The Mid-Atlantic Chapter of the American Fisheries Society 2023 Annual Meeting

Meeting Program and Abstract Book

American Fisheries Society

AMERICAN FISHERIES SOCIETY
MID-ATLANTIC CHAPTER

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Welcome!

The Mid-Atlantic Chapter of the American Fisheries Society (MAC-AFS, https://mid-atlantic.fisheries.org/) is a professional organization centered around the science and responsible management of fisheries and aquaculture in the Mid-Atlantic region. Our membership is composed of scientists, managers, students, and fishing industry members, who are affiliated with the universities, government agencies, non-profits, and companies of New Jersey, eastern Pennsylvania, and Delaware.

MAC-AFS is one of six geographic chapters within the Northeastern Division of the American Fisheries Society. The mission of the Chapter is to fulfill the parent society's objectives within the Mid-Atlantic Region:

- Promote the conservation, development, and wise use of the fisheries
- Promote and evaluate the development and advancement of fisheries science and practice
- Gather and disseminate scientific, technical, and other information about fisheries science and practice
- Encourage the teaching of fisheries science and practice in regional colleges and universities and the continuing education and development of fisheries professionals.

Each year, MAC-AFS hosts a conference that gathers fisheries professionals from the Mid-Atlantic. This annual meeting provides a platform for sharing information and ideas about the latest advancements in regionally-specific fisheries and aquaculture science and management. Cutting-edge science, new policy perspectives, challenges facing the region, and success stories worth celebrating are all discussed through oral presentations, poster displays, and social events.

The 2023 Annual Meeting of MAC-AFS is taking place on November 16-17 at the Chase Center on the Riverfront in Wilmington, Delaware!

Sponsors

Thank you to our sponsors!

This meeting would not be possible without the generous support of our sponsors. These organizations provided material resources to MAC-AFS, which defrayed the costs of the venue, the dinner, and the evening social event. These resources were also used to ensure that registration costs were manageable for all attendees. Additionally, these sponsors helped MAC-AFS offer free lodging for students. MAC-AFS is extremely grateful for the donations and support we have received.

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Donations to the Silent Auctions

We are also grateful for all the organizations, individuals, and MAC-AFS members who donated to our silent auction. All proceeds of the auction go towards supporting student-focused activities throughout the year. This includes supporting our student subunits, contributing to the AFS Hutton Junior Fisheries Biology Program (https://hutton.fisheries.org/), and covering the costs of student activities at future MAC-AFS Annual Meetings. This year, you'll find donated items from these organizations…

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Venue and Event Information

Meeting Venue

Thursday, November 16, 2023, 8:00 – 18:30
Friday, November 17, 2023, 8:00 – 12:00

Chase Center on the Riverfront
815 Justison Street, Wilmington, Delaware 19801
https://centerontheriverfront.com/

Mentor/Mentee Lunch

Thursday, November 16, 2023, 12:00 – 1:30

Del Pez Mexican Gastropub
400 Justison Street, Wilmington, DE 19801
https://www.delpezmexicanpub.com/all-day-menu

Dinner and Evening Social

Thursday, November 16, 2023, 18:30 – 21:00

Iron Hill Brewery and Restaurant
620 Justison Street, Wilmington, DE 19801
https://ironhillbrewery.com/location/wilmington-de/

Lodging

Check-in: 16:00 / Check-out: 12:00

Westin Wilmington
818 Shipyard Drive, Wilmington, DE 19801
https://www.marriott.com/en-us/hotels/ilgwi-the-westin-wilmington/overview/

Lunch Fundraiser: Eat at Del Pez!

Although lunch will not be provided for the meeting attendees who did not sign-up for the Mentor/Mentee Lunch,
the MAC-AFS Executive Committee strongly encourages all other attendees to eat their lunch at Del Pez Mexican Gastropub.

The MAC-AFS ExCom have secured a special fundraising opportunity with Del Pez.

Anyone who presents a special MAC-2023 voucher to the Del Pez waitstaff will have **20% of their meal's cost donated back to MAC-AFS!**

All meeting attendees will receive this voucher when they check-in at the registration desk.

https://www.delpezmexicanpub.com/all-day-menu

Schedule of Events

Thursday, November 16, 2023

8:00 – 8:45	Registration and Breakfast
8:45 – 9:00	Welcome Message (MAC-AFS President Johnny Moore)
9:00 – 9:15	AFS President Address (AFS Past President Dr. April Croxton)
9:15 – 10:00	Session 1: Crustaceans
10:00 – 10:15	Break
10:15 – 11:45	Session 2: Wind Energy and Fisheries Interactions Symposium and Panel Discussion (*sponsored by Community Offshore Wind*)
11:45 – 13:30	Lunch (on your own)* *Mentor/Mentee Lunch will take place at Del Pez Mexican Gastropub*
13:30 – 14:30	Session 3: Diadromous Fishes & Social Ecological Systems I
14:30 – 14:45	Break with Light Refreshments
14:45 – 16:00	Session 4: Marine Fishes
16:00 – 16:30	Break: Poster Session Set-up and Hotel Check-in
16:30 – 18:30	Poster Session, Silent Auction, and Afternoon Appetizers
18:30 – 19:00	Break: Poster Session Break-down and Hotel Check-in
18:30 – 21:00	Dinner and Evening Social at Iron Hill Brewery and Restaurant

*Lunch is only provided for Mentor/Mentee groups. However, anyone who eats at Del Pez and presents the MAC-2023 voucher will have 20% of their meal's cost donated back to MAC-AFS! See page 8 for details.

Friday, November 17, 2023

8:00 – 8:40	Registration and Breakfast
8:40 – 8:45	Welcome Message (MAC-AFS President Johnny Moore)
8:45 – 9:45	Session 5: Social Ecological Systems II & Aquaculture I
9:45 – 10:00	Break
10:00 – 10:45	Session 6: Aquaculture II & Biogeochemistry
10:45 – 11:00	Break
11:00 – 12:00	MAC-AFS Business Meeting and Awards Ceremony for Best Student Presentations

Thursday, November 16th			
Session	Talk_#	Est. Start Time	Title (Presenting Author's Last Name)
Registration & Breakfast		8:00	
Welcome		8:45	(Moore)
AFS Past President Address		9:00	(Croxton)
Crustaceans	Talk_1	9:15	Selective harvesting under a changing climate: Delaware Bay Blue Crabs (Cruz)
	Talk_2	9:30	Examining the impact of derelict crab pots and active fishing on Blue Crab (Callinectes sapidus) total catch and landings within a recreational fishery in a Mid-Atlantic Estuary (Feris)
	Talk_3	9:45	Developing fishery-compatible TED regulations in New Jersey's blue crab fishery (J. Brust)
Break		10:00	
Wind Energy and Fisheries Interactions	Talk_4	10:15	NEFSC Science Priorities for Offshore Wind Energy Development & Fisheries (Vasslides)
	Talk_5	10:30	Planning research and monitoring for offshore wind and fisheries; Considerations for planning studies that can be used for decision making (C. Brust)
	Talk_6	10:45	Non-extractive monitoring of fish communities at offshore wind sites in New Jersey using eDNA metabarcoding (Chin)
	Talk_7	11:00	Monitoring Surfclams at Offshore Wind Energy Project Sites in the Mid-Atlantic (Munroe)
	Talk_8	11:15	Repercussions of offshore wind development on fisheries population assessments and potential compensatory mitigation options for the Atlantic surfclam fishery (Borsetti)
	Panel Discussion	11:30	Panel Discussion on Wind Energy and Fisheries Interactions (Vasslides, Brust, Chin, Munroe, Borsetti, Robins)
Lunch		11:45	
Diadromous Fishes	Talk_9	13:30	Acoustic tagged American shad utilize historic spawning habitat following dam removal in northern Delaware (Roday)
	Talk_10	13:45	Examining variability of abundance in diadromous and resident fishes among three tributaries of Delaware, USA (O'Toole)
Social-Ecological Systems I	Talk_11	14:00	Casting a Wider Net — A report on… Strategies for Increasing Participation of Diverse Consumers in a Community Seafood Program (Tse)
	Talk_12	14:15	Using Seaspiracy to Engage Critical Questions in Ocean and Fisheries Conservation (McGuire)
Break		14:30	
Marine Fishes	Talk_13	14:45	A preliminary examination of fish diet data from New Jersey's ocean trawl survey (Celestino)
	Talk_14	15:00	Finding Marine Grocery Stores: A Lagrangian Approach to Prey Concentrating Features in Coastal Biological Hotspots (Veatch)
	Talk_15	15:15	Investigating the Relative Energetic Importance of Different Regions of the U.S. East Coast for the Migratory Sand Tiger Shark Using an Integrative Stable Isotope Mixing Model (Marsaly)
	Talk_16	15:30	Spatial and Temporal Patterns of the Prohibited Atlantic Angel shark, Squatina dumeril Within the Mid-Atlantic Bight (Maguire)
	Talk_17	15:45	Fish community of a shoreface sand ridge: A baseline for understanding dredging effects (Potts)
Break: Poster Session Set-up, and Hotel Check-in		16:00	
Poster Session, Silent Auction, and Afternoon Appetizers		16:30	
Break: Poster Session Break-down and Hotel Check-in		18:30	
Dinner and Evening Social at Iron Hill Brewery and Restaurant		18:30	

