CBFS Circulation

Academic Newsletter from the CBFS Faculty

"Transforming Students into Scientists"

~Concept and Design by Ajoy Kumar and Eliza Fries~

VOLUME 1, NO. 1 | 2023

Research Highlights

Inter-annual variability in the stratification regime off Eastern Shore, VA

The Eastern Shore, comprising of coastal water mass extending from Virginia to New Jersey, is a data-rich environment that provides an ideal test bed for developing adaptive conservation approaches to combat the effect of Global Climate Changes. Previous studies have shown that the coastal waters off the Eastern Shore have some of the most stratified continental shelf water on the planet (Campbell & O'Reilly, 1988). Increase in water stratification leads to less mixing of the surface and deeper, oxygen and nutrient rich waters. The Eastern Shore also encompasses the location of the 1976 Anoxic Episode, where intense stratification was one important element of the synergism resulting in anoxia and extensive fish/shellfish mortalities (Campbell & O'Reilly, 1988). The anoxic episode relates to warming of coastal waters and the resulting effect on oxygen absorption at the surface.

As water warms, the absorption of atmospheric oxygen by surface waters decreases. If oxygen levels decrease, shellfish and marine life die, birds starve, and the ecosystem overall is impacted. The tidal flats, salt marsh, and brackish marsh communities of the Eastern Shore region are highly productive and support

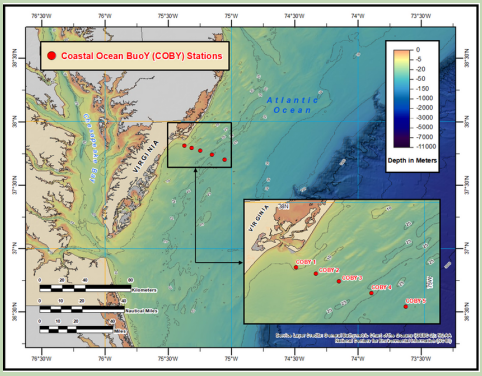
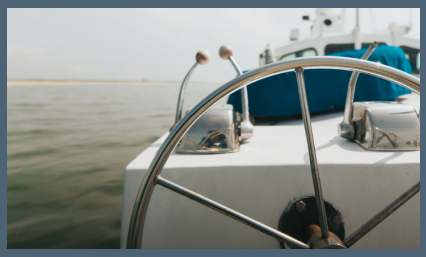


Fig. 1 - Time series of temperature & Salinity along the COBY transect (Reproduced from John Moisan, NASA)



Inside:

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a large variety of local and migratory bird species including the piping plover, red knot, and oystercatchers. Low oxygen conditions threaten their survival and may have an everlasting consequence to the Eastern Shore ecology.

Satellite derived chlorophyll estimation is commonly used to supplement *in situ* measurement of biomass in the ocean because shipboard measurements of *in situ* chlorophyll are sparse in many regions of the oceans. In regions of strong surface ocean stratification, and high biological production, most of the *in-situ* chlorophyll lies below the pycnocline (regions of sharp density gradient and are located below the ocean surface).

The measurement algorithm of chlorophyll from satellites are from above the pycnocline and hence satellite derived estimate of chlorophyll tend to underestimate chlorophyll from these high productive strong stratification regions. The Eastern shore stratified regions have historically been shown to underestimate chlorophyll and hence biomass estimates from satellites (Campbell & O'Reilly, 1988). *In situ*

