.g., carbonate chemistry, temperature, phytoplankton). Results indicate that scallop shell thickness declined over the past four decades throughout the region, though the rate of decline varied geographically and depended on local environmental conditions. Because thinner shells are likely to be more fragile, these findings suggest scallops may be increasingly susceptible to shell-crushing predators or damage-induced mortality. A better understanding of how spatial variation in habitat type, predator assemblages, and changing ocean conditions overlap and influence scallop shells can inform rotational management and help the fishery adapt to changing conditions.

Biological traits, habitat limitations and restoration perspectives of the black scallop (*Mimachlamys varia*) in the Bay of Brest (Finistère, France)

Aline Blanchet-Aurigny[1], Philippe Cugier[1], Laure Régnier-Brisson[1], Gwenndie Trehou[1], Martin Marzloff[1], Stéphane Pouvreau[2], Jonathan Flye-Sainte-Marie[2], Florian Breton[3], Lucas Pinsivy[2], and Jacques Grall[2]

[1]IFREMER, centre Bretagne, 29280 Plouzané, France ; [2]LEMAR-UMR 6539, IUEM, 29280 Plouzané, France ; [3]Ecloserie du Tinduff, 29470 Plougastel-Daoulas, France
ablanche@ifremer.fr

The black scallop (*Mimachlamys varia*) is an emblematic pectinid of the northeastern Atlantic coast. Since the 1970s its numbers have drastically declined, leading to the closure of its fishery in the Bay of Brest (Finistère, France) in 2018. To reverse the observed stock decline and contribute towards a sustainable fishery, a comprehensive and integrated study was conducted within the framework of the MASCOET project (2019–2025). This study combined *in-situ* monitoring, controlled experiments and modeling to investigate how environmental conditions shape variability in the species' biological and ecological traits. The results highlight, for example, a decrease in growth rates compared to the 1990s, with commercial size (40 mm shell height) now rarely reached before three years of age. This flagging growth rate is mainly driven by temperature and food availability. Growth modeling based on Dynamic Energy Budget theory, together with trophic ecology analyses, further indicate that although fresh phytoplankton is their primary food source, black scallops are able to exploit alternative trophic resources with varying efficiencies. Another key component of the project focused on stock assessment surveys across intertidal and subtidal areas of the Bay of Brest, alongside an evaluation of habitat quality. Using field data, statistical models were developed (Generalized Linear Models and Generalized Additive Models) to characterize spatial distribution patterns (presence/absence and abundance) of the black scallop and to assess potential habitat suitability (e.g., settlement substrates, predators, hydrodynamics, sediment characteristics, primary production). Both empirical estimates and model projections consistently suggest that the subtidal black scallop population currently persists only at marginal densities. Beyond the impact of predation, the hypothesis of a lack of suitable substrates essential for scallop settlement in the infralittoral zone, quickly emerged as one of the main explanations for the decline of the black scallop in the Bay of Brest. Thus, active restoration experiments targeting both the species and its habitat have been underway since 2020 in the Bay of Brest. These efforts are based on the deployment of bio-sourced eco-modules providing settlement substrates and refuges, and have yielded highly encouraging results. This work builds upon a strong local research effort in coastal restoration ecology (e.g., flat oyster reefs and maërl beds), offering a unique opportunity to add the black scallop to the list of species targeted for ecological restoration and management.

The use of probiotics to mitigate Atlantic sea scallop (*Placopecten magellanicus)* mortality following challenge with pathogenic *Vibrio* species

Kyle Brennan*[1], Jennifer Perry[1], Brian Beal[2,3], and Timothy Bowden[1]

[1]University of Maine, School of Food and Agriculture, Orono, ME, USA; [2]University of Maine at Machias, School of Marine Sciences, Machias, ME, USA; [3]Downeast Institute, Beals, ME, USA
Kyle.d.brennan@maine.edu

Atlantic sea scallop (*Placopecten magellanicus*) hatcheries in the state of Maine could reliably produce spat year-round, but struggle with mortality events, presumably induced by pathogenic bacteria. Probiotics have decreased mortality amongst infected bivalve larvae in other industries and could be implemented to decrease larval sea scallop mortality.

Seven probiotic bacteria were identified from research literature and screened *in vitro* for potential benefits to sea scallop larvae. Bacterial competition assays were used to examine the inhibition of a model pathogen, *Vibrio pectenicida*, by probiotic candidates. Challenge trials involving larval sea scallops and *V. pectenicida* (10^5 CFU/mL) were conducted to test the effectiveness of applied probiotics on challenged and non-challenged larvae. The bacterium, *Alteromonas macleodii* (10^5 CFU/mL) increased survival amongst challenged larvae (RPS 46% ± 11) and *Pseudoalteromonas espejiana* (10^4 CFU/mL) amongst non-challenged larvae (RPS 46%). The effect of both promising probiotic treatments on larval sea scallops was tested at hatchery scale with *in vivo* challenge trials. Results showed that *A. macleodii* had a negative impact on larvae growth and survival while *P. espejiana* improved the rate of larval sea scallop growth and development during the late straight hinge to early pediveliger stage, where larvae mortality typically occurs.

This study can improve hatchery protocols through the implementation of the probiotic *P. espejiana*. Future work involves isolating potentially problematic *Pseudomonas* and *Vibrio* species, discovering their associated bacteriophages, and exploring the use of phage therapy in the hatchery. The use of *P. espejiana* in conjunction with phage therapy may prove critical to the success of Atlantic sea scallop hatcheries in Maine.

Adapting to a new paradigm: Atlantic sea scallop management under climate change

Connor Buckley and Jonathon Peros

New England Fishery Management Council, Newburyport, MA, USA
cbuckley@nefmc.org

The Atlantic sea scallop (*Placopecten magellanicus*) fishery is one of the most economically important fisheries in the United States. Management measures in this fishery have consisted of limited entry, effort controls (days-at-sea), gear and crew regulations, and rotational area management. Under rotational area management, vessels are allocated several trips with a set catch limit to specific areas where annual surveys have tracked high densities of scallops of commercial size. While rotational management of the Atlantic sea scallop fishery has been widely regarded as a success, climate change is challenging the tenets of this model. The fishery is facing declining biomass in historically productive areas, and increasing ocean warming and acidification are likely to maintain that trend. Fishery managers and the industry need to adapt to this new paradigm with creative approaches to organize the fishery and promote sustainable harvesting.

Recently, scallop beds in the southern part of the resource have experienced low recruitment, increased incidence of disease and poor meat quality, and substantial mortality events. A review of annual survey data between 1999 and 2023 suggests a successive truncation of the southern and inshore extent of the scallop resource in the Mid-Atlantic. Annual surveys have detected large mortality events, including a die-off of a large year-class of incoming recruits detected in 2022. Recruitment in this region has been below average since 2013, while adult scallops of commercial size are now rarely observed. The fishery has also seen a decline in meat quality and a higher incidence of clappers, while surveys have observed a higher prevalence of nematodes and shell blister disease. This observed increase in natural mortality in the Mid-Atlantic is thought to be driven by changing environmental conditions consistent with climate change.

Within the management process, higher than expected natural mortality in the Mid-Atlantic has led to the recent systematic overestimation of exploitable biomass, and therefore fishing effort, in the region. In 2023, upwards of 99% of scallop fishing effort was directed to Georges Bank, resulting in a concentration of fishing mortality that may lead to localized overfishing. The Atlantic sea scallop fishery is considered the gold standard of U.S. fishery management, but fishery managers need to develop more adaptive approaches to respond to rapidly changing conditions across the range of the resource.

Poster

The SUMUSANO Project: Sustainable multiuse of ocean areas in South Africa and Norway – interactions with fisheries and aquaculture of low trophic resources

Gyda Christophersen[1], Jan Sunde[1], Snorre Bakke[2], Dagny Anastassiou[3], Pia Tuxen[4], Bernadette Brown-Webb[5], Dale Arendse[6], Gavin Maneveldt[7], and Conrad Sparks[8]

[1]Møreforsking, Ålesund, Norway; [2]Norwegian University of Science and Technology, Ålesund, Norway; [3]Ava Ocean Technology, Ålesund, Norway; [4]Marine Stewardship Council, London, UK; [5]Bio Solutiones Technicas, Cape Town, South Africa; [6]Department of Forestry, Fisheries and the Environment, Cape Town, South Africa; [7]University of the Western Cape, Bellville, South Africa; [8]Cape Peninsula University of Technology, Cape Town, South Africa
gyda.christophersen@moreforsking.no

In coastal nations like Norway and South Africa, economic activities tied to the use of ocean resources are an important part of the economy, which have traditionally provided stable, long-term employment opportunities. The development of more human activities in the coastal zone may result in over-exploitation or collapse of fish and invertebrate stocks, pollution and habitat degradation, as well as impacting the socio-ecological systems.

Ocean multiuse refers to the simultaneous utilisation of the ocean for various potentially conflicting and/or complementary purposes such as shipping, fishing, aquaculture, recreation, tourism and energy production. Due to increased pressures on ocean environments and increased demands for marine resources the concept of coexistence has gained significant attention in recent years. The need to find new ways of sustainable ocean management therefore is recognised.

Low trophic species, which include bivalves, echinoderms and seaweeds, are organisms that occupy the lower levels of the marine food chains. In SUMUSANO, interactions of fisheries and aquaculture of low trophic resources will be studied in an area showing signs of environmental stress and in an area where the signs are not yet visible. The SUMUSANO project targets developing scallop and sea cucumber fisheries using new harvesting technologies, and expansion of existing mussel farming into new areas and into integrated aquaculture practices.

Research collaboration between Norway and South Africa started more than 20 years ago, and the projects are financed by both countries. Each project is led by one Norwegian and one South African project leader. Besides academic relationships, the projects have extensive collaboration with participants outside of research, in industry, public sector, and civil society. The current study will report of research activities taking place in Saldanha Bay, Western Cape Province, South Africa, and in Møre og Romsdal county, Western Norway.

Evaluating the use of electronic monitoring in the United States Atlantic sea scallop (*Placopecten magellanicus*) fishery

Andrew D. Corso[1], Justin Potter[1], Michael Enzenauer[2], Shannon Secco Enzenauer[2], Carolina Breakell[2], and Kathryn Carovano[2]

[1]Coonamessett Farm Foundation, East Falmouth, MA, USA; [2]Saltwater Inc., Anchorage, AK, USA
acorso@cfarm.org

Fisheries managers rely on a network of industry-funded observers to collect data on the catch and effort of the Atlantic sea scallop (*Placopecten magellanicus*) fishery to develop management plans; however, observer coverage rates, or the percentage of total fishing trips sampled by observers, are historically inadequate, data quality can be poor, and the program is costly. Electronic monitoring (EM), or the use of video camera systems to virtually monitor fishing trips by recording fishing activity, is an effective tool to reduce costs of catch monitoring, provide a more representative coverage of a fleet than observers, more accurately regulate fishing behaviors, and results can be reviewed to improve data quality.

In 2024, a two-year pilot program was created to evaluate the feasibility of EM systems as a tool to modernize data collection and management in the sea scallop fishery. With six commercial vessels voluntarily participating from New Bedford, MA, Barnegat Light, NJ, and Cape May, NJ, this cross-regional project is the first of its kind for the industry. Camera systems were installed in 2024 and over 62 fishing trips have been recorded to date, amounting to a total of 534 days-at-sea (DAS) with reviewed footage of over 5,000 hauls. The CFF also partnered with the Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) program to outfit each vessel with dredge-mounted sensors that transfer temperature and depth data paired with each tow via Wi-Fi at the dock. Trips are processed and reviewed in the O2Review software at a 100% review rate. Reviewers follow the protocol developed by the Northeast Fishery Observer Program for use in operational EM programs such as the U.S. Northeast Multispecies fishery. Data elements include haul-level variables, information on vessel travel patterns, and catch composition. Review protocols specific to the sea scallop fishery were also incorporated, such as the presence of specific predator species and if high-grading or deckloading occurred.

Reviewers have been able to reliably quantify catch based on basket counts, which is compared against electronic Vessel Trip Reporting for each trip. They have also identified and tracked several deckloading events and can routinely identify priority bycatch species, such as flounders, monkfish, and Atlantic cod. At least one species of flounder was observed in 42 percent of the hauls that have been processed. Feedback from vessels has also been generally positive, with participants highlighting the EM system's ease of use, quality of data, and potential cost-savings. Results will lead to an improved estimation of days-at-sea which could lengthen fishing season duration and increase profitability, incentivizing fishermen to adopt EM; however, further modifications to EM systems, crew training, and additional vessel participants are necessary to move towards fleet-wide implementation and to achieve full replication of all data collected by observers. As decreasing sea scallop biomass, declining profitability, changing ocean conditions, and groundfish bycatch continue to create management challenges, it is important to develop cost-saving, effective EM to preserve these invaluable fisheries.