Friday, November 17th			
Session	Talk_#	Est. Start Time	Title (Presenting Author's Last Name)
Registration & Breakfast		8:00	
Welcome		8:40	Welcome (Moore)
Social-Ecological Systems II	Talk_18	8:45	The Evolution of Fisheries Management on the Atlantic Coast: Necessarily Complex or Needlessly Complicated? (Clark)
	Talk_19	9:00	Evaluating the Perceptions of Saltwater Anglers in New Jersey: from the Lens of Citizen Science and Science Education (Christensen)
Aquaculture	Talk_20	9:15	Quantifying Farmed Oyster Performance and Wild Oyster Recruitment in Delaware Bay, USA (Hudock)
	Talk_21	9:30	Establishment and Evaluation of Regionally Crossbred Hard Clam Mercenaria mercenaria (Coyne)
Break		9:45	
Aquaculture	Talk_22	10:00	Evaluating the Feasibility and Sustainability of an Integrated Multi-trophic Recirculating Aquaculture System Using Striped Bass (Morone saxatilis), Sand Worms (Alitta virens), and Sea Beans (Salicornia bigelovii) (Acquafredda)
	Talk_23	10:15	Changing Environmental Conditions and the Atlantic Surfclam (Spisula solidissima): Multi-stressor Laboratory Experiments and Experimental Off-shore Farming (Steeves)
Biogeochemistry	Talk_24	10:30	The global contribution of mesopelagic fish and other metazoans to the biological carbon pump (Pinti)
Break		10:45	
MAC-AFS Business Meeting		11:00	Business Meeting & Student Awards Ceremony (Moore)
End of Meeting		12:00	

Key	Student presenter

Oral Presentations

Listed in chronological order

Key:
* = presenting author
‡* = graduate student presenting author
†* = undergraduate student presenting author

Crustaceans

Selective harvesting under a changing climate: Delaware Bay Blue Crabs

Seleni Cruz ‡*, Anna Birkenbach, Kimberly Oremus**,** Jonathan Cohen & Taylor Hoffman

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Feedback mechanisms between fishing decisions and reproductive dynamics pose a challenge for effective fisheries management. Size-dependent pricing is common in fisheries and can result in the selective harvesting of a population subset, often differentiated by size or sex. In the mid-Atlantic blue crab fisheries, research suggests that market incentives to harvest large male crabs may negatively affect population dynamics by limiting sperm and operational sex ratios. In this paper, we simulate the effect of selective harvesting on the Delaware Bay blue crab population and compare the behavioral response of fishers to hypothetical new gear/catch limits, seasonal closures, and other policy scenarios. We develop a unique bioeconomic model that links size-dependent market incentives to population productivity in order to assess how policy scenarios could affect the sustainability of the fishery. Crab growth is simulated using an individual-based population model, which we link to an economic model in which fishers maximize the net present value of harvest by choosing levels of effort for each market category distinguished by shell status, size, and sex. Our model captures intra-seasonal dynamics by incorporating different marginal costs of fishing, prices, and gears used at different points in the season. Our policy scenarios, which are informed by recent management changes in the Chesapeake Bay to protect declining blue crab populations, are designed to explore the balance and trade-offs between economic and biological sustainability in this important fishery.

Examining the impact of derelict crab pots and active fishing on Blue Crab (*Callinectes sapidus)* total catch and landings within a recreational fishery in a Mid-Atlantic Estuary

Randy J. Feris Serrano ‡*[1], Jennifer Repp[1], Arthur Trembanis[1], & Edward A. Hale[1,2]

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Derelict fishing gear induces detrimental ecological and economic impacts worldwide to target species and bycatch alike. In this study, we explored the impact of both actively tended and derelict recreational crab pots on Blue Crab catch rates in a Mid-Atlantic estuary using a randomly stratified approach. Our goal was to understand how derelict gear affected Blue Crab catch and landings within three regions of Indian River Bay, USA. Our study was unique in that no commercial fishing is permitted in the area, allowing us to examine the influences of derelict gear on a recreational fishery free from commercial fishing pressure. Our study suggests that total catch (Linear Mixed Effects Model, $p < 0.05$, $n = 973$) and landings (Linear Mixed Effects Model, $p < 0.05$, $n = 639$) were negatively affected by interactions with derelict crab pots. Our findings confirm that derelict fishing gear, particularly recreational crab pots, significantly affects Blue Crab catch rates emphasizing the need for derelict gear retrieval. Our results underscore the necessity of mitigating the effects of ghost fishing in areas focused on recreational fishing, providing valuable insights into factors affecting Blue Crab populations, and emphasizing the importance of ongoing research to fully understand these complex environmental interactions.

Developing fishery-compatible TED regulations in New Jersey's blue crab fishery.

Jeffrey Brust* & Matthew Heyl

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*Jeffrey.brust@dep.nj.gov

A recent designation of diamondback terrapin (*Malaclemys terrapin*) as a non-game species in New Jersey has prompted efforts to reduce incidental mortality in New Jersey's commercial and recreational blue crab (*Callinectes sapidus*) pot fisheries. Initially proposed measures included reducing the size of terrapin excluder devices (TED) used in commercial-style crab pots, and making TEDs mandatory in all areas and seasons. Comments from industry advisors expressed strong opposition to these measures and identified several data gaps that could inform development of alternative proposals. New data collection programs to fill these gaps should provide perspective on regulatory options that provide additional protection for terrapins while maintaining viable commercial and recreational blue crab fisheries.

Wind Energy and Fisheries Interactions Symposium

The MAC-AFS 2023 “Wind Energy and Fisheries Interactions Symposium and Panel Discussion” is sponsored by Community Offshore Wind. The content of the presentations shared during this symposium was NOT influenced by Community Offshore Wind’s sponsorship.

NEFSC Science Priorities for Offshore Wind Energy Development & Fisheries

Elizabeth Methratta[1], Angela Silva[1], Andrew Lipsky[1], Kathryn Ford[1], Douglas Christel[2], Lisa Pfeiffer[3] & James Vasslides*[1]

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Offshore wind development (OWD) is set to expand rapidly in the United States as a component of the nation's effort to combat climate change. Offshore wind development in the United States is slated to begin in the Greater Atlantic region, where it is expected to interact with ocean ecology, human dimensions, fisheries data collections, and fisheries management. Understanding these interactions is key to ensuring the coexistence of offshore wind energy with sustainable fisheries and a healthy marine ecosystem. In support of National Oceanic and Atmospheric Administration (NOAA) Fisheries’ role as the nation's leading steward of marine life, agency fisheries scientists identified scientific research priorities for OWD in the Greater Atlantic region. This was done by extracting and analyzing OWD research needs from existing scientific documents and using this information as the basis to develop a list of priorities that align with five major OWD science themes that are of high interest to NOAA Fisheries. These NOAA Fisheries themes include supporting the regulatory process; mitigating the impacts to NOAA Fisheries' surveys; advancing science to understand interactions with NOAA Fisheries trust resources, the marine ecosystem, and fishing industries/communities; advancing the science of mitigation for NOAA Fisheries trust resources and fishing industries/communities; and advancing data management methods. The areas identified as research priorities will support the coexistence of offshore wind and sustainable fisheries and inform the development of NOAA Fisheries' science plan for offshore wind in the Greater Atlantic region, as well as cross-sectoral science planning efforts at the regional, national, and international levels.

Planning research and monitoring for offshore wind and fisheries; Considerations for planning studies that can be used for decision making.

Colleen Brust

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The first cohort of offshore wind energy projects in the United States has spawned a rapid growth and diversification of marine research in the North and Mid-Atlantic. There is an urgency to launch research programs in time to collect preconstruction data, but uncertainty about what data are most needed for decision making. The temporal and spatial scale of the development is unprecedented, and existing research and monitoring programs were not designed to answer questions specific to offshore wind construction and operation. The New Jersey Marine Resources Administration consults on project monitoring, mitigation, and regional research, including New Jersey's Research and Monitoring Initiative, and has been collaborating with other interested parties to consider the elements of effective and economical monitoring plans. Such plans will address the most pertinent, overarching questions related to managing fisheries during the development of offshore wind energy via the complementary approaches of project-specific and regional research and monitoring. Beginning with the extensive library of completed and ongoing studies from European wind farms and Block Island, we can focus on impacts that are most likely, and then prioritize resources based on vulnerability and ecological and economic importance. Critical information gaps include potential physical changes on various spatial and temporal scales, how to measure impacts on marine resources if they occur, and the efficacy of mitigation. A variety of guidance documents are now available on this topic, but it would be useful to consider approaches used in other environmental risk and impact studies. Offshore wind development has made funding available to conduct rigorous and long-term research, there are exceptional mitigation and monitoring requirements for the industry, and careful consideration of objectives and utility of data collection should be a priority for decision-makers.

