



Sea Grant  
Delaware



UNIVERSITY OF DELAWARE  
EARTH, OCEAN &  
ENVIRONMENT

2021 ANNUAL REPORT | VOLUME 40  
DELAWARE SEA GRANT COLLEGE PROGRAM

# REPORTER

RIISING TO THE  
CHALLENGES



# DELAWARE SEA GRANT

It will surprise no one to read that 2020 was an extraordinary year for Delaware Sea Grant (DESG). It was an extraordinary year for the entire world, and just as COVID-19 upended the lives of so many, it significantly altered both what we at DESG worked on and how we did it.

This issue of the *Reporter*, our program's annual report, describes many of the changes we made to existing programs as well as entirely new projects we created specifically to support members of our state's communities who were negatively affected by the social and economic impacts of the pandemic.

On pages 3 and 4, you will see two stories describing how DESG implemented rapid response funding from the National Sea Grant Program, which issued a similar grant to each of the 34 local Sea Grant programs to address COVID-19 impacts. In Delaware, we invested this money from the federal government in two areas critical to our state's economy and our residents' well-being: tourism and seafood.

We also used the challenges made clear by the pandemic to think about new initiatives we could launch to improve economic resilience. To help Delaware communities better prepare for the next disruption, whether a pandemic or a natural disaster, DESG created a community grant program, awarding several towns grants of up to \$10,000 for projects meant to diversify their coastal economies.



Responding to the changes in our society this past year was inevitably part of everything the program did. Look for our COVID-19 response icon throughout this report to see other ways we adjusted our work to be of the most help possible, whether in assisting with online education or maintaining research projects that usually relied on volunteer support.

And changes are continuing. I am stepping down as director of the Delaware Sea Grant College Program at the end of June 2021 as I prepare to retire from the University of Delaware College of Earth, Ocean and Environment. By stepping aside now, I will still be available as a resource to my successor for several months, and the new director will have the opportunity to work on critical strategic planning efforts that will guide the direction of the program for years to come.

It has been rewarding to lead DESG, which I first engaged with as a funded researcher. Helping to set the priorities and engaging more deeply with the extension and education elements of the program have been personally gratifying, and I hope that my service has helped to benefit all of our program's stakeholders.



**Kathy Coyne**  
Director, Delaware Sea Grant College Program



DESG purchased 75,000 farmed oysters and this investment will help our seafood industry and improve the ecology of the Delaware and Rehoboth Bays. Read more on pages 3-4.

The first-ever virtual Coast Day featured expert speakers (ex. Paddle Coastal Del.), home science activities, a virtual touch tank and much more. Check out page 13.



Weather-related disasters can happen anywhere! Our Broadkill Beach CoastSnap station took a direct hit by a nor'easter last fall. The station is fixed and ready for you to use. Learn how on page 10.



# DELAWARE SEA GRANT ADVISORY COUNCIL

*The Delaware Sea Grant Advisory Council—the statewide external advisory body to the Delaware Sea Grant College Program—was created in 1974. Its members hail from marine-oriented businesses and industry, resource management and engineering firms, state government, public interest groups, the educational sector and the media. Working within the national priorities identified by the National Sea Grant College Program, the council helps further define priority coastal issues relevant to Delaware.*

Chris Bason  
Center for the Inland Bays

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Tom Byrne  
Delaware Public Media

John Clark  
Fish & Wildlife, DNREC\*

Kimberly Cole  
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Brad Dennehy  
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Kathleen Doyle  
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Malcolm D'Souza  
Wesley College

Gerard Esposito  
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Tidewater Utilities, Inc. (retired)

Heidi Gurdo  
Delaware Technical Community  
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Kate Hackett  
Delaware Wild Lands, Inc.