Demonstrating the long-term efficacy and detectability of large-scale scallop transplanting in southern New England

Farrell Davis, Luisa Garcia, Ryan Munnelly, Natalie Jennings, and Ronald Smolowitz

Coonamessett Farm Foundation, East Falmouth, MA, USA
fdavis@cfarm.org

Atlantic sea scallop (*Placopecten magellanicus*) transplanting has been proposed as a tool to enhance and stabilize the wild fishery, yet its incorporation into management remains debated due to concerns regarding dispersal, mortality, and economic return. In this study, the long-term efficacy of sea scallop transplanting in southern New England was evaluated. Over 500,000 sea scallops were relocated from a harvest site with an average depth of 71 m and transplanted to a site with depths (49 m) more favorable to growth. A spatiotemporal model was developed to track the evolution of the transplanted scallop bed over 417 days post-release. Results demonstrated transplanting successfully established persistent and highly detectable scallop aggregation. Although natural dispersal occurred, expanding the effective footprint of the population by 181%, the core enhancement signal remained stable throughout the study period.

Stocking densities within the transplant site were maintained, and growth was sufficient to offset the effort required for harvest and relocation, indicating positive economic potential. The transplanted scallops did not dissipate into the surrounding environment but instead formed a structured, predictable, and sustained addition to local biomass. These findings provide empirical support for the use of transplanting as an effective management tool, offering a validated approach for establishing retention buffers, stabilizing high-density recruitment events, and enhancing productivity in suitable habitats.

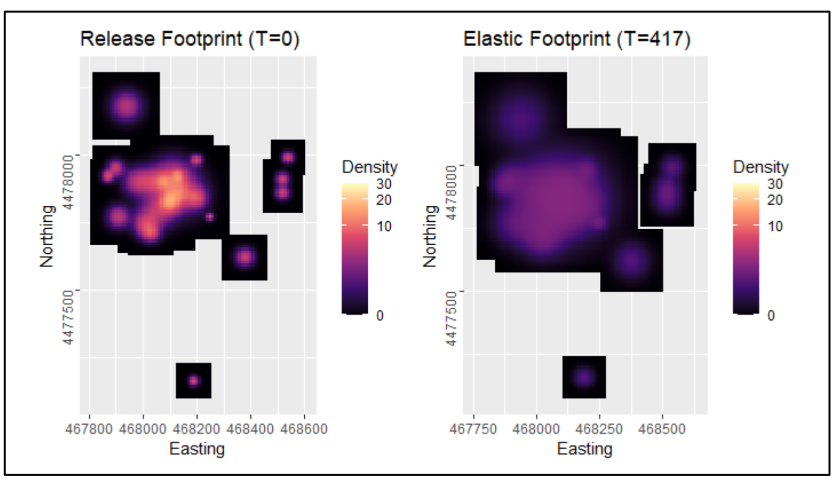


Figure 1: Spatiotemporal redistribution of transplanted sea scallops (T=0 to T=417). This figure illustrates the evolution of the scallop release site from the initial seeding event to the final simulated extent 14 months later.

Identification and recruitment success of aggregations of juvenile Atlantic sea scallops

Adam J. Delargy and Kevin D.E. Stokesbury

University of Massachusetts Dartmouth, New Bedford, MA, USA
adelargy@umassd.edu

Fishery-independent survey indices of juveniles within a population are important for fisheries management and stock assessment. Understanding the success rate and drivers of success of aggregations of semi-sessile, commercially important marine organisms recruiting into the fishable, adult population is highly useful information for fisheries that use spatial management techniques such as rotational areas. Data from a long-term Atlantic sea scallop (*Placopecten magellanicus*) fishery-independent survey were used to identify high-density juvenile aggregations and examine their success rates, and drivers of success, measured as an increase in adult scallop abundance within the vicinity of the juvenile aggregation over the next one to three years. Success rates ranged from 41.5 to 46.0% for two size groups of juvenile scallops. Lower fishing effort was significantly more likely to result in higher success rates for larger sized juveniles, and when a juvenile aggregation successfully increased adult population density then the magnitude of success was significantly higher on gravel substrates for all sizes of juveniles examined. These findings indicate that management could focus rotational closure efforts on gravel substrates in Atlantic sea scallop fisheries. Additionally, this research reinforces the concept that fishery recruitment from juveniles to adults, and the drivers of this, are highly stochastic. Research should continue to focus on obtaining and improving understanding of juvenile survey indices for commercially valuable species.

Recruitment variation and climate change - a journey to the unknown

Mike Dredge

3498 Huon Highway Franklin, 7113 Tasmania, Australia
mike.dredge47@gmail.com

While there is widespread concern about the potential impact of climate change on scallop fisheries, the number of case studies linking scallop populations and climate change is limited. One undocumented example is the New Caledonian saucer scallop (*Ylistrum balloti*) population, which was first identified in the late 1970s. It has been the subject of nine fishery-independent distribution and abundance surveys and three attempts to develop and maintain a commercial fishery between 1985 and 2019. Estimated population sizes from surveys and population densities based on catch rate data have varied widely but collapsed to negligible levels between 2016 and 2019. The New Caledonian *Y. balloti* population exists in a near-closed lagoon. Recruitment variation is therefore unlikely to be driven by variation in oceanic currents. The intermittent fisheries have taken a small proportion of available biomass – about 5% in the 2016 fishery – and are unlikely to have impacted on subsequent recruitment. Variation in population size is more likely to be driven by abiotic rather than biotic factors.

Surface water temperature data from 1985-2022, as measured by the NOAA High Res Blended Analysis of Daily SST data set do not show dramatic changes but are too crowded to apply to the limited data on *Y. balloti* in the Grande Lagon. The summarised data set given by the International Marine Heatwave International Working Group (IMHIWG) offers more insight about possible temperature-related impacts on saucer scallop recruitment.

The IMHIWG defines a Marine Hot Water (MHW) event as when the sea surface temperature in a given location is in the top 10% of temperatures ever recorded during that time of year for at least 5 straight days. Marine Cold Systems (MCS) events are defined in a similar manner. The MHW / MCS data for the Grande Lagon show that MCS events took place on 51 occasions between June 1985 and December 1997 with 9 such MHW events in this period. There were 52 MHW events and 7 MCS events between Jan 1998 and Dec 2019.

If the data set on MHW and MCS is linked to a qualitative summary of saucer scallop abundance there is a suggestion that scallop populations remain at a high level following MCS events but decline after MHW events.

There is a clear and well documented example of short-term water temperature change impacting on the Shark Bay (Western Australia) *Y. balloti* population in 2020, when a mass of warm water flowed from the Arafura Sea along the Western Australian coast in 2010. This water mass had a core temperature approximately 4°C above normal and was linked to massive population reductions in crabs, fish, shrimps, abalone, as well as scallops. The *Y. balloti* population recovered from a > 90% reduction to support commercial fishing after a four-year recovery period.

Poster

Interdisciplinary stock identification of U.S. Atlantic sea scallops (*Placopecten magellanicus*)

Paxton Easton*, Max Zavell, Geoff Cowles, and Steven Cadrin

University of Massachusetts Dartmouth, School for Marine Science and Technology, New Bedford, MA, USA
peaston@umassd.edu

Accurate stock identification is critical for sustainable management of Atlantic sea scallops (*Placopecten magellanicus*), yet the environmental and genetic drivers of marked regional differences across the U.S. northwest Atlantic shelf remain unclear. Synthesizing evidence from life history, morphometrics, environmental indicators, genetics, and larval dispersal modeling, this review assesses population structure, connectivity, and the appropriateness of the current single-stock framework in U.S. waters. Regional variation in growth, morphology, productivity, and parasite loads between Georges Bank and the Mid-Atlantic appears environmentally structured rather than due to reproductive isolation, as genetic studies show strong differentiation between U.S. and Canada but no clear structure within the U.S. stock. Larval dispersal modeling indicates oceanographic processes mediate connectivity, with retention on Georges Bank and variable exchange with Southern New England and the Mid-Atlantic Bight, though results are sensitive to assumptions about larval behavior and physical forcing. Overall, the evidence supports managing U.S. sea scallops as a single metapopulation with spatially explicit sub-management rather than as multiple independent genetic stocks. Priority needs include expanded genomic sampling, validation of larval behaviors, climate-informed connectivity modeling, and finer-scale studies, particularly in the Gulf of Maine and eastern Georges Bank, to enable adaptive, climate-resilient management.

Assessing the thermal tolerance of Atlantic sea scallop (*Placopecten magellanicus*) early life stages

Paxton Easton*[1], Tessa Houston[2], Brian F. Beal[2,3], Geoff Cowles[1], Kevin D.E. Stokesbury[1], and Max D. Zavell[1]

[1]University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, New Bedford, MA, USA; [2]Downeast Institute, Beals, ME, USA; [3]University of Maine at Machias, Machias, ME, USA
peaston@umassd.edu

Ocean warming affects numerous traits in early life history stages of invertebrates and fishes, which may reduce recruitment and harvestable biomass. A prime example is the Atlantic sea scallop (*Placopecten magellanicus*), which supports one of the most valuable fisheries in the northwest Atlantic with annual landings over $350 million USD. This fishery may be at risk due to its high sensitivity to projected future ocean conditions; prior studies have quantified decreases in recruitment, growth, biomass and population distribution shifts across the Mid-Atlantic Bight (MAB). Few studies, however, examine the response of planktonic larvae to future conditions, resulting in a critical knowledge gap on the thermal tolerance for larvae. To address this, fully factorial experiments were conducted to evaluate the physiological response of larvae across a range of current and future environmentally relevant temperatures. This study provides empirical physiological data which can be incorporated into bio-physical model parameterizations and used to improve predictions of future population dynamics in the MAB under expected temperature escalations. The results of this study will help sustain stock biomass and aid in adaptive fisheries management under future temperature projections.

Status of scallop fishery and aquaculture of Baja California Sur, México

Esteban Fernando Félix-Pico[1], José Manuel Mazón-Suastegui[2]**,** and Mauricio Ramírez-Rodríguez[1]

[1]Interdisciplinary Center for Marine Sciences, National Polytechnic Institute (CICIMAR-IPN), La Paz, Baja California Sur, Mexico; [2]Centro de Investigaciones Biológicas del Noroeste, S.C. (CIBNOR), La Paz, Baja California Sur, Mexico
efelix@ipn.mx

The Pacific calico scallop (*Argopecten ventricosus*) and the giant lion's paw scallop (*Nodipecten subnodosus*) have both been subject to intense overexploitation, resulting in long-term restrictions on the latter species since 2012. Although the precise causes of the collapse remain unclear, they likely involve a combination of overfishing, environmental variability, and possible disease outbreaks. Temperature anomalies appear to be associated with catch fluctuations, while widespread poaching has further contributed to stock declines; however, the role of specific pathogens and their associated diseases in shaping the population dynamics of both native species remains unknown.

The development of scallop aquaculture in Mexico has been characterized by discontinuous progress, yet it reflects sustained efforts by government agencies and producers. Over the past five decades, interest in scallop culture has steadily increased. Early initiatives focused on wild spat collection, whereas more recent advances have led to the adoption of suspension-culture methods adapted to coastal lagoon environments, including cages, pearl nets, and lantern nets. Larval rearing techniques are now relatively well established, and triploid lines of both species are currently being developed to evaluate the effects of relative sterility on production traits and enhance harvest performance. Hatchery seed production began in 1988 and reached approximately 25 million juveniles annually between 1994 and 2003. At present, two hatcheries remain in operation, producing between 2 and 3 million spats per year. Over the past 15 years, the number of farmers has increased to a maximum of 67, with annual production ranging from 180 to 1,215 tons (live weight).

Poster

When cold years break the pattern: temperature effects on seasonal scallop meat weight trends

Luisa Garcia, Natalie Jennings, Liese Siemann, and Farrell Davis

Coonamessett Farm Foundation, East Falmouth, MA, USA
lgarcia@cfarm.org

Seasonal increases in scallop meat weight are a key driver of both population productivity and fishery value, yet these patterns can vary among years. Using the seasonal survey data from Georges Bank, interannual differences in seasonal meat-weight patterns were examined to determine whether they could be explained by variation in bottom temperature. Generalized linear mixed models were used to predict scallop meat weight as a function of shell height, month, year, depth, and bottom temperature, focusing on model-based predictions for standardized 120-mm scallop at a range of depths.

Bottom temperature exhibited strong seasonal structure but also pronounced interannual variability, with 2024 characterized by anomalously cold conditions during late winter through early summer. Model predictions revealed a consistent early-summer (June) peak in meat weight in most years; however, this peak was notably absent in 2024. Across temperature scenarios, seasonal meat-weight curves differed in shape, with lower-temperature conditions associated with reduced meat weights and less pronounced changes across seasons, while higher-temperature conditions were associated with more distinct seasonal increases.

These results suggest that bottom temperature plays an important role in modulating the seasonal peak in scallop meat weight, offering insights into interannual variability in scallop condition and the interpretation of survey data. Ongoing seasonal surveys of scallops will continue to be critical for anticipating fishery performance under changing environmental conditions.