Non-extractive monitoring of fish communities at offshore wind sites in New Jersey using eDNA metabarcoding

Sam Chew Chin*[1], Shannon O'Leary[2], Keith Dunton[1] & Jason Adolf[1]

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Accelerating the development of offshore wind power is a core component of US renewable energy strategy. With dozens of leasing areas assigned on the East Coast, wind turbines, transmission cables, shore facilities, and associated vessel traffic are poised to become widespread features of the US seascape. As only a handful of offshore turbines are currently operational, the specific responses of marine life to the installation of large-scale developments are difficult to forecast. Determining the environmental impact of offshore wind developments on underlying marine ecosystems will thus depend on site-specific biological monitoring of the leasing areas before, during, and after construction. We present here preliminary findings from pre-construction monitoring of wind farm and control sites off the coast of New Jersey. Using environmental DNA metabarcoding of water samples, we assessed fish community composition and relative abundance. In anticipation of ongoing offshore wind development, we discuss the scalability of our approach and how it integrates with larger monitoring and management frameworks.

Monitoring Surfclams at Offshore Wind Energy Project Sites in the Mid-Atlantic

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The Atlantic surfclam fishery is among the most susceptible to impacts from offshore wind energy development due to potential displacement from fishing grounds that overlap with wind lease areas. These vulnerabilities underscore the need to survey surfclams in Mid-Atlantic wind energy areas. A survey tool that samples over a relatively large area and consistently catches large-bodied clams is needed to accurately estimate biomass, abundance, and size structure of the surfclam stock. A scientific hydraulic sampling dredge designed to catch a breadth of sizes of surfclams was constructed and used to survey surfclams at offshore wind lease locations. Surveys of the wind lease area and control locations will continue annually through the construction and early operation of two wind farms, and a before-after-control-impact sampling design will allow changes in clam abundance due to the wind project to be evaluated. Experiments to calibrate the dredge by quantifying its size selectivity and sampling efficiency have been completed, allowing data generated from this sampling tool to be compared to, and potentially integrated with, long-term federal survey data.

Additionally, the habitats in which these surveys occur are subject to ocean acidification and warming water conditions, environmental stressors to which surfclams are sensitive. A major gap in ocean acidification research is co-located environmental and biological response monitoring; therefore, simultaneous measurements of surfclam biological response indicators (e.g., abundance, size, growth, shell strength, condition index) have been measured in coordination with carbonate chemistry observations at the sampling locations. These coordinated survey programs will enhance understanding of how important fisheries resources may be impacted by construction of offshore wind projects and future environmental conditions.

Repercussions of offshore wind development on fisheries population assessments and potential compensatory mitigation options for the Atlantic surfclam fishery

Sarah Borsetti*[1], Daphne Munroe[1], Andrew Scheld[2], Caela Gilsinan[2], John Klinck[3], Eric Powell[4] & Eileen Hofmann[3]

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High demand for renewable energy has stimulated offshore wind farms' development along the east coast of the United States, with over two million acres currently leased for development. Lucrative shellfish fisheries in this region, such as the Atlantic surfclam fishery, are highly vulnerable to impacts from offshore wind energy development due to the overlap of large areas proposed for wind energy and fishing grounds, limitations to access for bottom-tending gear towed by large vessels, and the value of the landed product. The impacts of offshore wind farms on the Atlantic surfclam fishery were evaluated using a modeling framework that integrates spatial dynamics in stock biology, captain and fleet behavior, management decisions, and fishery economics. Access to important Atlantic surfclam fishing grounds is expected to be limited or lost due to the identified overlap with offshore wind energy development. Simulation results provide an understanding of changes to biological reference points due to the loss of access by the federal assessment survey. Excluding the Atlantic surfclam assessment surveys from the regions designated for offshore wind development can alter long-term stock assessments by increasing uncertainty in metrics used to set fishing quotas. Understanding the range of impacts of offshore wind development on fisheries resources provides information to regulators about the potential scale of fisheries mitigation necessary. If economically viable, stock enhancement is a potential compensation strategy for damages imposed on the surfclam fishery by offshore wind energy development. This research explored the viability of hatchery-supported stock enhancement of the Atlantic surfclam fishery at a large, fishery-relevant scale. The best available information about predatory losses, surfclam hatchery and nursery growth, and costs of production were used to explore the economic viability of several large-scale surfclam hatcheries to offset additional costs, reduced revenues, and potential job losses associated with the displacement of the fishing fleet.

Panel Discussion on Wind Energy and Fisheries Interactions

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Diadromous Fishes

Acoustic tagged American shad utilize historic spawning habitat following dam removal in northern Delaware

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The anadromous American shad (*Alosa sapidissima*) depend on freshwater rivers to successfully reproduce. In order to counteract decades of severe population decline, federal and state government agencies have initiated habitat restoration efforts by removing existing impediments to such freshwater habitats. In 2019, the state of Delaware removed the first barrier to anadromous fish passage on the Brandywine River, Dam 1. Twenty-six shad were opportunistically tagged with acoustic transmitters from 2021-2022 above recently removed Dam 1 and tracked in the Delaware River and estuarine and coastal waters of the Atlantic Ocean. The area of available habitat increased by 1.6km and 76% of tagged shad used historic spawning grounds in the Brandywine River immediately after dam removal. Ten fish appeared to exhibit long-term residency in the Brandywine River from May–June, demonstrating the importance of this newly available habitat to spawning adults. We observed handling effects, including tagging-related mortality and fallback, in five fish, four of which were tagged in 2022. We suggest future research examining the impact of hook and line vs. electrofishing on shad survival and performance. Further, we recommend increasing the number of acoustic receivers in Delaware River Basin tributaries, such as White Clay Creek and the Christina River, to further investigate how shad are using habitat near recently deconstructed dams.

Examining variability of abundance in diadromous and resident fishes among three tributaries of Delaware, USA

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Historical overharvest compounded with impairments to water quality, and the installation of impediments to fish passage for societal development have hindered populations of diadromous and resident fishes along many tributaries of the eastern United States. These barriers to population growth have resulted in low levels of spawning stock biomass for many diadromous fishes, including American Eel (*Anguilla rostrata*), American Shad (*Alosa sapidissima*), and Striped Bass (*Morone saxatilis*). Portions of Red Clay Creek, White Clay Creek, and the Brandywine River have all been dammed throughout history along multiple stretches per tributary. However, relatively recent dam removals have re-opened stretches of historical spawning habitat in the Brandywine River. With future dam removals planned in these waterways, our goal was to assess how resident and diadromous fishes used habitat corridors along these three tributaries. Our results to date suggest that some species including American Shad preferentially seek out habitats in the Brandywine River, while other species like juvenile Striped Bass were more concentrated in Red Clay Creek. We have found that diadromous fishes will seek out variable habitats within adjacent watersheds, suggesting that habitat value varies by species which may affect the prioritization of impediment removal and species rebuilding if recovery target species vary.

Social-Ecological Systems I

Casting a Wider Net — A report on… Strategies for Increasing Participation of Diverse Consumers in a Community Seafood Program

Amy Tse †*, Mimi Tran, Talia Young, Gabriel Cumming, Ellie Kerns, Kristin Hunter-Thomson, Harmony Lu, Tamara Manik-Perlman, Cassandra Manotham, Tasha Palacio, Narry Veang, Wenxin Weng, Feini Yin, & Cara Cuite

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Alternative food networks, which include community supported agriculture and fishery programs (CSAs and CSFs) are often looking to diversify their reach. Fishadelphia is a CSF program based in Philadelphia that is focused on selling fresh, high quality fish to socio-economically diverse customers. Fishadelphia's recent report, "Casting a Wider Net," shares seven strategies that can increase accessibility for low-income communities and communities of color: sliding scale pricing, flexible payment schedule, payment method, fish preparation, multiple communication channels and languages, pickup location, and recruitment method. The report is based on a manuscript by Young et al. that explores the diversity of community seafood programs. Fishadelphia's inclusion efforts can be loosely separated into two categories — tactical and structural inclusion. Tactical inclusion is the "what," things like price points and product offerings, and is easily transferred across different organizations. Structural inclusion is the "who," the people and places involved, and is difficult to transfer across different organizations. Crucially, inclusion is a journey, not a goal — achieving inclusion requires an ongoing commitment to accessible systems.