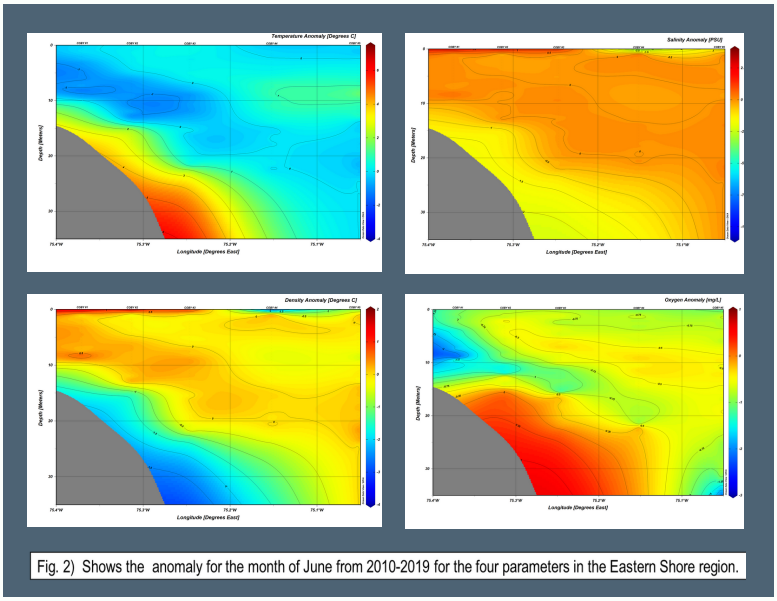


Fig. 2) Shows the anomaly for the month of June from 2010-2019 for the four parameters in the Eastern Shore region.

Table 1

Station number	Latitude (1N)	Longitude (1W)	Distance from St. 1 (km)	Total depth (m)
1	37.82	75.38	0.0	9
2	37.79	75.31	5.56	12
3	37.77	75.24	11.85	21
4	37.74	75.15	20.93	23
5	37.70	75.05	30.56	32

sampling by ships, undulating oceanographic samplers, gliders, moorings are thus required to characterize the region.

The research focus of Ajoy Kumar (Millersville University) will examine the long-term trend of the stratification in the Eastern Shore and its effects on oxygen and chlorophyll estimates. Five stations were sampled along a transect in nearshore waters off Eastern Shore, from 2010 to 2019 on the R/V Parker (Table. 1). All station distances are referenced from St. 1, which was 9 km from shore. At each station, a SeaBird 25 datalogger was deployed to measure temperature, salinity, light, oxygen, fluorescence, backscatter, and depth. Results from the sampling are shown in Fig. 2. Stratification can be seen at a depth of about 10-20m (Fig. 2). The stratification appears to be strengthening as seen from the positive anomaly in the density fields (shades of reds in Fig. 2). This strengthening of stratification coincides with negative values in the oxygen anomaly plots (shades of yellows and blues in Fig. 2). Our data from June 2010-2019 continues to illustrate that a trend exists in the strengthening of density fields and reduction of oxygen in the Eastern Shore region as illustrated by previous studies of the region. The future direction of Kumar's research includes continuation of the monthly sampling to examine the spatial and temporal extent of density stratification in the Eastern Shore and its effect on oxygen and chlorophyll estimation.

The Herpetofauna of Wallops Island, Accomack County, Virginia: A case study of a vulnerable community

Barrier islands are valuable models for evolutionary and conservation biology studies. Since 2010, Dr. Pablo R. Delis (Shippensburg University) with Dr. Walter E. Meshaka has investigated the herpetofauna of Wallops Island, Virginia, 25 years after a seminal study. We used combinations of taxon-specific field techniques to maximize accuracy. A total of four species of amphibians and seven species of reptiles were identified. The most abundant amphibian and reptile were Fowler's toad (Anaxyrus fowleri) and the North American racer (Coluber constrictor), respectively. We report three previously undetected amphibians and the likely prior misidentification of another. We also identified a new snake species. The diamond-backed terrapin (Malaclemys terrapin) is only seasonally abundant on the island, in contrast to the year-round well-established Eastern mud turtle (Kinosternon subrubrum), while only a few juveniles of the common snapping turtle (Chelydra serpentina) were detected. No lizards were found on the island. These limited yet interesting herpetofauna face momentous environmental challenges derived from global climate change and rising sea level.