Poster

Epibiont assemblages on Atlantic sea scallops and their relationship to meat yield on Georges Bank

Luisa Garcia, Natalie Jennings, Liese Siemann, Ryan Munnely, and Farrell Davis

Coonamessett Farm Foundation, East Falmouth, MA, USA
lgarcia@cfarm.org

Atlantic sea scallops (*Placopecten magellanicus*) provide essential hard substrate for sessile organisms to settle on, enhancing local diversity. The composition and growth of these sea scallop epibionts may reflect differences in benthic productivity or influence scallop physiology, condition, and meat yield. As part of a seasonal Research Set-Aside survey conducted from August 2023 through June 2024 on eastern Georges Bank, epibiont abundance and coverage were quantified on inner and outer scallop valves to evaluate seasonal patterns in assemblage structure and species-specific relationships with scallop meat weight. Epibiont counts and percent coverage were recorded separately for the interior and exterior of the upper valve, and lower valve surfaces. Scallop biological data (shell height, meat weight, and meat color) were collected concurrently.

Epibionts were most abundant and diverse on the upper valve and least abundant on the lower inside valve. Barnacles (*Balanus* sp.) dominated upper valve coverage, while spionid polychaete worms (*Polydora* sp.) were the most prevalent epibiont within valve interiors. Generalized additive mixed models were used to estimate scallop meat weight as a function of shell height, depth, survey month, meat color and epibiont density. Model results indicated that scallop meat weight declined with increasing *Polydora* density inside the shell and with higher blue mussel (*Mytilus edulis*) densities on the upper valve. Other epibiont groups did not exhibit significant relationships with meat weight.

The observed negative association between *Polydora* sp. infestation and meat weight is consistent with known impacts of shell-boring polychaetes on scallop health, including shell damage, mud blister formation, and impaired or compromised adductor muscle function. Similarly, high mussel densities may negatively impact scallop condition through physical impairment and competition for food resources, particularly where dense mussel aggregations co-occur with scallop beds. These findings suggest that epibiont assemblage composition, rather than total epibiont load, could play an important role in influencing scallop meat yield. Incorporating epibiont dynamics into seasonal monitoring programs may improve understanding of spatial and temporal variability in scallop condition and inform assessments of scallop productivity on Georges Bank.

Restoration of bay scallops (*Argopecten irradians*) in Florida has allowed maintenance of recreational stocks

Stephen P. Geiger, Erica A. Levine, and Kelly M. Williams

Marine Shellfish Biology, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Florida, USA
Stephen.Geiger@MyFWC.com

The commercial fisheries for bay scallops in Florida peaked in the 1950s then collapsed by 1980, after which seasonal closures were implemented. Commercial harvest was banned in 1994, but two of the three core populations remained open to a limited recreational harvest. Implementation of a monitoring program and extensive restoration of the core population, from 1998-2003 allowed for the re-opening of recreational harvest in Crystal River and Homosassa. That population remains open after two decades.

Following the Deepwater Horizon oil spill in 2010, Natural Resource Damage Assessment funds were devoted to areas directly impacted by oil, including seven western panhandle counties, Escambia through Franklin. Bay scallop population density, reproduction, and water quality, were evaluated in Pensacola Bay (PB), Choctawhatchee Bay (CB), St. Andrew Bay (SA), St. Joseph Bay (SJB), and the St. George Sound (SG) portion of Apalachicola Bay from 2015-2025.

Salinities in CB were found to be too fresh during most years to sustain scallops. Ephemeral populations appear in some years in PB, and modest populations persisted in SA, with harvestable populations in SJ and SG. Unfortunately, SJ, a historically resilient population, began to have recruitment failure (2012-2015) coincident with high mortality from a red tide in 2015. Fish and Wildlife Conservation Commission managers and biologists worked with local community leaders to develop a plan to reinvigorate the population. Restoration included a reduced harvest season, stock enhancement using natural spat, locally harvested scallops, and hatchery production coupled with volunteer participation led to several productive, though non-consecutive, harvest seasons.

The future of the bay scallop meta-population in Florida is uncertain, especially given the end of federal funding, increased harvest pressure on core populations, loss of peripheral populations and seagrass habitat, and intense hurricanes. There is a risk from both red tides of *Karenia brevis* (which kill bay scallops) as well as other harmful algal blooms (*Pyrodinium bahamense* and *Pseudo-nitzschia* spp.) which can render bay scallops toxic to human consumption.

Investigating the links between environmental conditions and scallop biology on Georges Bank

Jonathan H. Grabowski[1], Louise Cameron[2], Jennie Rheuban[2], Dylan Titmuss[2], and Zhaohui Aleck Wang[2]

[1]Northeastern University, Department of Marine and Environmental Sciences, Marine Science Center, Nahant, MA, USA; [2]Woods Hole Oceanographic Institution, Department of Marine Chemistry and Geochemistry, Woods Hole, MA, USA
j.grabowski@northeastern.edu

The northwest Atlantic is undergoing rapid change, with the Gulf of Maine experiencing sea-surface temperature warming between 1982 and 2013 that was three times the rate of the global average. Given the high economic value of the sea scallop fishery and its vulnerability to warming and acidification, efforts to understand better how they affect its growth and survival are merited. Oceanographic condition and scallop biology surveys were conducted on Georges Bank in the spring and fall of 2021. These surveys explored links between current oceanographic conditions and several scallop biological metrics such as shell weight, meat weight, and condition. In addition, future oceanographic conditions were projected to examine potential impacts on the scallop fishery. This research suggests that the shell dissolution and impacts on scallops already being observed on Georges Bank will likely worsen with future ocean acidification, thereby significantly impacting the fishery.

Towards transition from diver harvesting of scallop (*Pecten maximus*) in Norway

Ellen Sofie Grefsrud[1] and Gyda Christophersen[2]

[1]Institute of Marine Research, Bergen, Norway; [2]Møreforsking, Ålesund, Norway
ellen.sofie.grefsrud@hi.no; gyda.christophersen@moreforsking.no

It is increased interest in exploiting scallops both commercially and recreationally in Norway. The commercial harvesting of scallops (*Pecten maximus*) is traditionally diver based as in-shore dredging is banned. From 2024, scallop diving no longer has partial exemptions from the Norwegian Working Environment Act. This means that stricter regulation of working hours results in less economic sustainability for the hand harvesting industry. According to the main commercial actors, it is believed that the strict regulations will force the diver-based fishery to be phased out within the next years. Scientific diving, which is an essential tool when monitoring scallop populations, is also covered by this legislation.

Due to the changes in diver regulations the use of new technology, such as specially designed remotely operated vehicles (ROV), has been developed to replace or supplement traditional harvesting. The introduction of new harvesting technologies may face several challenges, including increased fishing pressure and environmental impact. Today's diver-based scallop fishery is considered sustainable due to the low impact, both on the scallop populations (rotational fishery) and the ecosystem (no bycatch). To meet this standard, tech-developers have focused on vehicles that are less invasive than scallop dredges aiming to harvest scallops only, leaving the bottom habitats intact.

Here, the diver-based fishery and results from a regional development project involving researchers, and technology and scallop industry partners will be presented. The main objective was to investigate whether the use of the new harvesting system also could be suitable for use in research and monitoring. Further, biological questions about populations were explored to provide knowledge-based advice to management.

Key issues were whether harvesting with ROV differs from harvesting with divers in terms of range and time consumption, whether technical modification can enable the collection of smaller individuals and recruits, and whether the technology can supplement the use of scientific divers in mapping and monitoring work. The ROV is in the process of being implemented in commercial harvesting, and the technology so far appears to be gentle on both target species and bycatch.

King scallop stock status: bridging the gap between assessments and fisher observations

Leander Harlow and Beth Mouat

UHI Shetland, Scalloway, Shetland, United Kingdom
leander.Harlow@uhi.ac.uk

Since 2000, the Shetland Shellfish Management Organisation (SSMO) has managed shellfish fisheries under a Regulating Order that devolves authority to establish management regimes within the six-nautical-mile zone around Shetland. The Board of Directors includes active members of the fishing fleet, local shellfish processors, and independent directors from the local council. As a result, management is strongly supported locally, and the relationships between science, management and industry are closely aligned.

Through routine biological sampling and fishery-dependent data collection, various stock assessment methods have been examined. Currently, landings per unit effort (LPUE), obtained from daily fishers' logbooks, underpin the annual stock assessment and serve as a proxy for stock abundance. These indices are embedded within predefined harvest control rules, based on historical trends in relation to agreed target and limit reference points. Earlier assessments using virtual population analysis (VPA) provided the basis for management reference points and broadly reflected observed fisheries trends.

More recently, collaborative work with the Marine Directorate has applied a state-space assessment model (SAM) to gain deeper insights into the population dynamics of Shetland scallops. Over time, SAM could supersede existing LPUE-based harvest control rules by producing biologically grounded reference points derived from spawning stock biomass (SSB), including a precautionary biomass reference point (Bpa) and F0.1 as a proxy for FMSY.

The latest assessment results suggest a systematic increase in stock status, with both spawning stock biomass and recruitment rising since 2000. Although recruitment has varied throughout the time series, the overall trend remains positive, leading to steadily increasing estimates of SSB. Conversely, some fishers have reported that increased effort is required to maintain landings, indicating reduced stock availability at the scale of fishing operations. Further investigation is necessary to reconcile these perspectives and enhance understanding of how assessment results relate to fisher experience, to support ongoing effective management of king scallops in Shetland.

Long-term history of the US sea scallop fishery and fishery science

Deborah R. Hart

NOAA Northeast Fisheries Science Center, Woods Hole, MA, USA
Deborah.Hart@noaa.gov

The US sea scallop fishery began in the Gulf of Maine in the late 1800s. It slowly expanded offshore between 1910-1940 with improved technology, including more powerful engines, availability of ice, and the development of the New Bedford-style scallop dredge. The fishery expanded after World War II and remained relatively stable and prosperous until the early 1960s. Large year classes in the early 1960s increased catch rates and landings at first, but also attracted new entrants into the fishery that induced increased fishing pressure on the scallop populations once the large year classes had been fished out. This pattern repeated itself until the populations were severely overfished by the mid-1990s.

The fishery was converted from open to limited access in 1994, with a fixed number of permits, each of which had a limited number of days that they could fish, as well as gear and crew size restrictions. Additionally, three large portions of Georges Bank and Nantucket Shoals were closed to all scallop and groundfish fishing. The closures had the strongest and most immediate effects; biomass in these areas increased 3 times by 1996, over 10 times by 1998 and 25 times by 2005. Two areas were closed for three years in the Mid-Atlantic in 1998, and the biomass in one of these areas also rapidly increased. Most of these closed areas were eventually reopened to fishing on a rotational basis, resulting in substantial landings. The effects of the other management measures on areas outside the closures was more subtle, but not less important, as catch rates increased by the early 2000s to 3-5 times that in 1994. The combined effects of these measures resulted in a highly prosperous fishery in the first two decades of the 21st century, with landings most years higher than the maximum from the 20th century. Biomass also remained high through most of this time period, fueled by strong recruitment including several large year classes.

The fishery has declined in recent years, mainly due to reduced productivity in the Mid-Atlantic because of increasing water temperatures. Other environmental factors such as increased predation and disease incidence have also contributed to the decline.

Scientific advances include the establishment of the dredge, drop camera and towed camera (Habcam) surveys, estimation of dredge efficiency, and understanding of life history processes such as growth. More theoretical work includes stock assessment modeling, and the development of fisheries theory applicable to rotational fishing and when the resource and fishing are heterogeneous in space.

Combining automated and manual annotations of underwater imagery to obtain unbiased estimates of abundance and biomass

Deborah R. Hart[1]**,** Jeremy Jenrette[1], Jui-Han Chang[1], and M. Conor McManus[2]

[1]NOAA Northeast Fisheries Science Center, Woods Hole, MA, USA; [2]NOAA Northeast Fisheries Science Center, Narragansett, RI, USA
Deborah.Hart@noaa.gov

The Northeast Fisheries Science Center has been collecting millions of seafloor images each year from the Habcam V4 vehicle, and more recently, autonomous underwater vehicles, as part of its annual sea scallop survey. Typically, only about 2% of these images (80,000 to 100,000 per year) are manually annotated. This situation can greatly benefit from computer vision software that can automatically annotate the images; however, automated annotations are not always correct so that estimates based on raw counts from such annotations are likely biased. Methods will be presented that combine manual and automated annotations using Generalized Additive Models (GAM) to obtain unbiased estimates of abundance and biomass from these data.

Evaluating age-reading agreement of king scallop (*Pecten maximus*) shells collected during stock assessment surveys

Jessica Harvey, Gwladys Lambert, Jenni Fincham, Idongesit Ikpewe, and Daniel Clarke

Cefas – The Centre for Environment, Fisheries and Aquaculture Science, UK
Jessica.harvey@cefas.gov.uk

Samples of ageing scallop shells have been collected since 2017 at the start of the stock assessment time series in English waters. Although these data are not currently incorporated into assessment models, we intend to integrate them into frameworks capable of utilising age information; however, ageing scallop shells present well-known challenges: check marks, variable growth patterns, shell condition, and differences in reader interpretation all contribute to uncertainty.