Using Seaspiracy to Engage Critical Questions in Ocean and Fisheries Conservation

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Upon its release in 2021, the Netflix documentary "Seaspiracy" made waves in and beyond the environmental community concerning its controversial exposé of the fishing industry. Topping Netflix charts, the broad consumption of this narrative outside scientific communities positively signaled public interest in the issues facing the ocean and marine life. While ecologically minded cinema can aid science communication, the single narrative of "Seaspiracy" is closer to dramatized fiction than science. Using statistics, quotes, and scientific results out of context, the documentary makes several claims – that sustainable fishing is not possible, the oceans will be empty by the year 2048, 46% of plastic pollution in the oceans comes from lost fishing gear – leading its audience to a simplistic recommendation that is neither realistic nor sustainable for most fish-eating communities: to stop eating fish.

Despite its misrepresentation of science in order to promote veganism, "Seaspiracy" completely ignores the issues of food security, culture, and systemic inequalities, which makes a rejection of seafood consumption unreasonable. Moreover, the reality is that local fishers, cooperatives, and organizations typically exemplify environmental ethics and stewardship. "Seaspiracy" remains a useful teaching tool since it was widely consumed, and for many viewers, it represents their primary source of information on the state of fisheries today.

Through a reexamination of the documentary's content, students can hone their scientific literacy skills while investigating six critical questions intertwined within ocean and fisheries conservation. Our teaching guide would offer a rebuttal "Seaspiracy's" arguments by re-presenting the issues using a set of 3-4 scientific articles that address the topics the documentary lays out. This approach would enable students to engage with the science sensationalism in "Seaspiracy" and then explore the problems and solutions with a nuanced and pragmatic lens that the Netflix documentary lacks.

Marine Fishes

A preliminary examination of fish diet data from New Jersey's ocean trawl survey

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Fish diet data are an indispensable source of data informing ecosystem models. The objectives of this study were to characterize the diets of several key fish predators as a potential input to coastwide ecosystem models. Diet data were collected in conjunction with the New Jersey ocean trawl, a stratified random trawl survey that samples five times per year from Cape May to Sandy Hook, NJ, between approximately 5 to 27 m isobaths. Diet data were collected between October 2017 and October 2022. We collected five fish per pre-determined length bin for weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*), tautog (*Tautoga onitis*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), bluefish (*Pomatomus saltatrix*), spiny dogfish (*Squalus acanthias*). For each predator, before the stomach was extracted, we collected length, weight, and where possible, sex and age. Stomach contents were identified to the lowest taxon possible. We binned prey into prey categories used in current coastwide ecosystem models and we estimated diet composition using cluster sampling estimators. In total, we collected over 3,200 stomachs. Aside from prey that did not fit into existing model prey categories ('other'), notable fractions of striped bass diets included shrimp, Atlantic menhaden, crustaceans, and megabenthos (e.g., *Ovalipes ocellatus*); bluefish diets were dominated by anchovies; summer flounder diets were dominated by squid, shrimps, magabenthos (e.g., *O. ocellatus*, *Cancer borealis*), and micronekton. Results from the NJ trawl were similar to those observed in other nearshore coastal diet studies. Future work will focus on characterizing the seasonal patterns in diet, as well as by size of predator and prey.

Finding Marine Grocery Stores: A Lagrangian Approach to Prey Concentrating Features in Coastal Biological Hotspots

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Food resources in polar oceans are relatively diffuse, and need to be concentrated for consumers. Concentrations of plankton at the base of the food web increase prey availability for intermediate and upper trophic levels, as if creating marine “grocery stores”. This leads to a patchy distribution of bioactivity and the biological pump. However, the mechanisms responsible for this heterogeneous distribution have yet to be fully quantified, especially on the small spatiotemporal scales of coastal regions. Lagrangian approaches applied to coastal ocean dynamics can identify the transport features responsible for plankton patchiness, linking highly nonlinear coastal flow to the spatial ecology of food webs. This study applies a Lagrangian Coherent Structure technique, Finite Time Lyapunov Exponents (FTLE), to coastal surface currents observed by High Frequency Radars (HFR) around a known biological hotspot, Palmer Deep Antarctica. FTLE results were compared to the spatial ecology of phytoplankton, Antarctic Krill (Euphausia superba), and foraging penguins, relating each level of the food web to Lagrangian transport. Simultaneous measurements of the physics and food web were gathered through the integration of vessel and autonomous glider surveys within the HFR footprint. Results show that transport features quantified by FTLE on sub-tidal spatiotemporal scales concentrate supplies of phytoplankton. The spatial distribution of phytoplankton is then reflected in krill swarming behavior, which then influences foraging efforts of local penguin colonies. This quantified relationship between ocean movement and food web dynamics can be applied to predictions of spatial ecology and changing prey conditions. Results emphasize the role of transport in the maintenance of the biological hotspot around Palmer Deep and potentially coastal ecosystems globally. Future work will apply these techniques to the Mid Atlantic on larger spatiotemporal scales, investigating if similar patterns can be found in more complex, migratory food webs.

Investigating the Relative Energetic Importance of Different Regions of the U.S. East Coast for the Migratory Sand Tiger Shark Using an Integrative Stable Isotope Mixing Model

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Recent decades have been characterized by rapid technological advances, providing researchers access to new tools to investigate various aspects of the ecology of marine species. However, aspects of the biology of many large elasmobranchs remain poorly understood, especially their migratory behavior and relative importance of different regions to energy budgets. The sand tiger shark (*Carcharias taurus*) seasonally migrates along the east coast of the United States. The species has experienced historical population declines to the point where the species is now listed as 'Critically Endangered' on the IUCN Red List. Improved understanding of the ecological role of sand tigers, and how this may vary across their seasonal migrations, will also inform management of their populations. We used a combination of acoustic telemetry and stable isotope analysis (SIA) to investigate relationships between movements and feeding ecology of sand tigers by tagging sharks with acoustic transmitters and collecting muscle tissue biopsies for SIA to estimate carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) ratios. We used a modified Bayesian isotope mixing model integrating acoustic telemetry and SIA data as well as information on tissue turnover rates and stable isotope discrimination factors to estimate the relative importance of different regions used by sand tiger sharks during their migration towards their overall diet. Our results will enhance our knowledge of the relationship between migratory behavior and foraging in sand tigers and advance our ability to directly integrate distributional and chemical tracer data to better characterize the migratory behavior of large marine predators.

Spatial and Temporal Patterns of the Prohibited Atlantic Angel shark, *Squatina dumeril* Within the Mid-Atlantic Bight

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Globally, Angel sharks (*Squatina* spp.), are one of the most threatened species of sharks with more than half of the 22 extant species currently classified as Threatened on the IUCN red list. Atlantic angel sharks (*Squatina dumeril),* are a "data deficient" species that ranges along the east coast of the US and is currently federally prohibited from being harvested. Distribution of this species along the east coast has been found to vary with depth and season. The objective of this study was to evaluate the spatial and temporal distribution of Atlantic angel sharks in the Mid-Atlantic Bight, through analysis of long-term coast wide offshore bottom trawl surveys conducted by the NJDEP, SEAMAP, and NMPS. Surveys were conducted seasonally and ranged from the Gulf of Maine to Cape Canaveral, FL which covers the Atlantic angel shark's entire geographic range. The highest number of angel shark captures on the Northeastern coast occurred in the summer season, and the highest number of captures on the Southeastern coast occurred in the winter season. A small subset of sharks (n=5) was surgically implanted with Vemco acoustic transmitters to evaluate long-term movements within this region. Sharks were detected at 22 different sites (n=1,388 unique detections) along the coast with most of the detections occurring off MD and NC. This information shows strong northerly summer and southerly winter migrations. Data also showed that Atlantic angel sharks migrated away from nearshore habitat in the winter months and were almost exclusively found offshore until early spring. Since Atlantic angel shark populations with the US are "data deficient", this information can is important in the understanding and conservation of this species.

Fish community a of shoreface sand ridge: A baseline for understanding dredging effects

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Coastline erosion critically impacts local ecology and human infrastructure. Mitigation frequently includes the dredging of offshore sand deposits as source material for beach nourishment. In the Middle Atlantic Bight, shoreface sand ridges are targeted but may be important to structuring fish habitat on a broad continental shelf. In this experiment, we will examine fish community response to sand ridge dredging. Here, we established a baseline for seasonal fish community composition at a sand ridge prior to dredging. Short-tow trawl survey supported by side scan sonar mapping revealed a strong spatial and temporal variability of fish species and community distributions, and provide important information on microhabitat use. This baseline provides critical bases to understand community and habitat changes following upcoming sand dredging through the site.