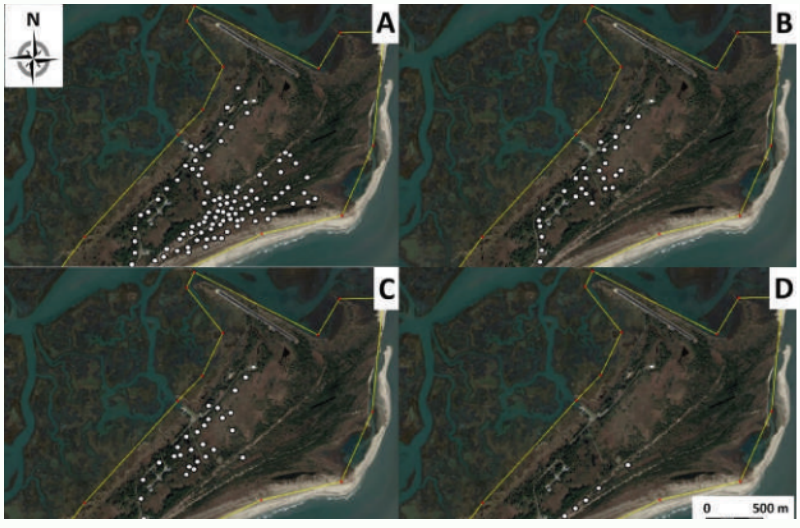


Fig. 1. Aerial photograph of the spatial distribution of amphibian specimens found at the north side, Wildlife Refuge, on Wallops Island, Accomack County, VA. Dots represent identification locations during the 5-year survey, 2011–2016. (A) Fowler's toad (Anaxyrus fowleri), (B) green treefrog (Hyla cinerea), (C) Southern leopard frog (Lithobates sphenocephalus), and (D) red-backed salamander (Plethodon cinereus). Modified from Google Earth 2017 images.

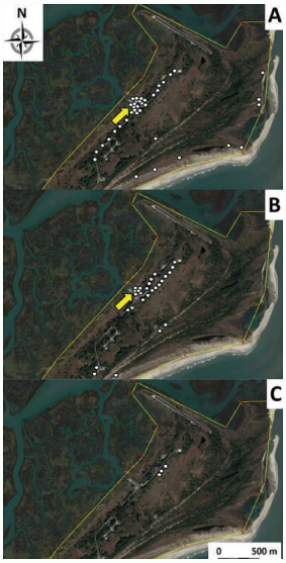


Fig. 2. Aerial photograph of the spatial distribution of turtle specimens found at the north side, Wildlife Refuge, on Wallops Island, Accomack County, VA. Dots represent identification locations during the 5-year survey, 2011–2016. Yellow arrows represent a heavily used nesting area. (A) Diamondback terrapin (Malaclemys terrapin), (B) Eastern mud turtle (Kinosternon subrubrum), and (C) common snapping turtle (Chelydra serpentina). Modified from Google Earth 2017 images.