Accurate age determination is fundamental to producing robust stock assessments for the king scallop, underpinning key biological parameters such as growth, mortality and recruitment strength. Yet the reliability of these metrics depends on consistent, repeatable age-reading. Variability, both within and between readers and across survey areas, can introduce uncertainty that is rarely quantified and often overlooked. Despite the national importance of scallop fisheries, agreement levels and associated error rates remain poorly characterised, highlighting the need for review.

This study evaluates inter-reader agreement using age data from multiple survey areas. Agreement is assessed using established metrics including coefficient of variation, percentage agreement and age-bias analyses. Differences between survey areas are examined to identify % discrepancies and age classes most prone to disagreement. These insights will inform the development of updated Standard Operating Procedures (SOP), with the overarching aim of improving the consistency and reliability of scallop ageing.

Preliminary analyses indicate notable variation in ageing accuracy among regions and readers, with certain age classes showing consistently lower agreement. These quantified error rates provide a benchmark for comparison and training. Establishing clear agreement levels and formalising SOP will enhance QA/QC processes, strengthen confidence in age-based indicators and ultimately support more accurate and defensible scallop stock assessments.

What happened to the juvenile scallops? Fishery and population dynamics of the sea scallop fishery in Cobscook Bay, Maine

Carl Huntsberger and Melissa Smith

Maine Department of Marine Resources, West Boothbay Harbor, Maine, USA
Carlton.j.huntsberger@maine.gov

The sea scallop (*Placopecten magellanicus*) fishery is a vital component in supporting coastal Maine economies in the winter months. The fishery in Maine nearly collapsed in 2005, which sparked development of the conservation management measures currently in place. In the past decade the fishery has recovered, landing approximately a million pounds of abductor muscles each year. Despite this recovery, the density of juvenile scallops has remained at low levels since 2020 with a continued decline in the density of harvestable scallops since 2021.

Cobscook Bay is a unique scallop habitat in eastern Maine along the border with New Brunswick, Canada. The bay is approximately 90 km^2 characterized by extreme tides, with large areas of ideal scallop habitat. This bay is managed as its own discrete area with the annual harvest dependent upon management actions. These management decisions rely heavily upon data supplied by the fisheries-independent scallop survey in this region; a preseason survey is conducted each fall, then these survey sites are resampled as the season progresses to monitor fishing pressure.

Initial evaluation of the scallop densities from these surveys indicated that prior to 2021 there were high densities of juvenile scallops and a strong recovery of the harvestable density each season. Since 2021 the density of juvenile scallops has been low, with a consistent decline in the legal density and less recovery in subsequent seasons. This work will examine these trends in relation to management actions and other factors.

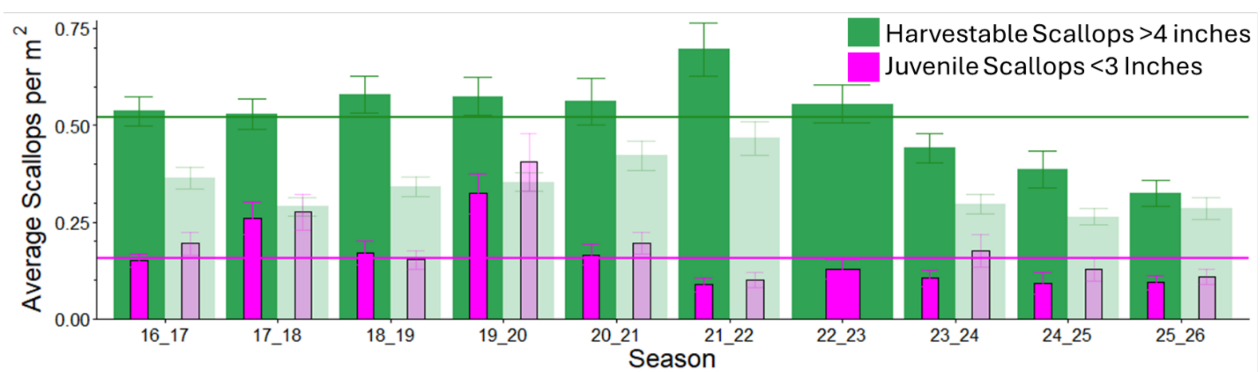


Figure 1: Average density for juvenile (pink) and harvestable (green) scallops for each preseason (dark) and final (right) Cobscook Bay, Maine scallop survey. Vertical lines represent the timeseries preseason average. Scallops in the 3 - 4 inch size bin are not included in this figure.

Spat happens: linking wild scallops and aquaculture futures

Phoebe Jekielek[1,4], Carla Guenther[2], Caitlin Cleaver[3], Madison Maier[4], and Ruby Krasnow[1]

[1]University of Maine Darling Marine Center, Walpole, ME, USA; [2]Maine Center for Coastal Fisheries, Stonington, ME, USA; [3]Colby College, Waterville, ME, USA; [4]Hurricane Island Center for Science and Leadership, Rockland, ME, USA
Phoebe.jekielek@maine.edu

The sustainability of lucrative wild capture scallop fisheries at both state and federal levels in the United States is uncertain, leading to an increase in shellfish and macroalgae aquaculture production, especially in Maine. The inshore Maine sea scallop fishery consists of highly productive shallow aggregations managed in three zones along the coast and utilizes combinations of fishing effort controls and spatial management, providing a winter income to upwards of 300 owner-operator fishing businesses. Sea scallop aquaculture is developing alongside this valuable winter fishery and efforts are underway to understand how sea scallop farming could complement the wild product in the marketplace; however, scallop culture is entirely dependent on successful reproduction and spat supply in the wild population as hatchery technology remains in an experimental stage.

Successful recruitment of scallop spat from its planktonic larval phase to benthic settlement represents a bottleneck to wild fishery sustainability and aquaculture compatibility. To better understand these dynamics, this team, in collaboration with scallop harvesters and farmers, has conducted three years of spat collection to evaluate the spatial variability in spat distribution from inshore to offshore along the coast of Maine (Figure 1). Preliminary data from the first three years of spat collection show high spatial variability in spat counts, with the greatest abundances in each year occurring in the Jericho/Blue Hill Bay area. Spatial variability in spat count estimates is also evident within each transect from inshore to offshore, where the drivers of these patterns have yet to be determined in large part, due to the high variability in measured environmental conditions at each site, each year. If completed, this five-year dataset will be the most comprehensive larval dataset for sea scallops in the United States.

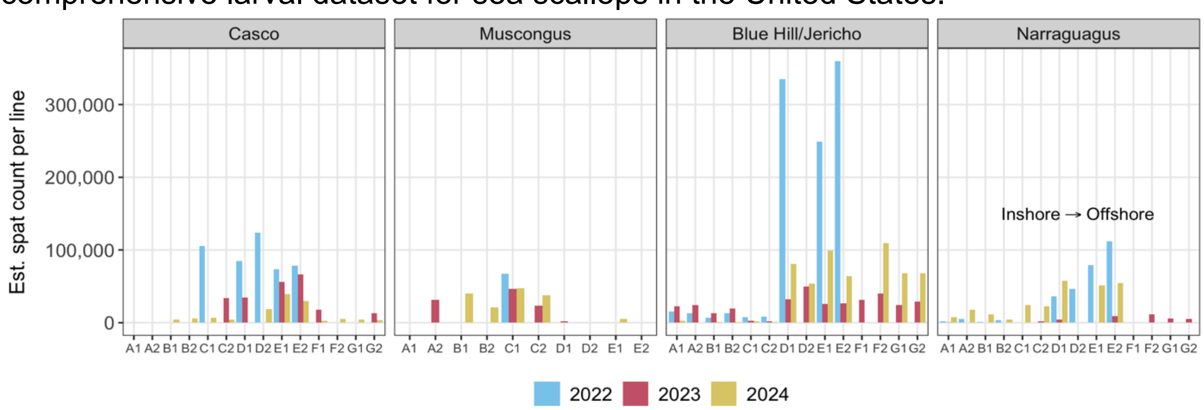


Figure 1: Estimated spat counts at each site within transects in each year of spat collection.

Energy balance controls on Atlantic sea scallop growth

Rubao Ji[1] and Zhengchen Zang[2]

[1]Woods Hole Oceanographic Institution, Woods Hole, MA, USA; [2]Louisiana Universities Marine Consortium, Houma, LA, USA
rji@whoi.edu

Atlantic sea scallops (*Placopecten magellanicus*) support one of the most valuable U.S. fisheries, yet their growth and size structure are increasingly shaped by ocean warming interacting with food supply. This study synthesized a sequence of model–data studies to link environmental forcing, energy balance, and population outcomes across the northeast U.S. Shelf. Using a scope-for-growth modeling approach, this study showed that food availability sets the baseline energetic capacity for scallop growth, but only within a thermally permissible window. When temperatures exceed physiological optima, warming drives net energy deficits that suppress growth regardless of food supply, with impacts that intensify with scallop size. Analysis of observed size structure variability reveals that thermal stress dominates shallow habitats, while fishing mortality remains more important in deeper regions. Together, these results highlight how spatial heterogeneity in temperature and food supply governs scallop growth, size structure, and resilience in a changing ocean.

Drivers of the rapid decline in the Canadian Georges Bank sea scallop stock

David Keith, Freya Keyser, and Tricia Pearo-Drew

Fisheries and Oceans Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada
david.keith@dfo-mpo.gc.ca

Canadian Sea Scallop fishery landings in the Martimes Region grew rapidly in the late 1990s. This was related to an increase in the productivity of the stocks during this period throughout much of the sea scallop range. The offshore component of the Canadian Sea Scallop fishery lands upwards of 75% of the scallop in Canada, with most of this fishery occurring on Georges Bank, where the average landings were more than 4800 tonnes between 1999 and 2022.

In 2023, a widespread increase in scallop condition was observed both on Georges Bank and throughout the Maritimes Region. On Georges Bank this was followed by a rapid increase in natural mortality and a dramatic decline in scallop condition in 2024. While conditions recovered in 2025, natural mortality remained high. As a result of these rapid swings in productivity, the scallop stock has declined by upwards of 75% between 2023 to 2025.

Here, the influence of natural mortality, growth, recruitment, and fishing mortality on stock dynamics will be quantified. How these components have contributed to the rapid changes in stock biomass in recent years and discuss potential drivers of these changes will be explored. Results highlight the challenges of managing stocks in periods with rapid and unpredictable changes in productivity.

Fishermen-led injury prevention strategy: ergonomic intervention for scallopers

Jeong Ho Kim[1], **Farrell Davis**[2], Yinong Chen[3], Liane Hirabayashi[4], Pam Milkovich[4], Leigh McCue-Weil[5], and Julie Sorensen[4]

[1]Texas A&M University, Department of Environmental and Occupational Health, College Station, TX, US; [2]Coonamessett Farm Foundation, East Falmouth, MA, USA; [3]Texas A&M University, Department of Mechanical Engineering, College Station, TX, USA; [4]The Northeast Center for Occupational Health and Safety, Cooperstown, NY, USA; [5]George Mason University, Department of Mechanical Engineering, Fairfax, VA, USA
fdavis@cfarm.org

Commercial scallop shucking is a small-space, high-repetition, and high-force task that exposes workers to substantial ergonomic risk. While prior research has largely focused on biotoxin exposure and laceration prevention, the cumulative musculoskeletal demands of scallop shucking remain poorly characterized. This study reports findings from a fisherman-led research-to-practice project supported by the Northeast Center's incubator, aiming to objectively quantify muscular loading during scallop shucking and to evaluate a worker-designed hand-tool modification intended to reduce that load. A repeated-measures, field-based study was conducted with 20 professional scallopers in Massachusetts during their normal offshore working shifts. Participants shucked scallops under two conditions: a standard stock shucking knife and an intervention knife with a taped handle developed through a fisherman-led initiative. Surface electromyography (EMG) was used to measure muscle activity in the dominant hand's extrinsic finger flexor (flexor digitorum superficialis) and extensor (extensor digitorum communis). EMG signals were normalized to maximum voluntary contractions and summarized using Amplitude Probability Density Function metrics (10^{th}, 50^{th}, and 90^{th} percentiles). Perceived fatigue was assessed using the Borg CR-10 scale, and tool usability and preference were recorded using Likert scales. Generalized linear mixed models were used to compare outcomes between knife conditions. Across participants, scallop shucking with the stock knife required sustained muscle activities exceeding 25% of maximum voluntary contraction in extrinsic finger muscles, a level associated with elevated risk for work-related musculoskeletal disorders in highly repetitive tasks. Use of the taped-handle intervention knife significantly reduced median and peak muscle activity in both flexor and extensor muscles and was associated with lower perceived hand and wrist fatigue and higher usability ratings. These findings demonstrate that simple, fisherman-generated modifications to hand-tool design can meaningfully reduce muscular demands during scallop shucking. More broadly, the study illustrates the value of incubator models that connect researchers and practitioners to translate worker experience into evidence-based ergonomic interventions for injury prevention in commercial fisheries.