Social-Ecological Systems II

The Evolution of Fisheries Management on the Atlantic Coast: Necessarily Complex or Needlessly Complicated?

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Societies have long sought to ensure access to fisheries by managing effort or the environment while also ensuring the fish populations aren't extirpated in the process. Delaware provides an example of how fisheries management on the Atlantic Coast has evolved over the centuries, from the simple measures of colonial times to the complex multisector fishery management plans of today. Much of today's management efforts have grown out of past failures to protect fish populations. Delaware, as with other Atlantic Coast states, started passing state laws to protect and allocate fisheries in the late 19th century. By the early 20th century, it was apparent that states needed to work together to protect fish populations that migrated between states, such as striped bass, and Atlantic States Marine Fisheries Commission (ASMFC) was created in 1942 for this purpose. State waters typically extend three miles from shore and, for most of US history, international waters, which were open to all nations to fish, began at that point. However, the US declared an exclusive fishing zone (now known as the EEZ) extending from 3 to 200 miles from shore in 1977 with the passage of the Magnuson-Stevens Act (MSA). The MSA also created the eight Fishery Management Councils, which allow the fishing industry to work cooperatively with state and federal governments to manage fish in the EEZ in each Council's region. Currently, some fisheries are managed exclusively by the individual states, some jointly by the states through ASMFC, some exclusively by the Fishery Management Councils, some exclusively by the National Marine Fisheries Service, and some jointly by the preceding three entities. Today's complex fishery management relies on fishery dependent and independent data to fairly allocate fish populations among the various fishery sectors and states while trying to ensure the that the managed populations thrive.

Evaluating the Perceptions of Saltwater Anglers in New Jersey: from the Lens of Citizen Science and Science Education

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There are many project specific barriers between the development of useful technology based recreational fishing apps and angler use, especially for the purpose of conservation. Successful citizen science projects vary extensively and provide established frameworks for topics such as bias, distrust, buy-in and validity while simultaneously educating the public. Establishing trust and transparency of shared goals shape recreational anglers in becoming a useful resource for established management programs. Human dimensions data are needed to better understand the needs of local anglers and to support the scientifically defensible data they collect. The largest barriers to citizen science fisheries data collection include public lack of knowledge about programs and other factors that decrease fishing time whereas major motivators include providing data synthesis and showing value of the data. Our New Jersey saltwater angler survey is based on previous literature and addresses questions about: (1) demographics, (2) preferred method of data entry, (3) fishing preferences/occurrences, (4) Information individuals are willing to give, (5) major concerns they have, and (6) their preferences and desires for new technology (i.e. app). The purpose of the distribution of this survey is to better understand the types of anglers in NJ who participate as well as their motives and concerns. Analysis of these results may drive and justify the development of a new technology (i.e. app). This survey was recently approved by Stockton's IRB and will be systematically distributed among stakeholder groups in NJ by following previous frameworks. Analysis of the results of this survey would not only provide insight on recreational angler perspectives but could be used to drive the development of a user-friendly platform that would best serve anglers, researchers and stakeholders.

Aquaculture

Quantifying Farmed Oyster Performance and Wild Oyster Recruitment in Delaware Bay, USA

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The commercial oyster aquaculture industry has experienced substantial worldwide expansion over the last century. Furthermore, there is a widespread push to carry out restoration initiatives to replenish natural oyster populations. These efforts offer valuable ecosystem benefits such as curbing shoreline erosion, promoting local biodiversity, and mitigating excess nutrients in estuarine environments. As these efforts expand, it is crucial to understand how water quality factors (temperature, salinity, dissolved oxygen) and biological variables (local biodiversity, spawning stock, recruitment) affect oyster performance for both commercial and restorative purposes.

In estuarine regions with significant spatial and temporal variations, rapid fluctuations in physical and biological factors over short distances are crucial for oyster recruitment and retention success. Delaware Bay estuary, a sizable coastal plain with fluctuating salinity levels in response to bidirectional flow, is located in the Mid-Atlantic region of the eastern United States. Within systems like this, habitat suitability models can be implemented to anticipate prospective sites for oyster aquaculture or restoration, considering both environmental and ecological factors.

Data collection efforts are in progress to gather information regarding the survival and growth of two strains of cultivated oysters and the recruitment of wild oysters across various points along the estuarine gradient of Delaware Bay. We aim to build and validate a bay-wide habitat suitability index model with this data. This model will guide estuary restoration and commercial activities, predicting ideal locations for oyster-based living shorelines, reef restoration, and commercial viability. Findings from our first field season suggest that both tidal position and strain had a statistically significant effect on mean oyster length across all weeks (p-value < 0.01, Schreirer-Ray-Hare). Additionally, no significance was found in spat recruitment against tidal position each week (p-value > 0.05, Schreirer-Ray-Hare). We will share further findings from our first field season and report early stages of model development.

Establishment and Evaluation of Regionally Crossbred Hard Clam *Mercenaria mercenaria*

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Hard clam (*Mercenaria mercenaria*) aquaculture is currently impacted by mass-mortality events caused by QPX (quahog-parasite unknown). The growth of cultured clams is slow and needs to be improved. To determine if the performance in QPX resistance and growth can be improved by interstrain hybridization, we produced the following four hybrid and pure crosses of hard clams in summer 2023: a NY hatchery (NYH) stock selected for QPX resistance, a wild stock from Barnegat and Great Bays of New Jersey (NJW), a hybrid cross (HYB) between NYH and NJW, and a hatchery stock from New Jersey (NJH). The four groups were produced by mass spawn of 12 – 23 parental clams with 4-5 replicates per group. No difference was observed in larval size among the groups from day 1 and day 14. Survival to D-stage at Day 1 was significantly lower ($p < 0.05$) in the hybrid cross than other crosses. Larval survival from D1 to Day 7 and Day 14, however, was significantly higher ($p < 0.05$) in the hybrid cross. After metamorphosis, the number of juveniles survived to 3-5 mm was 51,780 for HYB, 24,500 for NJW, 2,450 for NJH and 1,788 for NYH. While preliminary, results of this study suggest that the hybrid cross has higher larval survival after D1, which may be attributable to increased genetic diversity. Juveniles from the four groups are being maintained in the nursery for field deployment and evaluation.

Evaluating the Feasibility and Sustainability of an Integrated Multi-trophic Recirculating Aquaculture System Using Striped Bass (*Morone saxatilis*), Sand Worms (*Alitta virens*), and Sea Beans (*Salicornia bigelovii*)

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In many ways, striped bass (*Morone saxatilis*) aquaculture production using recirculating aquaculture systems (RAS) is commercially ready in the United States. However, as with other forms of finfish aquaculture, waste management is a major challenge constraining its expansion. The objective of this project was to investigate whether integrated multi-trophic aquaculture (IMTA) is a suitable strategy for mitigating the wastes produced by RAS-reared striped bass. Specifically, we tested the capacity of sand worms (*Alitta virens* = *Nereis virens*) and sea beans (*Salicornia bigelovii*) to utilize solid and dissolved wastes, respectively. In this experiment, two nearly identical RAS were established: one system was designed for striped bass monoculture and the other was designed for bass–worm–sea bean IMTA. Over the course of the five-month experiment, we measured and assessed the growth of the focal organisms, waste accumulation and reduction, and striped bass and system-wide feed conversion ratios (FCR). We found that the monoculture and IMTA-reared striped bass grew at statistically similar rates. Approximately 45% of the total solid waste collected from the IMTA system was recycled as worm feed, and total worm biomass increased by ~114%. Dissolved waste mitigation was also observed in the IMTA system. Compared to the monoculture, the IMTA system exhibited significant reductions in nitrate and phosphate concentrations and a significant increase in pH. More than 24.5 kg of sea beans were also produced during the study. Finally, while the striped bass of both systems exhibited a similar FCR (~1.2), the IMTA system-wide FCR was ~64% lower than the monoculture system-wide FCR. Taken together, this project demonstrates that striped bass, sand worms, and sea beans can be successfully co-cultured in RAS. Future studies should investigate the economic costs (e.g., added labor and utility costs) and benefits (e.g., diversification and new sources of income) of this IMTA system.