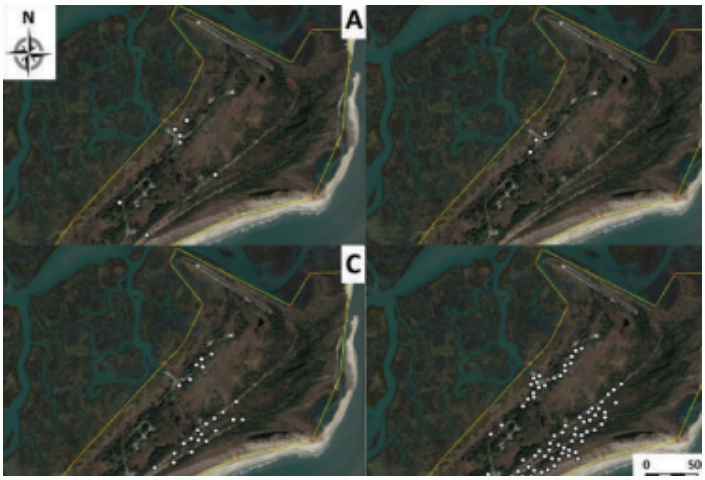


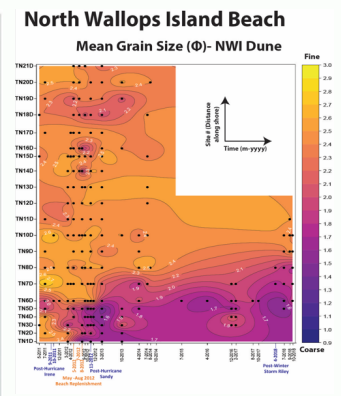
Fig. 3. Aerial photograph of the spatial distribution of snakes found at the north side, Wildlife Refuge, on Wallops Island, Accomack County, VA. Dots represent sighting locations, and not individuals, during the 5-year survey, 2011–2016. (A) Eastern rat snake (Pantherophis alleghaniensis), (B) common garter snake (Thamnophis sirtalis), (C) Eastern hog-nosed snake (Heterodon platirhinus), and (D) North American racer (Coluber constrictor). Modified from Google Earth 2017 images.

Investigating the Effects of Sea Level Rise and Environmental Change along the Barrier Islands and Salt Marshes of the Southern Delmarva Peninsula

This research project, established in 2011 by Dr. Adrienne Oakley and Dr. Sean Cornell, is a collaborative effort between Kutztown University undergrad students and faculty, Shippensburg University students and faculty, the Chincoteague Bay Field Station, US Fish and Wildlife Services (FWS), and NASA Wallops Flight Facility (WFF). Our research group studies coastal processes: erosion and sediment transport, barrier island formation and movement, and salt marsh evolution and restoration on the Eastern Shore of VA on the Delmarva Peninsula. This region is experiencing sea level rise at twice the global average and is often threatened by large coastal storms such as hurricanes and Nor'easters. As sea level continues to rise, coastal zones will experience more frequent instances of intensive erosion and sustained flooding that threaten existing infrastructure, natural habitats, and communities.

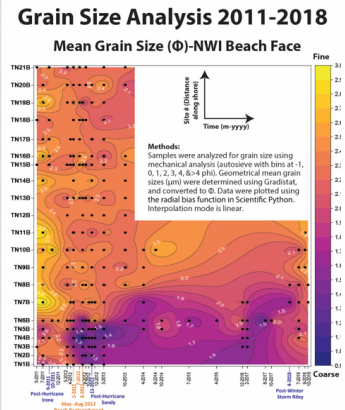
To create resilient and sustainable coastal communities and protect infrastructure and critical habitats on barrier islands in the face of climate change and sea level rise, we must understand how the island is affected by both natural coastal processes (sediment transport, barrier island rollover, etc.) and human alterations (shoreline hardening, beach replenishment, construction, etc.).

We must study both the current conditions along the shoreline and the underlying geologic history of the region. For our most recent project we are collecting, processing, and analyzing high-quality datasets from Assateague and Wallops Islands to investigate the effects of sea level rise and environmental change. These data will inform management and mitigation strategies implemented by NASA to protect Wallops Flight Facility infrastructure on this eroding barrier island. Our data from southern Assateague Island will inform Chincoteague National Wildlife Refuges' future restoration project of Swan Cove Pool and surrounding salt marsh.



Grain Size Trends: Dune

- NWI dune sediment at TN5 & 6 coarsened immediately following replenishment. Dune sediments to the north coarsened through time at a rate of **~127 m/yr** (0.35 m/day).
- The primary dune line on NWI is now well seaward of the pre-replenishment dune line.



Grain Size Trends: Beach Face

- Beach face sand along NWI coarsened northward following replenishment from 2012-2018, at a rate of **~76 m/yr** (.21 m/day) for coarser sands (phi <1.7) and **229 m/yr** (.62 m/day) for fine sand (phi 2.1). NWI beach face is coarsening ~1.8x faster than the dunes.
- Data from 2018 indicate that the beach south of TN 7 is begining to return to pre-replenishment GS.
- GS data from samples collected in 2019, 2021, and 2022 will be added to update these figures.

Our field based college courses allow students access to the combined knowledge and resources of our member universities. Courses provide students with valuable field experience, college credits, and lasting connections.