Poster

Evaluating management options for high-density recruitment events in the Atlantic sea scallop fishery: a decision tree approach

Kaitlyn R. Kowaleski[1,2], Andrew M. Scheld[1], Jonathon Peros[3], Sally A. Roman[1], Roger Mann[1], and **David B. Rudders**[1]

[1]Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA, USA; [2]Washington Sea Grant, College of the Environment, University of Washington, Seattle, WA, USA; [3]New England Fishery Management Council, Newburyport, MA, USA
rudders@vims.edu

A major challenge in managing wild capture fisheries is their dependence on natural recruitment, which can be highly variable. The Atlantic sea scallop, *Placopecten magellanicus,* supports one of the most valuable fisheries in the USA, with annual ex-vessel values of USD $360–600 million since 2010. Fishery managers utilize annual surveys to document recruitment events and rotational area management to protect juveniles from fishing pressure. While effective, recent high-density recruitment events have prompted consideration of a broader set of management options. The authors propose developing decision trees to aid in the management of future high-density recruitment events. To guide decision tree development, the authors asked resource managers, industry advisors, and researchers to rank their concerns associated with managing high-density recruitment events, evaluate the feasibility of proposed management measures, and rank the importance of management information in their decision-making process. Participants expressed high levels of trust in the results of annual population surveys used to delineate the abundance and distribution of the resource but were concerned about elevated fishing mortality due to poor fishing practices in high-density areas. Participant perceptions of the proposed management measures informed the development of two decision trees: 1) evaluating management options for new recruitment events and 2) evaluating management options for rotational areas currently closed. The decision trees developed here provide a structured framework to evaluate management considerations with the aim of streamlining the management process for future high-density recruitment events in the sea scallop fishery.

Developing spatio-temporal models to derive standardized abundance indices from Welsh scallop fisheries data

Tom Leven* and Natalie Hold

School of Ocean Sciences, Bangor University, Menai Bridge, UK
tml25dzl @bangor.ac.uk

Indices of abundance are an integral part of fisheries management and stock assessments. They can be derived from both fishery-independent surveys and fishery-dependant Catch Per Unit Effort (CPUE) data; however, these indices need to be standardised as they can be influenced not only by the underlying stock dynamics but also by spatial, temporal, and behavioural processes. Particularly in scallop fisheries, spatial stock structuring, patchy distributions, and environmentally driven variability can lead to bias in abundance indices if not accounted for.

The Vessel Monitoring System (VMS) provides information on vessel position and speed, while logbook records provide information on what was landed. When combined, this allows scientists to reconstruct fishing footprints and to link catches to specific locations and times. Methods have been developed that aim at maximizing the information there is to gain from VMS-logbook data. This includes interpolating vessel tracks between individual VMS pings, assigning fishing vs. non-fishing status (e.g., steaming), and moving from a point-based analysis towards using lines, which more accurately represent the spatial footprint of fishing activities.

These methods were tested and adjusted for Welsh scallop vessels. The scallop fishery in Wales takes place mainly in three areas (Liverpool Bay, Caernarfon Bay, Cardigan Bay) and consists of around 20 vessels. Different methods to analyze VMS data will be compared, for example interpolation vs. non-interpolation and the effects of the clustering algorithm on the analysis (Fig. 1). The application of these methods and their utility can be applied to the sustainable management of scallop stocks, for instance for swept area ratio's, a proxy for stock status through spatio-temporal indices of abundance, exploitation status and fishing mortality, as well as local depletion effects. Ultimately, it could lead to a new protocol for VMS-logbook processing for scallop fisheries.

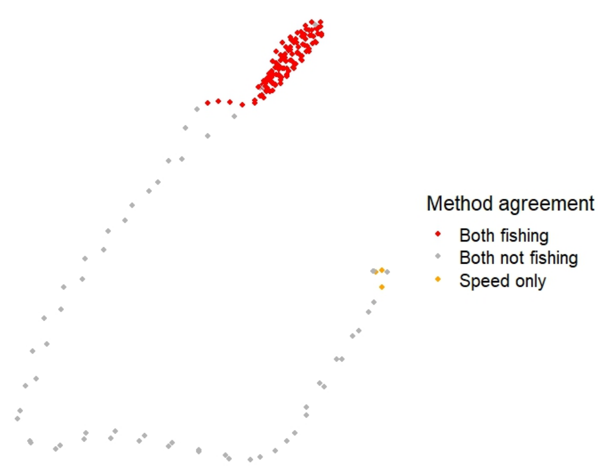


Figure 1: Vessel track to compare results from assigning fishing status based on speed only and utilizing the clustering algorithm.

A large-scale A.I. benchmark for optical benthic survey automation

Heng Lian[1], Daniel M. Runfola[1], **Roger Mann**[2], Deborah Hart[3], and Yi He[1]

[1]Dept. of Data Science, William and Mary, USA; [2]Virginia Institute of Marine Science, William and Mary, USA; [3]NOAA Northeast Fisheries Science Center, Woods Hole, MA, USA
rmann@vims.edu

Long-term monitoring of benthic ecosystems is critical for sustaining marine biodiversity and supporting fisheries management. Traditional survey methods such as dredging and trawling are invasive, labor-intensive, and spatially limited. Underwater Optical Survey (UOS) systems provide a scalable, non-invasive alternative by capturing high-resolution seafloor imagery; however, automated analysis of benthic imagery remains underexplored due to the absence of domain-specific benchmarks and systematic evaluation of modern vision and multimodal models.

Benthic Benchmark is a large-scale, high-resolution underwater image dataset curated in collaboration with NOAA Fisheries. The dataset contains over 720,000 HabCam images spanning more than 10 years across two ecologically and commercially significant regions: the Mid-Atlantic Bight and Georges Bank. It covers seven representative benthic species: scallop, crab, whelk, skate fish, flatfish, roundfish, and eel. From this corpus, more than 110,000 annotated 640×640 sub-images are constructed for controlled evaluation.

Fourteen representative artificial intelligence (A.I.) models on this benchmark database were systematically evaluated. These A.I. models span five typical neural-net architectures in computer vision, convolutional neural networks (i.e., ResNet, MobileNet, EfficientNet), vision transformers (i.e., ViT, Swin), object detectors (i.e., Faster R-CNN, Cascade R-CNN, YOLOv11, DETR), segmentation model (i.e., SAM), and multimodal models (i.e., CLIP, LLaMA, LLaVA, Janus). This establishes the first standardized, large-scale evaluation platform for A.I.-driven benthic biomass estimation and monitoring, highlighting the performance limitations of current model architectures in realistic underwater environments and provides a foundation for future research of scalable ecological modeling.

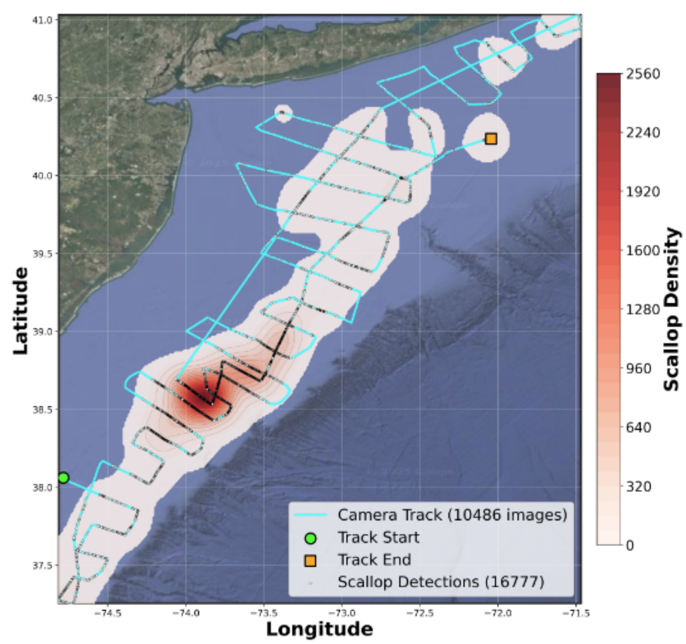


Figure 1: Demonstration of scallop distribution estimated by human annotators (blue stripes) and A.I.-powered UOS (heatmap).

A length-based stock assessment of king scallop (*Pecten maximus*) in Cardigan Bay

Silvia Malagoli[1], Robin M. Cook[2], Michael R. Heath[2], Douglas C. Speirs[2], and Natalie Hold[1]

[1]University of Bangor, School of Ocean Sciences, Anglesey, Wales, UK; [2]University of Strathclyde, Department of Mathematics and Statistics, Glasgow, Scotland, UK
s.malagoli@bangor.ac.uk

The king scallop (*Pecten maximus*) is the third most valuable species landed by UK fishing vessels. Full analytical stock assessments typically depend on fisheries-dependent and age-specific data; however, these approaches are often constrained by limitations in data availability and quality.

This research investigates the potential of a length-based assessment approach for king scallop by applying a Bayesian model (the Survey-LAndings Model, SLAM) under different data-availability scenarios.

The model produced estimates of fishing mortality and spawning stock biomass (SSB) comparable to those from an age-based assessment model, although results were moderately sensitive to changes in the shape of survey and fishing selectivity, and highly sensitive to the removal of fisheries-dependent compositional data. Results conclude that SLAM can produce reliable assessments even when only length information is available.

Exploring temporal and spatial variation in age structure and growth rates of the scallop, *Placopecten magellanicus*

Roger Mann, David Rudders, Sally Roman, Derek Jackson, Reece Aponte, Conor O'Meally, Melissa Southworth, and Liam Miller

Virginia Institute of Marine Science, Gloucester Point, Virginia, USA
rmann@vims.edu

Age versus length relationships in exploited fish and shellfish stocks are base requirements for age-based assessments and facilitate estimates of growth and mortality rates. An example of a population level plot of age versus length, one point per individual, is given in Figure 1. Subsumed within a population level plot, especially one that includes multiple years of collection data, are descriptions of spatial and temporal variation that reflect concurrent variation in environmental variables, food availability, longer term trends driven by climate change, predation, parasites, disease, acidification, exploitation pressure, and more (note variation in Figure 1). Large data sets allow exploration of this variation at the regional or even individual organism level, and, where annual growth increment measures are available, growth of targeted year classes within a region and/or location (Figure 2). This presentation explores such variation in an assemblage of ~ 6000 individual scallops collected in mid-Atlantic and Georges Bank surveys between 2018 and 2025

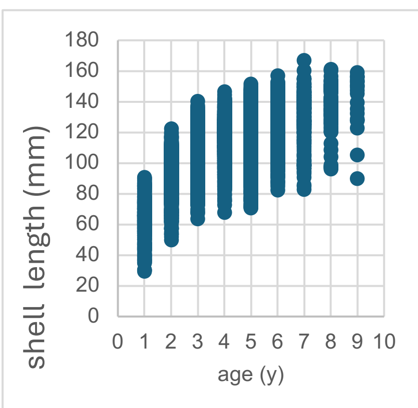


Figure 1. Age v length for 5048 scallops, collected 2018-2023

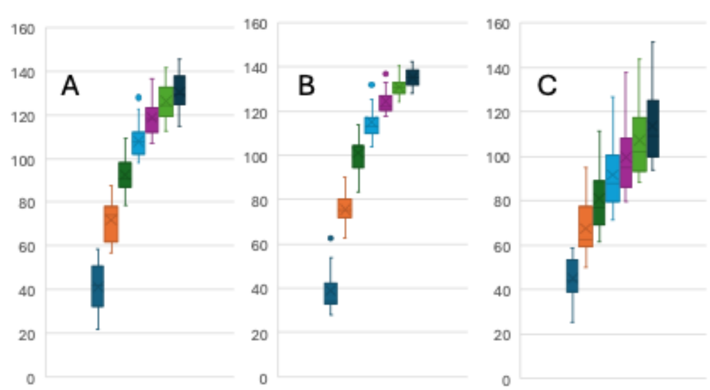


Figure 2. Age v length of a single year class, 7-year-olds, collected in 3 regions in 2022. LAT & LONG A: 38.70, 73.71. B: 40.25, 72.75. c: 40.80, 68.02

Describing the identity and impacts of shell blister in Atlantic sea scallops

Liam Miller*, Sally A. Roman, David Rudders, and Jan McDowell

Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA, USA
wbmiller@vims.edu

The occurrence of shell blister in the Atlantic sea scallop (*Placopecten magellanicus*) in the Mid-Atlantic region poses a challenge to the fishery by impacting growth and marketability of affected individuals. This condition is typically associated with boring polychaetes penetrating the shell, leading to the scallop secreting a nacreous blister over the opening. These blisters may become filled with detritus and can increase in size and severity over time. The blister can also foul the adductor muscle directly.