Changing Environmental Conditions and the Atlantic Surfclam (*Spisula solidissima*): Multi-stressor Laboratory Experiments and Experimental Off-shore Farming

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The Atlantic surfclam (*Spisula solidissima*) is an economically important species, supporting commercial fisheries in the mid-Atlantic region of the United States. Growing surfclams in aquaculture farms presents an opportunity to support surfclam production with a unique product that would not compete with fished surfclam (i.e., a steamer sized clam ~55mm). Although aquaculture farms are usually in protected coastal areas, farming in the open ocean presents an opportunity to farm shellfish where space is less competitive, water quality is often higher, and where species naturally occur. Here, we have collaborated with fishing industry partners to provide information about the potential for the surfclam to be cultivated at commercial scales in the open ocean. This fall we deployed over 200,000 seed size surfclams (~15mm length) at five different stocking densities in four novel growout cages in federal waters off the coast of Atlantic city. This year, we will monitor growth and survival rates of these clams while collecting a timeseries of environmental data within the cages (e.g., pH, temperature, salinity, oxygen). Further, to examine how changing ocean conditions in potential aquaculture areas may impact surfclam survival and growth rates, we will use laboratory experiments to observe surfclam performance at ambient and stressful levels of temperature and carbonate chemistry (reflective of ocean acidification). This collaborative research effort will provide information about the potential to produce surfclams in offshore aquaculture farms, and the ability surfclam to survive and grow in changing oceanographic conditions.

Biogeochemistry

The global contribution of mesopelagic fish and other metazoans to the biological carbon pump

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Many marine organisms perform vertical migrations, as they seek to balance their feeding opportunities and predation risk. Metazoans such as zooplankton and mesopelagic fish perform diel vertical migrations (DVM), typically spending the day at depth hiding from visual predation, before ascending to the surface to feed at night. These vertical migrations actively transport organic carbon from the ocean surface to the depth, contributing to the biological carbon pump. Here, we provide estimates of carbon export (the flux of carbon from the surface to the depths) and carbon sequestration (the amount of carbon stored in the ocean's interior) mediated by these diel vertical migrations. We use a game-theoretic food-web model to simulate diel vertical migrations and estimate near-global (global ocean minus coastal areas and high latitudes) carbon fluxes and sequestration by fish and zooplankton due to respiration, fecal pellets, and deadfalls. We then couple our results to a global ocean circulation model to estimate carbon sequestration mediated by these organisms.
While the export production of metazoans is modest (~20 % of global total), we estimate that their contribution to carbon sequestered by the biological pump (~800 PgC) is conservatively more than 50 % of the estimated global total (~1300 PgC) and that they have a significantly longer sequestration timescale (~250 years) than previously reported for other components of the biological pump. Fish and mesopelagic fish in particular appear to contribute significantly to global carbon sequestration.

Poster Presentations

Listed in alphabetical order by presenting author's last name

Key:
* = presenting author
‡* = graduate student presenting author
†* = undergraduate student presenting author

Fish-ics: Cold Pool Influences on Commercial Species Dynamics in the Mid-Atlantic Bight

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The Mid Atlantic Bight (MAB) is a dynamic ocean region with strong seasonal cycles. Thermal variability in the MAB is dominated by a distinctly cold, nutrient-dense, "pocket" of bottom water that forms annually known as the Cold Pool. The timing of the annual Cold Pool spring formation, summer intensification, and fall breakdown can all vary from year to year. This interannual evolution of the MAB Cold Pool supports ecological services for a variety of commercial and recreationally targeted species, including the summer flounder (*Paralichthys dentatus*), striped bass (*Morone saxatilis*), and spiny dogfish (*Squalus acanthias*). With a goal of 11 gigawatts by 2040, New Jersey is at the forefront of offshore wind development in the coming years. To isolate the effects of offshore wind development on MAB oceanography and ecology, we must first comprehend how the system functions prior to construction. The baseline interactions between the seasonal evolution of the Cold Pool and the ecology must serve as context to any changes observed during and after construction of these offshore facilities. The New Jersey Department of Environmental Protection's Ocean Bottom Trawl Survey contains fisheries and oceanographic data sampled across all seasons for ~30 years (1990 to 2019). In conjunction with a temperature model, this research aims to analyze decadal trends of bottom temperature and cold pool interannual development relative to species abundance and biomass. The goal of this research is to assess critical ocean habitats that overlap with offshore wind lease areas and to quantify long term trends of these commercial species.

Student Lesson Activity: Marine Community Video Documentation of Habitat on Shellfish Farms

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Development of different educational technology and tools have expanded as the access to the internet has increased. Using real research as a teaching tool has the potential to benefit students by engaging them in active scientific research while encouraging them to develop science-literacy skills. Specifically, data derived from real research projects that are visually engaging can further enhance public outreach and learning experiences. Shellfish growers routinely observe fish and invertebrates interacting with their aquaculture gear. To quantitatively assess these observed interactions, point-of-view (GoPro) cameras were used to document fish activity in and around an oyster farm in Barnegat Bay, New Jersey (2018 and 2019) and a mussel farm in Blue Hill Bay, Maine (2022). Using the video data collected in this study, a lesson plan targeting middle school students was developed. This lesson plan can also be modified to cater to younger or older age groups. The plan was designed to be completed individually by students or in small or large groups. In the lesson plan, a summary video was be made from a compilation of videos collected from the three years is provided to students. After watching the video, students are guided through making observations. Students are directed to ask questions generated from observations of the videos that engage critical thinking. This lesson plan has the potential to enhance a student's scientific experience in the classroom while also interacting with real research, with the goal of improved scientific literacy.

Evaluating the Impacts of Windfarm Construction on Structure-Associated Species off Southern New Jersey

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Fishery monitoring plans (FMP) are critical for evaluating potential impacts of offshore wind development on natural resources. A comprehensive FMP for Ørsted's Ocean Wind 1 windfarm off New Jersey was developed using different extractive (bottom trawl, trap, rod-and-reel, surfclam dredge, acoustic tagging) and non-extractive (eDNA, baited remote underwater video, towed camera, autonomous gliders) fisheries surveying methods. Surveying will occur for six years (2022-2028) with two years planned for before, during, and after construction. Our Structured Habitat Survey (SHS) is designed to evaluate the impact of windfarm construction on structure-associated species. This survey simultaneously deploys two extractive gears, chevron traps and rod-and-reel, and one non-extractive gear, which includes both benthic and pelagic stereo-baited remote underwater videos (S-BRUVs). Survey stations include impact sites within the windfarm at proposed turbine locations, control "phantom" turbine sites outside of the windfarm lease area, and control shipwreck sites at a nearby artificial reef. Seasonal surveying (six days/season: winter, spring, summer, and fall) for pre-construction monitoring began during the spring of 2022. Relative abundance estimates from the Chevron trap and rod-and-reel sampling, as well as from video footage analysis of S-BRUV deployments, are documenting the baseline seasonal variability in species important to local fisheries. S-BRUV footage is being scored manually using two sub-sampling methods to compare different processing efforts, and their statistical similarity to full watch sampling. In addition to manual scoring, a portion of S-BRUV footage is being annotated using Video & Image Analytics for Marine Environments (VIAME). These annotated datasets will contribute to training and developing computer vision AI models for qualifying species classifications. Collaboration with findings from the other complementary surveys within this FMP will contribute to a comprehensive evaluation of windfarm construction impacts on fisheries resources that serves as a valuable model for monitoring other windfarms in the northeast and other US regions.

Potential methods for using stable isotope analysis and isoscapes to determine the food web ecology and energy flows that support young-of-the-year sandbar sharks (*Carcharhinus plumbeus*) in Delaware Bay

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Delaware Bay is an important habitat and a primary nursery for young-of-the-year sandbar sharks (*Carcharhinus plumbeus*) along the east coast. Sandbar sharks are a protected species in Delaware, but an understanding of their ecology in the bay is critical for their continued conservation. Given their role as top trophic level predators, sandbar sharks are important for the local ecology as they exhibit top-down control on the rest of the food web. Prey items of adult and young-of-the-year sandbars are important fisheries in Delaware Bay, including blue crabs (*Callinectes sapidus*), weakfish (*Cynoscion regalis*), and Atlantic menhaden (*Brevoortia tyrannus*). Nutrients sources and flows of primary production in Delaware Bay can be split into three broad categories: river drainages, salt marshes, and open ocean upwelling and phytoplankton communities. To determine which of these nutrients and primary production sources are supporting young sandbar sharks, stable isotope measurements for carbon, nitrogen, and sulfur from around the bay can be used to construct an isoscape map of Delaware Bay. By sampling stable isotopes at the bottom of the food web through primary consumers and up the food web to young-of-the-year sandbar sharks and their prey, we aim to create a resource that allows us to determine what parts of the bay, what prey items, and what nutrient sources are supporting their nursery. This iscoscape and food web methodology can be applied to other species that the bay supports with the aim to inform conservation efforts and effectively allocate resources.