..... Spotlight on Courses Offered at CBFS: .....

Coral Reef Ecology

BIOL 294

Taught by: Dr. Jay Hunt (East Stroudsburg University) and Dr. Dominique Didier (Millersville University)

Course Description:

Coral reefs are critically endangered; however, numerous efforts are being mounted to preserve and restore these delicate habitats. Students will hone SCUBA skills for applied research on coral reefs including identification of all major groups of coral reef animals and plants as well as utilizing various methods for quantifying diversity. Participants will also be tasked with putting their skills to use in the development and execution of their own independent project. Upon completion of the course students will have honed their underwater research skills and be prepared to conduct basic field research on coral reefs and related marine habitats.

General Description of Field Activities:

One week at the Chincoteague Bay Field Station. Two weeks in Roatan, Honduras. SCUBA certification required. Will dive 20-25 times over two weeks along a variety of coral formations.

Prerequisites:

- Two semesters of college biology with labs
- Up to date passport
- Have (or will have) a valid scuba certification

Field Methods in Oceanography

ESCI 267

Taught by: Dr. Ajoy Kumar (Millersville University)

Course Description:

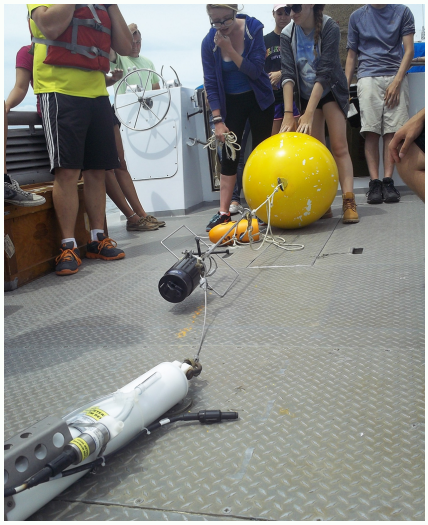
The course is designed to familiarize students with the dynamic marine environment and work on board small research vessels, including the use and application of standard oceanographic instruments and sampling devices; to promote and encourage independent research. Students will learn how to deploy instruments from boats, acquire data, analyze the data and make a report.

Marketable Skills Gained from This Course:

- Oceanography instrument handling, data retrieval, and data analysis
- Report writing skills
- Computer skills in Excel, Word, Ocean Data View, GIS

General Description of Field Activities:

- Various navigation techniques including work with GPS unit
- Operation of a winch
- Meteorological observations: air temperature, pressure and humidity, wind speed and direction, shortwave, and longwave from Epley sensors
- Profiling of conductivity, temperature, dissolved oxygen, irradiation, fluorescence, and backscatter with SeaBird 25 datalogger
- Measurements and analysis of light in water using LiCor light sensors, YSI meters, Secchi disk
- Concepts of attenuation of light in water, critical depth and optical depth
- Beach profiling, longshore currents and longshore transport
- Falmouth Acoustic Current Wave and Tide meters
- Sampling of epifauna and infauna on the sea floor
- Nansen bottle and reversing thermometer, Salinometer, Niskin or Van Dorn bottle



Prerequisites:

- Any introductory ocean or marine course

Marine Mammals

MAR/BIO 340

Taught by: Dr. Greg Sibler (Kutztown University)

Course Description:

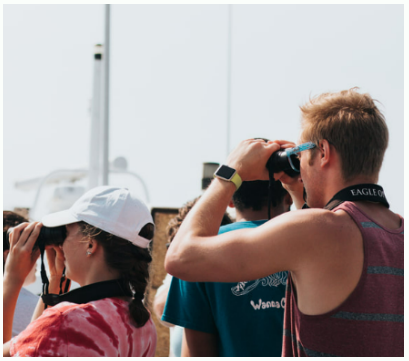
The student will obtain a solid grasp of the breadth and diversity of marine mammal species, their habitats, and their importance and roles in oceanic and coastal ecosystems. We will focus primarily on ecological and predator/prey relationships. By the end of the course you will be able to: describe the distribution, habitat use, acoustic communication systems, behavior, evolutionary history, and feeding adaptations for a number of marine mammal species; identify threats to marine mammals and efforts to protect them; read and understand a scientific paper effectively; and conduct basic field work on a wild dolphin population and describe your findings. We will conduct original research on bottlenose dolphins inhabiting waters near Chincoteague National Wildlife Refuge and Wallops Island.