Despite persistent prevalence in surveyed areas, the identity of the boring parasite(s) responsible for shell blister across this region, as well as the potential for multispecies interactions on blister presence, remains poorly characterized. Visual morphological identification, Sanger sequencing, and environmental DNA assays were used to determine the identity of the blister associated polychaetes across the Mid-Atlantic and Georges Bank. Visual identification and Sanger sequencing were used to identify blister associated polychaete samples, while environmental DNA assays were used to identify species presence in bottom water samples collected in surveyed regions. Morphometric analyses of affected shells were conducted to quantify the relationship between blister severity and shell deformation, and the association between species presence in the water column and blister severity. Preliminary results indicate a potential multispecies contribution to blister severity, involving both boring and non-boring polychaetes. These findings provide insight into the drivers and consequences of shell blister in Atlantic sea scallops.

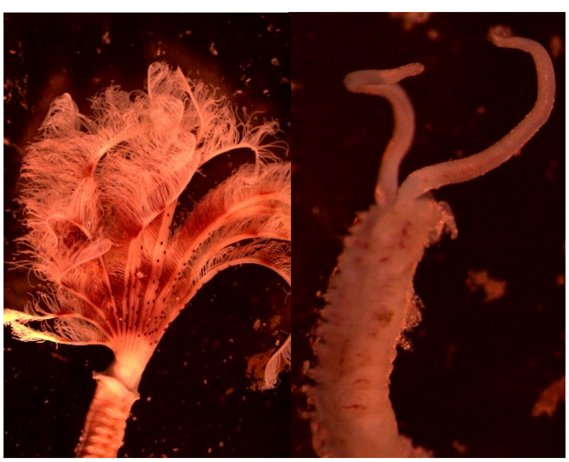


Figure 1. Blister-associated polychaetes: (a) *Parasabella microphthalma*; (b) *Dipolydora giardi*.

Atlantic sea scallop (*Placopecten magellanicus*) shell oxygen isotope signatures ($\delta^{18}O$) as a proxy for benthic temperature and seasonal growth rates across fishing areas

Alanna Mnich[1], Susan Inglis[2], and Kevin Stokesbury[1]

[1]University of Massachusetts Dartmouth, School for Marine Science and Technology, New Bedford, MA, USA; [2]Commercial Fisheries Research Foundation, Saunderstown, RI, USA
amnich@umassd.edu

Scallop shells increase in size through accretion of calcium carbonate, producing visible growth rings and retaining water mass characteristics such as stable isotope ratios of oxygen ($\delta^{18}O$). Shell signature is determined by that of the surrounding seawater, which is driven by salinity, as well as the temperature experienced during deposition.

In this study, 52 previously tagged scallop shells were selected for $\delta^{18}O$ analysis. Shells were collected from George's Bank Northern Edge (20), South Channel 1 (10), South Channel 2 (10), Tower (10), and Elephant Trunk (2). Shells were measured from umbo to the shell margin at the time of tagging and upon capture and subsequently aged using concentric growth rings on the shell surface and the resilium. Material for stable isotope analysis was micromilled from approximately one year prior to tagging until recapture at intervals of 0.5 to 1.0 mm. Samples were analyzed at the University of Michigan Isotope Laboratory and reported in conventional delta notation relative to the Peedee belemnite (PDB) carbonate standard. Benthic temperature and salinity estimates for each site in the years of the study were obtained using the Finite-Volume Community Ocean Model (FVCOM).

Using temperature and salinity data paired with $\delta^{18}O$ signatures, shell $\delta^{18}O$ was tested for validity as a proxy for predicted temperature. The individual variation in shell $\delta^{18}O$ and predicted temperature was tested amongst scallops from each site. Seasonal patterns in $\delta^{18}O$ were observed and generally aligned closely with expectations of years reflected in deposited material based on tagging data and annual growth rings. Growth rates based on shell measurements and age estimation by ring count and $\delta^{18}O$ signatures were generated for each fishing area.

The Cecil B. DeMille method of building a scallop farming industry in Maine

Dana L. Morse[1] and Hugh Cowperthwaite[2]

[1]Maine Sea Grant College Program, and University of Maine Cooperative Extension, Darling Marine Center, Walpole, ME USA; [2]Coastal Enterprises Inc., Brunswick, ME, USA
dana.morse@maine.edu

In 2026, Maine is now going into its eighth year of putting farmed scallops – both shucked and live/whole – on the market; the only source of farmed scallops in the country. While production remains small, landing are rising, demand outpaces supply, and farm-gate prices for both scallop adductors and whole scallops significantly exceed wild product. Outreach to chefs and restaurateurs indicates interest in novel and quality ingredients such as whole scallops, and farm production opens the door to value-added products. New producers are coming to the sector with their own ideas, energy and insights.

This story, of early-stage progress, continues to write itself however, and the paths to profitability are still being cleared. Maine has proven to be an unusually well-suited place to be, with good spat supply, appropriate environmental conditions, engaged and well-informed regulators, and industry members, and support from a variety of sectors.

The cast of characters to do all this is large, and the work has played out over 25+ years. This presentation will cover some of the recent and more-distant history of how this sector came together, and some of the important milestones in regulation, technology, science and community-building, and the people who have made it happen.

Predation, natural mortality, and implications for Atlantic sea scallop management

Chandler Nelson and Connor Buckley

New England Fishery Management Council, Newburyport, MA, USA
cnelson@nefmc.org

The Atlantic sea scallop (*Placopecten magellanicus*) supports one of the most economically valuable fisheries in the United States. In recent years, however, increasing evidence suggests that elevated natural mortality, potentially associated with predation, is reducing biomass in managed areas. Understanding the ecological drivers of this trend is essential for effective management.

The most common predators of *P. magellanicus* include sea stars (*Asterias vulgaris, A. forbesi, Leptasterias tenera,* and *Astropecten americanus*) and crabs (*Cancer irroratus, C. borealis*). Predation pressure varies across life stages and habitats, but recent stock assessment information indicates that natural mortality has increased across the resource, although the degree to which predation is driving this trend warrants additional research. Clappers, empty shells with the hinge still intact, are frequently observed in survey tows, and sea stars are often visible in survey imagery co-occurring with dense scallop aggregations. Together, these observations suggest that predation is limiting the growth expected in closed areas under rotational management.

Environmental change appears to be altering predator–prey dynamics by influencing both predator distributions and scallop vulnerability to predation. Warming bottom temperatures may facilitate the expansion of predators into more northerly and shallower waters while also reducing the effectiveness of scallop escape responses. In addition, declines in primary productivity can reduce scallop condition and increase vulnerability to predation. Collectively, these factors are negatively affecting the distribution and scale of scallop recruitment and natural mortality, contributing to greater uncertainty in projections of scallop growth and yield.

This presentation summarizes the predation challenges facing *P. magellanicus*, impacts on the fishery, and potential management responses. As climate conditions continue to change, adapting management approaches to account for evolving predator–prey dynamics will be increasingly important for sustaining both the scallop resource and the fishery that depends on it.

Evidence for direct transmission of bay scallop Marosporida in *Argopecten irradians*

Emmanuelle Pales Espinosa[1], Guillaume Cacot[1], Kristen Savastano[1], Richard Snyder[2], Harrison Tobi[3], Stephen Tettelbach[3], and Bassem Allam[1]

[1]Stony Brook University, Stony Brook, NY, USA; [2]Virginia Institute of Marine Science, William & Mary, Eastern Shore Laboratory, Wachapreague, VA, USA; [3]Marine Program, Cornell Cooperative Extension, Southold, NY, USA
Emmanuelle.Palesespinosa@stonybrook.edu

The bay scallop (*Argopecten irradians*) is a commercially, culturally, and ecologically important species naturally distributed along the Atlantic and Gulf coasts of the United States. It is emblematic in New York, where it supports a major fishery and is recognized as the official state shell. Since 2019, bay scallop populations in New York have experienced large-scale summer mortality events, resulting in over a 95% reduction in the biomass of adult, market-size individuals. Preliminary investigations into these events revealed a 100% prevalence of an apicomplexan parasite, Bay Scallop Marosporida (BSM), infecting kidney tissues, suggesting high transmission efficiency.

To investigate the mechanisms and potential pathways of intraspecific transmission, two lines of naïve bay scallops (a New York line and a North Carolina line [ESL], produced by the VIMS Eastern Shore Laboratory) were either exposed to infected kidney tissue homogenates or co-incubated with infected scallops collected from the Peconic Estuary, NY.

Results showed that BSM successfully infected both lines of naïve scallops, regardless of the exposure method. Infection occurred rapidly in naïve scallops, with BSM detectable as early as three days post-exposure. In parallel, laboratory and field investigations revealed that live, infected scallops can release BSM into the environment during excretion of waste material (via the excretory system) and during spawning. Altogether, these findings support that BSM can be released into the environment by both live and dead (via tissue degradation) infected scallops, particularly during the summer months when new scallop recruits settle to the benthos and become suitable hosts.

Poster

Nearest-neighbor distance, clumping, and fertilization success in Atlantic sea scallops from Georges Bank

Ashwin Panicker* and Kevin Stokesbury

University of Massachusetts Dartmouth, Department of Fisheries Oceanography, School for Marine Science and Technology, New Bedford, MA, USA
apanicker@umassd.edu

Atlantic sea scallops, *Placopecten magellanicus*, are broadcast spawners whose reproductive success depends on the interaction between population density, nearest-neighbor distance, and spawning synchrony. While large-scale declines in scallop density are often assumed to reduce fertilization success, fine-scale spatial structure may mitigate these effects. Field observations from Georges Bank indicate that scallops frequently occur in small, dense clumps, resulting in reduced nearest-neighbor distances even when overall population density is low. This study examines how fine-scale clumping influences fertilization success under controlled conditions designed to replicate densities characteristic of scallop aggregations with a focus on Habitat Area of Particular Concern within Closed Area II on Georges Bank.

Experimental trials will quantify fertilization success across a range of nearest-neighbor distances reflecting observed clump structure. In addition, the relationship between shell height and egg production will be evaluated to verify size-based fecundity estimates, and gonad volume will be measured to refine estimates of total gamete output. Together, these metrics will be used to improve understanding of reproductive potential at biologically relevant spatial scales.

By isolating the effects of nearest-neighbor distance while maintaining realistic aggregation patterns, this work aims to bridge the gap between classical fertilization models and field observations. Results are expected to improve predictions of reproductive output in managed scallop populations and contribute to a more mechanistic understanding of how fine-scale spatial structure supports population resilience.

Production and trends of the scallop fishery in the Ría de Ferrol (N.W. Spain) over the last 15 years

M. Luz Pérez-Parallé and Antonio J. Pazos

ARCUS (Aquatic One Health Research Centre) and Dpt. of Biochemistry and Molecular Biology, Universidad de Santiago de Compostela, Santiago de Compostela, Spain
luz.perez-paralle@usc.es

The Ría de Ferrol in Galicia (NW Spain) is an estuary of fluvial origin, important for its deep-sea inlet which makes it an excellent natural port. It is approximately 18 km long and has a maximum width of about 3 km, with a narrow mouth of about 740 meters, covering an area of about 25 km².

Regarding the commercial production of pectinids, it focuses on the presence of two species, the great/king scallop (*Pecten maximus*) and the variegated scallop/black scallop (*Mimachlamys varia*). In fact, the Ría de Ferrol is the only remaining natural bank of this last species in Galicia, although the king scallop is produced in other Galician estuaries with total landings amounting to 1,635 tons. The Ría de Ferrol fishery is a small inshore fishery involving 3 Fishermen's Guilds (Ferrol, Barallobre, and Mugardos) with 13 small-size boats that use an artisanal rake adapted to pectinids. The catches are regulated by Regional Government laws with closed seasons (variable depending on the year and population control), and strictly regulation of catches per boat (25 kg of *P. maximus* or 20 kg of *M. varia* per fisherman). In addition, catches are always conditioned by toxin levels; high levels of the amnesic shellfish poisoning (ASP) and the diarrhetic shellfish poisoning (DSP) prevent harvesting.

Total production in the last 15 years has amounted to 460 T. of great scallops and 189 T. of black scallops. Great scallop catches have remained low but fairly stable, although they have increased in the last three years. In the case of black scallops, however, there has been a notable decrease in 2024 and 2025. Despite its small size, the scallop fishery of the Ría de Ferrol represents an important economic activity amounting to more than 3 million euros in recent years, with also socio-economic importance for the population of the area, which has even led to the creation of a product processing company, since the scallops must be eviscerated before been sold fresh or frozen.