Analysis of New Jersey Migrant Fishes and Shelf-Estuary Connectivity: Implications for Offshore Windfarm Development

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Much of the New Jersey continental shelf consists of unconsolidated sediments that provide seasonal habitat to many migratory fish species. A prominent structural feature is the connection with numerous estuarine inlets. These provide highly productive and seasonally warm growth habitats. The relative contribution of these estuaries and shelf habitat to residence period in this region has not been quantified. Stakeholders are concerned that these connections may be impacted by infrastructure from planned offshore windfarms. We are telemetering estuarine-dependent or -facultative fish species and horseshoe crabs (*Limulus polyphemus*) to examine life history patterns of ocean-estuary connection. Fixed hydrophones (VR2W) monitor all estuarine inlets from Belmar to Cape May along the Atlantic Coast of New Jersey. Mobile hydrophones on vessels, deployed traps, and submersible gliders episodically monitor coastal waters. All hydrophones have detected fish passage through estuarine inlets, including those tagged by our own program, primarily summer flounder (*Paralichthys dentatus*) and smooth dogfish (*Mustelus canis*), and many fish tagged by other researchers and programs. Collaborations with other telemetry efforts through the Mid-Atlantic Acoustic Telemetry Observation System (MATOS) and the Atlantic Cooperative Telemetry Network (ACT) are important to providing a thorough understanding of the shelf-estuary connection off New Jersey. The migratory patterns and shelf-estuary connectivity of multiple species will be described with attention to the implications for potential impacts from offshore windfarm construction.

Seeding bay scallops (*Argopecten irradians*) in Lagoon Pond, MA

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Both a commercial and recreational fishery in Massachusetts, the populations of bay scallops (Argopecten irradians) in heavily settled and touristed waters is under significant stress from human activity. The object of the bay scallop propagation and seeding projects conducted in Lagoon Pond by the Martha's Vineyard Shellfish Group (MVSG), the Tisbury Shellfish Department, and the Oak Bluffs Shellfish Department is to maintain healthy bay scallop population levels for the entertainment of recreational shellfish harvesters, the livelihood of commercial shellfish harvesters, and the health of the water and its ecosystems. The Martha's Vineyard Shellfish Group, a non-profit working on the island since 1976, spawns and raises bay scallops through the planktonic larval and juvenile stages. A single bay scallop produces both eggs and sperm, which are released into the water column during spawning periods in the wild. At MVSG, they are spawned in hatchery equipment. Fertilized eggs develop into swimming larvae, and are transferred to the hatchery's aerated, food abundant larval tanks, where they live for about two weeks until they undergo metamorphosis. During metamorphosis, they become juvenile shellfish, losing their swimming organ and developing gills and a foot. They settle out of the water column, and are transitioned to sitting on sieves within the tanks and finally to large silos. After reaching a few millimeters of growth, the juvenile bay scallops are collected by the Shellfish Departments and moved to protected nursery systems within the natural habitat of Lagoon Pond. The departments then continue to monitor and care for the juveniles in field gear for three months to one year of growth, before they are seeded out into the wild or used as broodstock. Department employees assist with additional initiatives relevant to shellfish heath as well, including water quality testing and collection, eelgrass habitat restoration, and predation control.

1 https://www.mvshellfishgroup.org/seed-production
2 https://dnr.maryland.gov/Fisheries/Pages/Fish-Facts.aspx?fishname=Shellfish+-+Bay+Scallop
3 https://www.mvshellfishgroup.org/seed-production
4 https://www.mvshellfishgroup.org/seed-production

Integrating New Jersey Community Scientists in Fisheries eDNA Monitoring of Offshore Wind

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As offshore wind farm development in New Jersey rapidly approaches, many stakeholders have voiced concerns over impacts on fish community composition, fishing opportunities, and the economy. Well-designed and resilient survey methods that include data collected consistently before, during, and after construction of wind farms are essential to understanding any such impacts. Analyses of the DNA left behind by fish, so called eDNA, can yield fish community composition data that is useful to fisheries monitoring plans (FMPs) for offshore wind development. We are piloting a program to involve community scientists in eDNA collection for fisheries monitoring of offshore wind farm development. Here, community scientists will sample eDNA from the surf zone along the NJ coast, representing the landward boundary of an eDNA sampling grid designed to detect potential impacts of offshore wind development. Sampling the surf zone in the context of offshore wind development is important because of the potential for changes in surf zone fish community composition which could impact recreational anglers. We anticipate that this will allow for the comparison of citizen science eDNA collection techniques to lab based eDNA collection techniques, and engage the community, fostering a direct line of communication between those who research and those who utilize the areas of impact.

Effect of Electromagnetic Fields on Shellfish Growth

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With the growth of offshore wind (OSW) projects, concerns have been raised about the effects of electromagnetic fields (EMF) on marine organisms. Buried electrical cables will expose benthic organisms, including many shellfish species, to a chronic EMF. Little is known about the impact of EMF on shellfish, and considering the expansion of the OSW industry in the mid-Atlantic region, there is a need to research any possible effects of EMF on shellfish. In this study, we are testing the effects of EMF on three species of economically important shellfish, the Atlantic surfclam (*Spisula solidissima*), adult and juvenile eastern oysters (*Crassostrea virginica*), and the northern quahog (*Mercenaria mercenaria*). Using a commercially-sourced EMF generating machine, these effects are being tested in a flow-through seawater system using an electrical gradient that ranges from strong (~4000 V) in close proximity to the machine, to low (~50 V) at a distance of 3 m away. Preliminary results show no effect of EMF on shellfish growth for the three species tested at any distance from the machine compared to a no-EMF control. These reflect similar results from a previous study, where *C. virginica* deployed in the Delaware Bay exposed to an EMF for a short duration showed minimal changes in growth. The species used in this trial are essential mid-Atlantic fisheries species and have habitats that overlap with proposed OSW development, making these results relevant to concerns about EMF generated from OSW projects. Future studies will evaluate the effect of EMF on shellfish growth over a longer duration of exposure and analyze the effect of EMF on overall shellfish condition.

Investigating Changing Species Composition in the Northeast U.S. Shelf

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Rapid climate change is driving substantial changes in the makeup of marine ecosystems, through environmental stressors like warming waters and ocean acidification. Marine species have shown to be highly sensitive to warming waters, and respond quickly to ocean temperature changes. Major shifts in marine taxa distribution have been observed in the Northeast U.S. Shelf, due to climate and fishing pressures. In this study, species composition of the Northeast U.S. Shelf Ecosystem was examined, through bottom trawl survey data, from the Northeast Fisheries Science Center Multispecies Bottom Trawl Survey on the NOAA Ship Henry B. Bigelow. This data spans 1963-2020, with coverage from Cape Hatteras, NC to Nova Scotia. We found that there was overall higher species richness in the spring than in the fall. This difference peaked in the 2010s, when there were dramatic changes in spring species composition, but not in the fall species composition. Overall catch is also increasing over time in spring trawls, but not in fall trawls. The total CPUE per year (corrected by number of trawls in that year) was also larger in the fall when compared to the spring, across nearly every year in the dataset. Additionally, many individual species exhibited dynamic patterns in biomass through time that may be linked to species' vulnerability to climate change and other human impacts. As climate changes, marine species will continue to be affected, regional species richness may be threatened, and community composition will be altered; this will continue to be exacerbated as our climate continues changing. Changes in the distribution and richness of species can change regional composition of marine fish communities. These shifts in regional fish composition drive substantial impacts on fishing communities, through changing catch compositions, distances traveled to fish, misalignment with regulations, and conflicts due to fisheries' movement across borders. Accurate assessments of climate's effect on marine ecosystems are crucial to incorporate into scientific advice and management planning.

Stock Origins, Micro-Habitat Preference, and Population Health *of Morone saxatilis*

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Striped bass are the most sought-after inshore game fish on the east coast, generating tourism, business, and industry for New Jersey. However, there is ambiguity around the micro-habitat preference, migration behavior, and stock origins of this important recreational, commercial, and ecological marine resource. Though the general migration patterns of spawning size striped bass are somewhat understood, there are nuances across fish size and age. The behavior of smaller bass is very different from the larger spawning size bass, and the former's behavior will vary across different areas. Striped bass have high fidelity to the spawning grounds in which they were hatched. The Jersey shore is not a major spawning ground, but rather a highway of mixed-migratory groups of stripers during spring and fall. The derived proportions from the major (and minor local) spawning grounds of this migratory stock are unclear. With the use of tagging instrumentation, catch logs, and scale-/tissue-sampling, followed by DNA sequence comparisons, clarity maybe gained on 1) changes in migration and location preference and 2) the extent to which each spawning ground contributes to our local mixed-migratory stock, and possibly illuminate differences between that of the fall and spring groups. Statistical analysis was also performed on researchers' catch log data for illumination of striped bass behavioral/feeding patterns.