Marketable Skills Gained from This Course:

- Marine mammal species identification
- Marine mammal field observation and research techniques

General Description of Field Activities:

We will be conducting behavioral observations and photo-identification studies of a wild bottlenose dolphin population from via CBFS-chartered boats and a dedicated land site.



Prerequisites:

- two semesters of college biology with labs
- Up to date passport
- Have (or will have) a valid scuba certification

A brief History of the Chincoteague Bay Field Station:

In 1968, The Marine Science Consortium was founded by a consortium of three Pennsylvania state colleges as “The Marine Science Consortium of Pennsylvania State Colleges and Universities”. First located in Cape May, NJ, and then Lewes, DE, the Consortium expanded to 13 member colleges and universities. In Spring 1971, the Consortium became a Corporation, changed its name to “The Marine Science Consortium, Inc.” and, in 1971, moved to its permanent site in the area of Wallops Island, VA. The campus, located next door to NASA’s Goddard Flight Facility was named “Wallops Island Marine Science Center”. In 2013 the organization underwent a name change from The Marine Science Consortium to Chincoteague Bay Field Station.

Student Spotlight

Sarah Moriarty, CBFS Alumna, Kutztown University Class of 2017, Marine Science/Oceanography and Geology

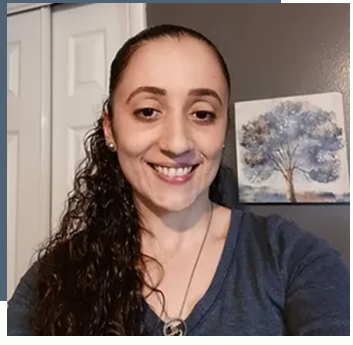
In late April 2019, Sarah Moriarty ate Reese's cups at the bottom of the Pacific Ocean, 2500 meters below sea level! She completed her first deep ocean dive in the Alvin Submarine operated by Woods Hole Oceanographic Institution (WHOI). Sarah studied fluid cycling at hydrothermal vents on the East Pacific Rise and other mid-ocean spreading centers for her master's degree in Earth Sciences at Memorial University of Newfoundland, Canada (2020) and is continuing her research for her PhD. During her graduate career, Sarah has participated in multiple research cruises in the Atlantic and Pacific Oceans and has analyzed seawater and rock samples at top geochemical laboratories around the United States. Hailing from Catasauqua, PA, Sarah completed a dual major at Kutztown University in Marine Science and Geology in 2017. She took three courses at the CBFS and conducted marine geology research on Assateague Island, VA as part of Dr. Adrienne Oakley's coastal zone mapping project. As an undergraduate, Sarah presented her research at the national meeting of the Geological Society of America. "Kutztown University's collaboration with CBFS enhanced my education by instilling realistic expectations for working in field settings and affording me invaluable career building opportunities that not only enabled me to get into the graduate school of my choice but have been critical to my overall success as a scientist."

-Sarah Moriarty

Sarah Tirado, CBFS Alumna, Millersville University Class of 2022, Animal Behavior/Biology

Sarah Tirado is a recent graduate of Millersville University and was a biology major with a concentration in animal behavior. She began this research project, "Comparison of Small Mammal Trap for Conducting Biological Surveys" with the MU Applied Conservation Lab as part of an internship at the Chincoteague Bay Field Station (CBFS) in Wallops Island, VA. Tirado previously took Behavioral Ecology at CBFS and it had a powerful impact on her, igniting her passion for field research. This project compares the efficacy of a novel camera trap, Mouse Cam, to that of traditional trapping methods for use in rapid biological assessments. Tirado hopes to continue conducting field research on mammal behavior to improve conservation efforts in the future. She is currently working as a biological technician with a spotted skunk research project in Kansas with Pittsburg State University. "Thank you to Dr. Aaron Haines for all the support and guidance throughout this project, the MU Conservation Biology Class of 2021 and Mammalogy Class of Spring 2022 for setting traps, and to Dr. Raymond Dueser and Dr. John Porter of the University of Virginia for designing the Mouse Cam"