The fishing production activity has been affected by the presence of the military arsenal (Spanish Navy base), the presence of different industries, such as naval shipyards or gas companies, as well as by the construction of an outer port and the impact of the filling of about 2.4% of its original surface for port and industrial uses over the centuries. The low scallop production is due to different causes. The first one is the intense fishing pressure during the last century and the presence of poachers, resulting in the reduction of the natural banks, especially in the case of *Mimachlamys varia*. The decline in natural scallop banks is also influenced by their limited range of natural habitats and the changes in the natural oceanographic conditions and the industrial contamination. Catches are also affected by the impossibility of fishing when toxin levels are high and persistent over time due to the low detoxification rate of the great scallop.

Survey dredges do not sample well in high-density scallop grounds: new evidence from high-definition cameras

Chris Rillahan[1], Sally Roman[2], David Rudders[2], and Pingguo He[1]

[1]University of Massachusetts Dartmouth, School for Marine Science and Technology (SMAST), New Bedford, MA, USA; [2]Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA, USA
crillahan@umassd.edu

The Atlantic sea scallop, *Placopecten magellanicus*, fishery is one of the most valuable fisheries along the US East Coast, with an ex-vessel value in excess of $670 million USD from a landing of 19,631 mt of scallop meat in 2021. The fishery is typically supported by several surveys (i.e., dredge and optical surveys), which provide multiple, spatially explicit annual biomass estimates. From 2015 to 2022, significant divergence in area-specific biomass estimates were noted between the different survey methods, where optical survey estimates were greater than dredge estimates in areas of high scallop density. The main theory for these differences is that the dredge may have saturated during the standard 15-minute tow in high-density areas. The objective of this study was to assess the influence of scallop density on dredge efficiency (q). High-definition cameras were placed on the dredge to enumerate the number of scallops in the dredge path. Estimates of efficiency were derived by comparing the number of scallops in the dredge path to the number collected in the dredge bag. Additionally, the behavior and capture of bycatch species were examined. The estimated dredge efficiency for sea scallops was observed to decline with increased scallop density. At low densities, q estimates were similar to those reported in the 2018 stock assessment (0.4). As densities increased, q declined to 0.09, indicating gear saturation. This finding suggests that the assumption of static catchability is invalid and needs to be adjusted to account for high-density scallop aggregations.

Development of a GRTS survey approach for the VIMS sea scallop dredge survey

Sally A. Roman and David B. Rudders

Virginia Institute of Marine Science, William and Mary, Gloucester Point, VA, USA
saroman@vims.edu

Several approaches for constructing survey designs exist to estimate population abundance, including random and stratified random sampling theory. Generalized Random Tessellation Stratified sampling (GRTS) is a contemporary sampling approach that aims to ensure spatially balanced sampling for large survey areas and is being applied to fishery surveys across the United States.

The National Oceanic and Atmospheric Association sea scallop (*Placopecten magellanicus*) dredge survey transitioned to a GRTS sampling approach in 2025. The Virginia Institute of Marine Science (VIMS) conducts a complementary sea scallop dredge survey of the Mid-Atlantic Bight and portions of Georges Bank in the Northwest Atlantic, using a stratified random sampling approach. For 2026, VIMS is evaluating the application of a GRTS for the organization's future dredge surveys.

Several decision points need to be considered for the VIMS survey when developing a GRTS. The time series of prior data to use for estimating biomass for station allocation is one consideration. A similar issue related to biomass estimation is the treatment of biomass in weight and number of animals (i.e., transformation of these values in modeling efforts). Another concern is how to potentially combine strata to ensure that all portions of the sea scallop resource receive a sufficient number of stations. The use of a minimum distance constraint between allocated stations also needs to be considered. How to communicate the new sampling design to stakeholders, as well as the time allocated for VIMS staff to investigate this approach, also needs to be taken into consideration. Analysis of the decision points and a comparison to a stratified random sampling station allocation for 2026 will be discussed.

Quantifying the habitat preference of a scallop dredge fishery: implications for marine spatial planning

J.A. Sameoto[1], C.J. Brown[2], D.M. Keith[1], and C. McGonigle[3]

[1]Fisheries and Oceans Canada, Dartmouth, Nova Scotia, Canada; [2]Dalhousie University, Department of Oceanography, Nova Scotia, Canada; [3]Ulster University, School of Geography and Environmental Sciences, UK
Jessica.Sameoto@dfo-mpo.gc.ca

Small-scale fisheries often operate in coastal areas where they are faced with increasing competition for space by other stakeholder groups. Although it is well known to fishers that not all areas are equal, understanding what defines suitable fishing grounds is critical to account for fishers' interests in marine spatial planning decisions. Using the scallop fishery in the Bay of Fundy, Canada, from 2004 to 2023, this study characterized spatiotemporal fishing patterns, developed an approach to quantify the value of habitat areas, and quantified the impact of a proposed conservation closure on the fishery. This fishery utilized between 28 – 40% of the available management area; however, high fishing intensity areas only account for 1 – 6% of the total area yet correspond to between 21–69% of the annual catch. Fishing patterns demonstrated clear habitat preferences for mixed sediments and gravel/sand followed by sand, with the relative catch of scallop from both mixed sediments and gravel/sand approximately three times that of sand. The quantified impact of a proposed conservation closure demonstrates that mixed sediments and gravel/sand combined would contribute to 67% of potential losses to the fishery in the proposed closed area despite only representing 32% of the area. These results highlight the significant impact that may occur to scallop fisheries if spatial planning decisions do not carefully consider a fishers' habitat preferences and demonstrates the need for purpose made analyses to support marine spatial planning decisions.

Utilizing loggerhead turtle (*Caretta caretta*) foraging patterns to characterize Atlantic sea scallop (*Placopecten magellanicus*) range changes through the Mid-Atlantic Bright

Nathan Shivers[1], Samir Patel[1], Paxon Easton[2], Max Zavell[2], Geoffrey Cowles[2], Brian Beal[3,4], and Kevin Stokesbury[2]

[1]Coonamessett Farm Foundation, East Falmouth, MA, USA; [2]University of Massachusetts Dartmouth, School for Marine Science & Technology, Dartmouth, MA, USA; [3]Downeast Institute, Beals, ME, USA; [4]University of Maine, School of Marine Sciences, Machias, ME, USA
nshivers@cfarm.org

The Atlantic sea scallop (*Placopecten magellanicus*) fishery historically spanned as far south as Cape Hatteras, North Carolina. Recently, fishing effort has seen a northern shift in the Mid-Atlantic Bight (MAB), moving the southernmost region to areas off Virginia. Reductions in sea scallop recruitment in their southernmost range have raised the importance of identifying larval thermal tolerances in the context of rising water temperatures. Using controlled laboratory experiments, temperature-specific mortality rates and temperatures that induce 50% mortality (L_{50}) of scallop larvae were determined. Larval thermal tolerances (L_{50}) were coupled with high-resolution georeferenced temperature through depth data collected by sea turtle-borne sensors to estimate range reductions for MAB scallop larvae. General additive models (GAM) were created with loggerhead turtle (*Caretta caretta*) *in-situ* temperature-depth data and were validated with NOAA CTD and glider data. GAM and L_{50} data were then used to quantify the depths and degree days (DD) that larvae were exposed to temperatures at or above their L_{50} from 2009 to 2025. Through the first round of laboratory experiments, scallop larvae needed relatively low temperatures for at least 50% survival past 4 days, specifically between 12 - 14°C. For the MAB, modeling ocean water temperatures through both the spring spawn, April 1st to June 30th, and the fall spawn, September 1st to October 10th, provides high-resolution data to elucidate the spatiotemporal trends in thermal habitat for both spawning periods.

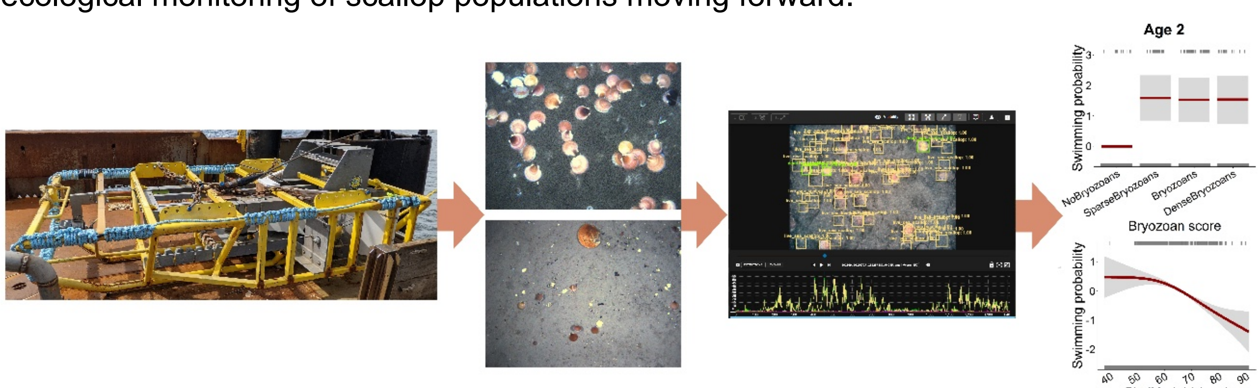
Using machine learning to study Atlantic sea scallop distributions and swimming behavior with large optical datasets

Liese A. Siemann[1], Matthew Dawkins[2], Luisa Garcia[1], Jonathan Crall[2], and Tasha O'Hara[1]

[1]Coonamessett Farm Foundation, Inc., East Falmouth, MA, USA; [2] Kitware Inc., Clifton Park, NY, USA
lsiemann@cfarm.org

Machine learning offers a powerful approach to expand the value of large marine optical datasets and improve the understanding of Atlantic sea scallop (*Placopecten magellanicus*) ecology. The Habitat Mapping Camera (HabCam) V3 vehicle, operated by Coonamessett Farm Foundation (CFF), is used to conduct benthic ecosystem monitoring surveys across US scallop grounds, collecting spatially specific image and environmental data. While subsets of these optical datasets are traditionally analyzed using manual image annotation, this process is time-consuming, limiting the potential value of the imagery collected during these surveys. To address this limitation, CFF partnered with Kitware, a technology company with expertise in technical computing and artificial intelligence, to develop and apply tools capable of rapidly analyzing large optical datasets collected during HabCam surveys. Kitware has been developing the open-source computer vision platform Video and Image Analytics for Marine Environments (VIAME) since 2017.

Improved scallop detectors and habitat classifiers were developed within VIAME, and these models were applied to HabCam imagery collected in 2019 and 2021. Over 1.3 million images were analyzed in a fraction of the time required for manual annotations. The resulting large-scale analysis enabled researchers to investigate rare behaviors like scallop swimming across different age classes and habitat types. The analysis revealed that scallop densities change as scallops mature in relation to different benthic habitat types including gravel, shell hash, bryozoans, sea star beds, sand dollar beds, and sand waves. Models of swimming behavior confirmed that juvenile scallops swim more frequently than adults, and this behavior is influenced by benthic habitat type. These findings provide new insights into habitat-specific scallop behavior across life stages and demonstrate the value of using automated tools to process large-scale optical datasets. Overall, this study highlights the potential for machine learning to fully leverage existing and future optical datasets, offering a more efficient and comprehensive approach to ecological monitoring of scallop populations moving forward.



Operationalizing *ScallApp*: A tool to engage the fishing industry in tracking scallop health and reproduction

Rebecca Smoak, Linus Stoltz, and N. David Bethoney

Commercial Fisheries Research Foundation, Saunderstown, Rhode Island, USA
smoakr@cfrfoundation.org

Changing ocean conditions are impacting the biology and physiology of the Atlantic sea scallop (*Placopecten magellanicus)* through the emergence of diseases and changes in reproductive dynamics. Scallop health and reproduction are monitored during annual dredge surveys, but these surveys almost exclusively occur from late spring to summer. The need for year-round, area specific information on scallop reproduction and meat quality can be filled by the fishing industry. With this in mind, the Commercial Fisheries Research Foundation (CFRF) created a fishery-dependent smartphone application to collect data that tracks these conditions through space and time.

The smartphone application, coined *ScallApp*, was designed as a self-guided, quick to use tool, that can be downloaded and operated by members of the scallop fishing community. Through *ScallApp*, scallopers collect timestamped and geolocated disease and gonad stage data along with images of individual scallops. The data is managed by CFRF, and the images are fed to a data portal that generates interactive maps for use by the broader fishing industry, as well as fisheries scientists, managers, and educators.

Additionally, to encourage scallopers to use *ScallApp* outside the context of Research-Set-Aside quota, the CFRF created "*ScallApp* Games", a reward-based incentive program designed to further incentivize sampling effort. Together, these project components provide a comprehensive infrastructure that can be utilized by a broader fleet of participating fishermen to collect images year-round, across the full range of the resource, and contribute to a near real-time understanding of environmental impacts to sea scallop biology. This presentation highlights the development of *ScallApp*, its successes and challenges as a cooperative research tool, and outlines next steps for expanding its use.