Physiological, Behavioral, and Growth Responses of the Atlantic surfclam (*Spisula solidissima*) to Altered Ocean Acidification States

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The Atlantic surfclam (*Spisula solidissima*) is an economically important bivalve species, supporting the third-largest commercial fishery by weight in NOAA's Mid-Atlantic region and drawing increased interest in the aquaculture industry. The surfclam is distributed along the Atlantic coast from Cape Hatteras to the Gulf of St. Lawrence, a region being strongly impacted by ocean acidification (OA), which can impact bivalve physiology. The goal of this study was to improve understanding of OA impacts on surfclams over time. Surfclams in two size classes were exposed to three seawater pH treatments in a laboratory experiment, using ambient seawater from the Cape May Canal in June and July, 2023. After twenty-four hours, two weeks, and six weeks, surfclams were sampled from each treatment to evaluate feeding physiology, burrowing behavior, and growth rate. After two weeks, two key feeding physiology processes, clearance rate and rejection rate, were significantly reduced in low pH treatment surfclams compared to ambient pH treatment surfclams. Burrowing frequency after thirty minutes and mean shell length growth rate were highest in medium pH treatment surfclams. After six weeks, both clearance and rejection rates were reduced overall, and no differences were observed in burrowing frequency and growth rate between treatments, likely due to warm water temperatures at the end of the experiment (>26˚C). Overall, pH changes were seen to have significant impacts on key processes for surfclam function and survival at the two-week timepoint with thermal stress possibly masking the effects of OA at the six-week timepoint. This project aims to assist fishing industry members and managers in best managing the wild stock as well as planning aquaculture activities in light of changing marine conditions.

Informed Management of an Endangered Species: Monitoring Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) Recruitment and Spawning Run Abundance with Forecasts of Abundance in the New York Bight DPS

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Sturgeons are one of the most imperiled families of fish resulting from historical over-harvest, habitat loss/degradation, bycatch in commercial fisheries, and other sources of mortality. For the Atlantic sturgeon (*Acipenser oxyrichus oxyrinchus*), understanding their population dynamics is crucial to the conservation of the species. Presently, there is little information available on estimates of adult abundance for most rivers in the United States. This study is a multi-organizational project to pair side-scan sonar imaging and acoustic telemetry to model stock estimates and forecast future projections for the species. We are focusing on two of the United States' largest populations of Atlantic sturgeon, the Delaware River and the Hudson River, belonging to the New York Bight DPS. This project brings together components of multiple state universities, governmental organizations, and commercial fishers located along the northeast United States. Side-scan sonar surveys will take place during the peak of the spawning season for both rivers for the years 2023-2025. Furthermore, 104 Atlantic sturgeon were successfully tagged in Delaware Bay during the months of July and August 2023. River-resident juveniles surveys will be conducted from 2023-2025 providing data for sturgeon age-0 to age-2. Pairing side-scan sonar and acoustic telemetry data, statistical modelling will be conducted centered around empirically estimating river-resident juvenile Atlantic sturgeon, spawner abundance for both rivers, and forecasted estimates of adult abundance of Atlantic sturgeon. Adult and river-resident juvenile estimates will be used to propose and track recovery objectives for the species outlined in the ASMFC Benchmark Stock Assessment (2017). In addition, the need for these estimates are identified in the New York's Sturgeon Management Strategy, the Hudson River Estuary Action Agenda, the Delaware Wildlife Action Plan, Amendment 1 to the Interstate FMP for Atlantic Sturgeon, and required for the Section 7 of ESA consultations.

Marine predators's selection for Lagrangian features

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The capacity to predict where marine predators are located is important for both conservation and fisheries management. To that end, a lot of effort has been put into understanding how marine predators interact and select for specific environmental conditions. Most studies of pelagic predators have focused on ocean conditions coincident in time and space with the animal (Eulerian or state predictors), without consideration of the dynamic history of the water parcel occupied by the predator. Such Eulerian predictors track changes in water characteristics (temperature, chlorophyll, etc.) at a given location.
In contrast, Lagrangian predictors follow the evolution of a water parcel along its trajectory, providing a critical complement to the Eulerian viewpoint. The Lagrangian framework, thus, can capture along-trajectory processes such as accumulation of biomass that cannot easily be extracted from Eulerian fields. In addition, analyses of movement tracks of some marine organisms (including elephant seals, frigatebirds, penguins) hints that marine predators may select for Lagrangian features that aggregate planktonic biomass. But to our knowledge, no study has systematically explored the use of Lagrangian features by marine predators.
Here, we present a method that tests for the selection for Lagrangian features in marine predators. Using the TOPP (Tracking of Pacific Predators) dataset, we assess the selection of Lagrangian features by 10 different species of marine predators, ranging from sea turtles to sharks and seals. We then relate the selection of the different organisms to their size, energy requirements, trophic level, and habitat (inshore / offshore) to infer relationships between marine predator traits and selection for Lagrangian features.

An Improved Approach to Dredge Depletion Experiments

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Depletion experiments are conducted by repeatedly sampling an area until the resource is depleted and provide information about the density of the resource and efficiency of the gear. These experiments are important for estimating absolute abundance of a resource but are time-consuming and expensive to conduct. Additionally, it is often difficult to determine whether the target sampling location has been sampled multiple times, or if the gear has missed portions of the target area. To mitigate this spatial uncertainty, we used a combination of tow-by-tow spatial and catch analysis to determine the experiment efficacy in real time. Our case study was a series of experiments that will estimate catch efficiency of a hydraulic dredge targeting Atlantic Surfclams. In these experiments, a high-resolution GPS receiver was used with navigation software to record location every two seconds. After each tow, the sampled track locations were loaded into ArcGIS and ArcPy was used to determine the percent overlap of the tows. Simultaneously, the number of individual clams and volume of catch was recorded. The catch time series was evaluated as both depletion relative to the highest catch in the time series and using a depletion model. When the percent tow overlap was greater than 80%, the catch (both volume and number caught) was depleted to 20% of the highest observed, and the slope of the depletion curve was below 20% of the maximum slope, the experiment was considered complete. Using these metrics in real time improved the data quality derived from the experiments and made the experiments more efficient.

Examining Size and Abundances of Juvenile Atlantic Surfclams (*Spisula solidissima*) over the Last Four Decades in New Jersey State Waters

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The Atlantic surfclam (*Spisula solidissima*) has been an important commercial fishery in New Jersey for many decades. Surfclams have been monitored annually since the 1980s by New Jersey state and federal fisheries departments. Changes in the population have been observed throughout these surveys. This project examines the changes in juvenile surfclam size and abundance from the New Jersey Department of Environmental Protection's state surfclam surveys from 1988 to 2019 (except 2013 and 2014). These state surveys sampled approximately 300 stations along the coast of New Jersey annually with a benthic grab, which retrieves the top 5 to 10 centimeters of sediment and collects the newly settled surfclams that live in the upper sediments. Each benthic grab was sorted, retaining the <51 millimeter size classes of juvenile surfclams, which were then measured. Since 1988, these benthic grab surveys collected a dominant juvenile surfclam size class of 3 millimeters. Beginning in 2000, a second dominant size class of 10.5 millimeters appeared. These two size classes could derive from two distinct seasonal surfclam spawns during the previous year or indicate earlier spawns each year. In the later years, there was a lower abundance of juvenile surfclams (e.g., 2019 = 362 juvenile surfclams caught) compared to the earlier years (e.g., 1988 = 8,959 juvenile surfclams caught). The southernmost stations tended to have a lower abundance of juvenile surfclams. These changes could suggest a change in recruitment patterns in the Atlantic surfclam to cooler waters. Future studies will analyze other biological and oceanographic timeseries that extend the scope of this timeseries, such as the 1972 to 1986 juvenile surfclam surveys conducted by the Haskin Shellfish Lab. We can additionally compare the historic juvenile surfclam timeseries to modern surveys in federal waters to examine how dynamics of the population are changing offshore.

The Relationship Between Sex Change in Black Sea Bass and Body Size: Sex-Changing Females Tend to be Larger than Non Sex-Changing Females

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Black sea bass (*Centropristis striata*) have the ability to change sex from female to male in order to maintain a population's sex ratio, such that the absence of males can prompt the largest females to change sex. As a commercially important species, it is critical to understand how fishing laws that set minimum size cutoffs for black sea bass may affect the species' population composition. This project aimed to examine how sex change in black sea bass affects body length and to compare the body lengths of sex-changing females to non sex-changing females in order to understand how fishing pressures may affect sex ratio. Black sea bass were caught off the New Jersey coast in 2011 and 2012, and information about sex, length, and recapture history were recorded. We found that sex-changing females tend to be significantly larger than non sex-changing females before changing sex. Additionally, sex-changing females are significantly larger than both non sex-changing females and males after changing sex. All sex-changing females also increased in length after their sex change, although not significantly. These findings indicate that larger females may have more energy to devote towards changing sex and suggest that sex-changing females invest energy in growth as well as in the sex change itself. Future studies should investigate how size and sex ratio may fluctuate in a population under size-selective pressure on a long-term time scale.

Thank you for coming! See you in 2024!

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