-Sarah Tirado



Alumni Spotlight

Teddy Them

After my tenure at Shippensburg University, I moved to College Station, TX and began graduate school in the Department of Oceanography at Texas A&M University. In 2012, I moved to Blacksburg, VA and began my doctoral research under the supervision of Dr. Benjamin Gill in the Department of Geosciences at Virginia Tech. After graduating in 2016, I moved to Tallahassee, FL and began my two-year postdoctoral fellowship under the supervision of Dr. Jeremy Owens at the National High Magnetic Field Laboratory at Florida State University. In 2018, I moved to Charleston, SC to begin a position as an assistant professor of geology at the College of Charleston. I now lead the Geochemistry of Ancient and Modern Environmental Systems (GAMES) Laboratory (www.games-lab.org) and supervise undergraduate and graduate students who undertake an array of research projects.

I remember taking trips on the marine vessels and shucking raw oysters with some local fishermen. Dr. Cornell opened my eyes to the wealth of opportunities available at CBFS and eventually supervised several projects I was involved in over the next two years. I have fond memories of taking beach profiles, measuring salinity in groundwater, seining, trawling, kayaking in the lagoon, and learning about why these areas serve as biodiversity hotspots. Paired with our own history of the region, Wallops Island and the CBFS also represent a unique setting in the country to learn about the interactions between humans and the environment; it serves as a true “living classroom.” My time at CBFS culminated in a travel-intensive summer course, Coastal Environmental Oceanography, also taught by Dr. Cornell. The research I conducted at CBFS gave me the opportunity to attend my first conference, the Geological Society of America annual meeting, in Portland, OR in 2009.

My experiences and memories at CBFS represent some of the most important moments while in college, and they were fundamental to my chosen career path. Although my trips to CBFS were always with Dr. Cornell, it is clear that the efforts of faculty from many scientific disciplines and universities and the CBFS employees have ensured the facility has not only continued with its core mission but has grown to serve a wide range of people from different backgrounds. I consider my experiences at CBFS paramount to where I am today, so I hope that its facilities will be used to train our students for generations to come. I personally look forward to returning to CBFS soon to give back to students what I had the opportunity to experience over a decade ago.

Chris Smyth

My first experience with the Chincoteague Bay Field Station began after my freshman year at Lock Haven University in 2010. I enrolled in Ichthyology with Dr. Ken Thompson, eager to dive into my first course towards a marine biology concentration. I remember spending three weeks completely immersed in fish biology, surrounded by classmates and professors equally dedicated to learning about some aspect of marine science. After trawling from the R.V. Parker and tromping through Tom's Cove with a seine net, I remember thinking how lucky my professors were to be able to teach these classes as part of their job. Throughout college, I returned to the field station several times, taking Biological Oceanography with Dr. Vaillancourt, and Marine Ecology with Dr. Hunt. In addition to being some of my most memorable experiences, these courses inspired me to continue pursuing my interests in marine science in graduate school and beyond.

I was fortunate that summer courses weren't my last experience at the field station. After graduating in spring of 2013, I took a job as a summer camp counselor, where I spent long summer days with k-12 students exploring marshes, estuaries, dunes and beaches. This was certainly one of the most rewarding, and exhausting experiences I've had to date. At the end of that summer, I entered a doctoral program in Plant Pathology and Environmental Microbiology at the Pennsylvania State University, where I studied the diversity and ecology of marine fungi. My research took me on a field excursion to the beaches of Florida, where I studied an emerging fungal disease of sea turtle eggs known as Sea Turtle Egg Fusariosis.