Cumulative impact of offshore wind energy development on sea scallop larval dispersal and settlement over the U.S. northeast shelf

Lu Wang, **Changsheng Chen**, Siqi Li, Liuzhi Zhao, Pingguo He, Kevin Stokesbury, Junhyung Kim, and Adriano Giangiardi

University of Massachusetts Dartmouth, School for Marine Science and Technology, New Bedford, MA, USA
c1chen@umassd.edu

A high-resolution, wind-turbine-resolving coupled atmosphere–ocean–scallop modeling system was applied to examine the cumulative impacts of offshore wind (OSW) development on the dispersal and settlement of sea scallop larvae over the U.S. northeast shelf. The modeling system incorporates updated Construction and Operations Plans (COP) for all lease areas off the coasts of Massachusetts and Rhode Island, with turbine capacities ranging from 8–14 MW and representative monopile diameters of approximately 6–16 m. Extensive validation was conducted for winds, currents, surface waves, and temperatures within and surrounding wind farm regions during the progressive development of OSW facilities over Nantucket Shoals. The model skillfully reproduces meteorological and oceanographic conditions at both regional and local scales, capturing key atmospheric variables, including wind speed, air pressure, humidity, and temperature, as well as oceanic parameters such as currents, temperature, salinity, sea surface temperature (SST), waves, and sea level.

The validated wind-turbine-resolving physical model is coupled with an individual-based scallop model (Scallop-IBM) to assess the cumulative effects of wind turbine generators (WTG) on scallop larval dispersal and settlement across the Northeast Shelf. Simulation results for a single lease area (Vineyard Wind) indicate that turbine-induced circulation changes can modify larval transport pathways, enhancing larval retention and settlement in areas with favorable benthic conditions, particularly within and near the Nantucket Lightship Closed Area. These circulation-driven changes lead to measurable increases in scallop densities across recruitment-relevant size classes (40–90 mm shell height), with size-dependent increases on the order of 10–30%. Additional simulations examining scenarios that include all WTG planned off the coasts of Massachusetts, Rhode Island, and the southern coast of Long Island, New York are currently being conducted for both fall and spring spawning periods. Preliminary results suggest that larval dispersal and settlement patterns may be substantially altered as wind farm development expands. Updated results will be presented at the conference.

Spatially variable growth responses of Atlantic sea scallops to warming: integrating observational data and dynamic energy budget modeling

Zhengchen (John) Zang[1], Rubao Ji[2], Deborah R. Hart[3], Romain Lavaud[4], Changsheng Chen[5], Kirstin Meyer-Kaiser[2], Siqi Li[5], Antonie S. Chute[3], and Roger L. Mann[6]

[1]Louisiana Universities Marine Consortium, Chauvin, LA, USA; [2]Woods Hole Oceanographic Institution, Biology Department, Woods Hole, MA, USA; [3]National Oceanic and Atmospheric Administration Northeast Fisheries Science Center, Woods Hole, MA, USA; [4]Louisiana State University Agricultural Center, School of Renewable Natural Resources, Baton Rouge, LA, USA; [5]University of Massachusetts Dartmouth, School for Marine Science and Technology, New Bedford, MA, USA; [6]Virginia Institute of Marine Science, William and Mary, Gloucester Point, VA, USA
zzang@lumcon.edu

Atlantic sea scallop (*Placopecten magellanicus*) is an important commercial species in the U.S., and its growth rate is strongly modulated by temperature. This study quantified the interannual variations in scallop growth rate and found that the scallop growth rate variations were overall synchronized between the shallow (< 60 m) and deep (≥ 60 m) Mid-Atlantic Bight (MAB) prior to 2015. The response of growth rate to warming in 2015 and 2016 showed marked spatial heterogeneity, with slower growth rates for scallops in the shallow habitats and elevated growth rates in the deep habitats, respectively. A dynamic energy budget model was developed to explain the distinct growth rate response to warming at different depths. The model results showed that bottom temperatures in 2016 exceeded the optimal range in the shallow subregions, limiting the energy available for growth. In contrast, warming created more favorable thermal conditions in the deep ocean habitats. This work reveals the spatiotemporal patterns of scallop growth rates in the MAB and provides valuable insights into the impacts of thermal stress on sea scallop population dynamics under future warming.

Carbonate buffering reduces the CO_2 footprint of the U.S. sea scallop fishery

Max Zavell[1], Alanna Mnich[1], Amy Martins[1,2], Adam Delargy[1], Sandra E. Shumway[3], and Kevin Stokesbury[1]

[1]University of Massachusetts Dartmouth, School for Marine Science and Technology, New Bedford, Massachusetts, USA; [2]National Oceanic and Atmospheric Administration, Northeast Fisheries Science Center, Woods Hole, Massachusetts, USA; [3]University of Connecticut, Groton, Connecticut, USA
mzavell@umassd.edu

The sea scallop, *Placopecten magellanicus*, supports one of the most economically important single-species fisheries in the United States. The carbon footprint of this fishery was assessed using thirty-one years of fishery-dependent observer data and the potential contribution to the oceanic buffering of atmospheric CO_2 from discarded shell dissolution was quantified. The scallop fishery used nine to eleven times less fuel than pot fisheries to harvest one kg of seafood. Mean (± SE) CO_2 footprint (kg) per serving of scallops was 0.93 for trips from the Mid-Atlantic (0.03) and New England (0.04), which is a similar CO_2 footprint to a serving of chicken. When buffered CO_2 from shell dissolution was accounted for, the scallop CO_2 footprint decreased by ~ 91%, making it one of the lowest greenhouse gas protein sources. This study highlights the positive influence of discarded scallop shells on the ocean carbonate system and environmental sustainability of a wild-capture fishery.

LIST OF ATTENDEES

Last Name	First Name	Organization	Country	Email Address
Abdallah	Aisha	The Lyell Centre for Earth and Marine Sciences - Heriot-Watt University, Edinburgh	United Kingdom	aa2354@hw.ac.uk
Alcivar-Warren	Acacia	Environmental Genomics	USA	environmentalgenomics.warren@gmail.com
Alexander-Nevells	Stacy	Atlantic Shellfish, Inc.	USA	stact@atlshellfish.com
Allam	Bassem	Stony Brook University	USA	bassem.allam@stonybrook.edu
Avena	Sydney	Maine Aquaculture Innovation Center	USA	savena@maineaquaculture.org
Bailey	Richard	Northeastern University	USA	r.bailey@northeastern.edu
Berger	Halle	University of Connecticut	USA	halle.berger@uconn.edu
Bethoney	N. David	Commercial Fisheries Research Foundation	USA	dbethoney@cfrfoundation.org
Binney	Francis	Government of Jersey Marine Resources	Jersey	f.binney@gov.je
Blanchet-Aurigny	Aline	IFREMER	France	aline.blanchet@ifremer.fr
Bragdon	Todd	Oneonta Fisheries	USA	toddresilient@gmail.com
Brawn	Togue	Downeast Dayboat	USA	togue@downeastdayboat.com
Brennan	Kyle	University of Maine	USA	kyle.d.brennan@maine.edu
Buckley	Connor	New England Fishery Management Council	USA	cbuckley@nefmc.org
Cadrin	Steve	UMASS Dartmouth - SMAST	USA	scadrin@umassd.edu
Calabrese	Nicholas	UMASS Dartmouth - SMAST	USA	ncalabrese@umassd.edu
Callahan	Grace	Northeastern University	USA	callahan.gr@northeastern.edu
Cassidy	Kyle	UMASS Dartmouth - SMAST	USA	kcassidy@umassd.edu
Cate	O'Keefe	New England Fishery Management Council	USA	cokeefe@nefmc.org
Chen	Changsheng	UMASS Dartmouth - SMAST	USA	c1chen@umassd.edu
Christophersen	Gyda	Møreforsking	Norway	gyda.christophersen@moreforsking.no
Corso	Andrew	Coonamessett Farm Foundation	USA	acorso@cfarm.org
Davis	Farrell	Coonamessett Farm Foundation, Inc.	USA	fdavis@cfarm.org
Delargy	Amber	UMASS Dartmouth - SMAST	USA	amber.delargy@umassd.edu

Last Name	First Name	Organization	Country	Email Address
Delargy	Adam	UMASS Dartmouth - SMAST	USA	adelargy@umassd.edu
Delargy	Amber	UMASS Dartmouth - SMAST	USA	amber.delargy@umassd.edu
Dredge	Mike	Retired	Australia	mike.dredge47@gmail.com
Easton	Paxton	UMASS Dartmouth - SMAST	USA	peaston@umassd.edu
Felix Pico	Esteban	CICIMAR-IPN	Mexico	efelix@ipn.mx
Geiger	Steve	Fish & Wildlife Research Institute - FWC	USA	Stephen.Geiger@MyFWC.com
Grabowski	Jonathan	Northeastern University	USA	j.grabowski@northeastern.edu
Grefsrud	Ellen Sofie	Institute of Marine Research	Norway	ellens@hi.no
Hager	Mark	New England Marine Monitoring	USA	Mark@nemarinemonitoring.com
Haines	Shauna	W Trading, Inc.	USA	shaunamassfab@gmail.com
Hamano	Kei	Japan Fishing Machine, LLC	Japan	hamano@jfm.co.jp
Hansen	Eric	Hansen Scalloping Inc	USA	ehansen4b@comcast.net
Harlow	Leander	UHI Shetland	United Kingdom	leander.harlow@uhi.ac.uk
Hart	Deborah	NOAA/NEFSC	USA	deborah.hart@noaa.gov
Harvey	Jessica	Affiliation	United Kingdom	jessica.harvey@cefas.gov.uk
Huntsburger	Carlton	Marine Science	USA	Jammie.Smalley@maine.gov
Jekielek	Phoebe	University of Maine	USA	phoebe.jekielek@maine.edu
Ji	Rubao	Woods Hole Oceanographic Institution	USA	rji@whoi.edu
Keith	David	Fisheries and Oceans Canada	Canada	David.Keith@dfo-mpo.gc.ca
Kvilhaug	Magnar	Michigan Fishing Inc	USA	magnar.kvilhaug@odinpharmacyinnovations.com
Lawrence	Hannah	Town of Bourne, Dept. of Natural Resources	USA	hlawrence@bourne-ma.gov
Lee	Wendy	High Line College	USA	ilovinvest@aol.com
Lego	Craig	UMASS Dartmouth - SMAST	USA	clego@umassd.edu
Leven	Tom	Bangor University	United Kingdom	tml25dzl@bangor.ac.uk
Mann	Roger	Virginia Institute of Marine Science	USA	rmann@vims.edu
Martins	Amy	UMASS Dartmouth - SMAST	USA	amartins6@umassd.edu
Merhoff	Stephanie	UMASS Dartmouth - SMAST	USA	smerhoff@umassd.edu
Miller	Liam	Virginia Institute of Marine Science	USA	wbmiller@vims.edu
Morgan	Brittany	UMASS Dartmouth - SMAST	USA	bmorgan@umassd.edu
Morse	Dana	Maine Sea Grant	USA	dana.morse@maine.edu

Last Name	First Name	Organization	Country	Email Address
Nelson	Chandler	New England Fishery Management Council	USA	cnelson@nefmc.org
Nevells	Hollis	Atlantic Shellfish, Inc.	USA	nevellshollis@gmail.com
Norton	Helena	UMASS Dartmouth - SMAST	USA	hnorton@umassd.edu
Painten	Andie	UMASS Dartmouth - SMAST	USA	andiepainten@gmail.com
Panicker	Ash	UMASS Dartmouth - SMAST	USA	apanicker@umassd.edu
Parsons	Jay	Quebec	Canada	jay.parsons007@gmail.com
Perez-Paralle	Luz	ARCUS - Universidad de Santiago de Compostela	Spain	luz.perez-paralle@usc.es
Quinn	John	UMASS Dartmouth - SMAST	USA	jquinn3@umassd.edu
Roman	Sally	VIMS	USA	sallyroman@hotmail.com
Rothschild	Matthew	UMASS Dartmouth - SMAST	USA	mrothschildmccoll@umassd.edu
Sameoto	Jessica	Fisheries and Oceans Canada	Canada	Jessica.Sameoto@dfo-mpo.gc.ca
Sanderson	Melissa	Cape Cod Commercial Fishermen's Alliance	USA	melissa@capecodfishermen.org
Shumway	Sandy	Univeristy of Connecticut	USA	Sandra.shumway@uconn.edu
Smoak	Rebecca	Commercial Fisheries Research Foundation	USA	smoakr@cfrfoundation.org
Stokesbury	Kevin	UMASS Dartmouth - SMAST	USA	kstokesbury@umassd.edu
Travers	Bella	UMASS Dartmouth - SMAST	USA	btravers@umassd.edu
Wachala	Sierra	UMASS Dartmouth - SMAST	USA	swachala@umassd.edu
Walsh	Andrew	Town of Bourne, Dept. of Natural Resources	USA	awalsh@bourne-ma.gov
Zang	Zhengchen (John)	Louisiana Universities Marine Consortium (LUMCON)	USA	zzang@lumcon.edu
Zavell	Max	UMASS Dartmouth - SMAST	USA	mzavell@umassd.edu