In addition to this research, I gained a lot of teaching experience in graduate school, serving as both a teaching assistant and adjunct faculty at nearby universities. This, combined with my educational roots at a public undergraduate institution, shaped my post-Ph.D. career. From 2018-2020 I was an Assistant Professor at my alma mater, Lock Haven University, where I taught a variety of courses, including microbiology and introductory biology. During the summer of 2019, my experiences with the field station came full circle when I designed and offered my first course at the Chincoteague Bay Field Station, Coastal and Marine Mycology.

Today, I am a Lecturer at Binghamton University in New York, where I teach introductory biology, Mycology, and Marine Biology. I love my job, and the diversity of graduate and undergraduate students that I get to work with on a daily basis. I continue to be inspired by my experiences at the Chincoteague Bay Field Station, and strive to get my students out of the classroom and into the field whenever possible. One day soon, I hope to bring my Binghamton University students to the barrier islands of Virginia so they too can experience all that a hands on, feet wet education has to offer.

Nate Murry

After spending ten years in corporate IT, I was ready for a career change. Science, particularly ocean science, had lurked in the back of my mind since high school. So, after much consideration, I decided to enroll in the ocean science program at Millersville University in September of 2010. Shortly thereafter, I met Dr. Kumar, and joined his research at the NASA Wallops Island Flight Facility. We studied the effects of sea level rise and the degree of potential inundation at the Wallops Island facility, of which the CBFS is a close neighbor. This connection served as my introduction to the CBFS, as it was an excellent 'field base' for our research endeavors in the area.

It is rather peculiar for an ocean scientist to train inland, as I did at Millersville, so it was very attractive to me that the University had a close connection with a coastal field station that offered direct access to oceanographic field methods training, research opportunities, and vessels for short offshore cruises. As I progressed in my oceanography education, it became a critical base of operation for my own research as well. I was able to perform underwater field surveys with a robotic submersible as an undergraduate, and then hydrographic surveys and more advanced submersible work as a graduate student. These field and research opportunities were only available due to the connections that were maintained between Millersville University and the CBFS. Otherwise, I would have had no avenue for oceanographic fieldwork, or I would have had to add classes from a coastal institution, which would have been nearly impossible given my domestic life situations at the time. After graduation, I was able to give back as an adjunct instructor at Millersville, assisting students in the same research modes and methods at the CBFS as I did as part of my own education.

My education at Millersville, and field training at the CBFS culminated in August of 2018, when I was hired as a contractor with NOAA's National Ocean Service at the Center for Operational Oceanographic Products and Services (CO-OPS) as an oceanographer and GIS analyst. While I had excellent educational and research credentials, it stood out to the hiring team that I had those credentials in addition to a healthy amount of field training, all of which I acquired at the CBFS. That training was again very helpful in July of 2022, when I was hired as a full-time, permanent federal employee at NOAA CO-OPS as a full-fledged physical oceanographer.

I am not sure where my career will go from here, but for the moment, I am doing exactly what I hoped to do when I started at Millersville with Dr. Kumar in 2010. The Field Methods in Oceanography course, related studies and research at the CBFS were instrumental to my career success, and also among my favorite educational experiences in the whole of my academic career. I am grateful to Dr. Kumar and the staff at the CBFS for their invaluable help, training, and assistance along the way, as well as the opportunities for oceanographic fieldwork that would have otherwise been unavailable to me.

CBFS

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Summer 2023 CBFS Course Schedule

Session I: May 21 - June 9

Invertebrate Zoology
Marine Biology
Biological Oceanography
Coral Reef Ecology*

Session II: June 11 - June 30

Marine Ichthyology
Field Methods in Oceanography
Marine Ecology
Coastal Herpetology

Session III: July 2 - July 21

Conservation Biology
Coastal Environmental Oceanography
Behavioral Ecology
Wetlands Ecology

Session IV: July 23 - August 11

Marine Invertebrates
Marine Ecology
Marine Mammals
Marine Geology

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