Simeon Hahn  
National Oceanic and Atmospheric  
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Michelle Rodgers  
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Delaware Museum  
of Natural History

Namsoo Suk  
Delaware River Basin  
Commission

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Environmental Control

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Dennis McIntosh  
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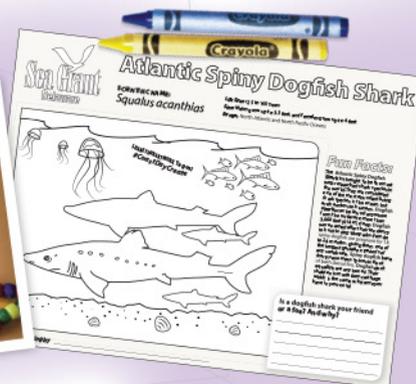
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## VISUAL CONTRIBUTORS



△ A few of Coast Day's educational activities include building a marine animal DNA bead bracelet/key chain and an informative dogfish coloring page. Available at [decoastday.org](http://decoastday.org)

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# SEA GRANT RESPONDS TO COVID

When the country entered its initial lockdown due to the COVID-19 pandemic in Spring 2020, the National Sea Grant Program recognized early on the impact it would have on the economy. As a result, it prepared a special grant initiative for state Sea Grant programs to tailor a local rapid response to help shore up coastal economies.

Delaware Sea Grant moved quickly to help address negative impacts to education, community resilience, the seafood industry and tourism in the state, implementing a number of responses almost as soon as the lockdown began in the spring and continuing through the fall of 2020. In addition to the work summarized here, DESG also collected resources for the public for dealing with COVID-19 through remote learning, nature-based recreation and support for specific situations. Some work that may not have been a direct response to the pandemic was still altered in significant ways. Look for the COVID-19 Response icon in the sections on Healthy Coastal Ecosystems, Resilient Communities and Economies and Environmental Literacy and Workforce Development.

The resulting efforts in Delaware proved innovative, creating some programs that are continuing to grow and evolve and will likely become sustained work to benefit the state's commercial seafood producers and residents. Details about these efforts are described in this spread by the general need they addressed.



## COMMERCIAL FISHING & AQUACULTURE

Changes within the restaurant industry caused by COVID-19, such as prolonged closures and decreased seating capacity, created a bottleneck between seafood producers and consumers, which significantly affected seafood sales in 2020. To help seafood producers shift sales directly to consumers, Delaware Sea Grant created a webpage ([deseagrant.org/seafood](http://deseagrant.org/seafood)) to help promote local, sustainable seafood options and connect the public with seafood providers. DESG also ran advertising campaigns in the summer and fall to promote the webpage and local seafood consumption, especially of Inland Bays Oysters.

The advertising campaign, together with an online seafood cookbook with recipes from local chefs and winners of an online recipe contest, effectively drove thousands of people to the directory of seafood providers.

To further develop a consumer base, DESG implemented a community seafood purchaser network, where DESG collected and relayed consumer demand directly to aquaculturists and commercial fishers and hosted pick-up events, providing supplier exposure and generating about \$8,000 in sales from 10 events reaching 100 customers.

The program helped provide a market for commercial fishers and kept them operating when many other traditional buyers were ordering far less. Buyers had a welcome sense of community when picking up the week's catch in parking lots in the Lewes area, and Delaware's small community of commercial fishers was grateful for the support.

Mobile seafood market for commercial fishers to sell their daily catch directly to the community generating about

# \$8,000

in sales from 10 events reaching 100 customers.



Some seafood buyers were pleasantly surprised to learn there are locally caught lobsters.

Inland Bays Oysters ad campaign that ran in four local publications during Fall 2020.



"I have new buyers calling everyday thanks to Delaware Sea Grant's help," said crabber Brian Hoffecker during the 2020 season. "I really appreciate it! I could sell 100 bushels a day."

In addition to organizing the community seafood purchasing effort, DESG itself purchased 75,000 farmed oysters from aquaculturists for use in an ongoing restoration effort in Rehoboth Bay and for further growth in Delaware Bay waters where commercial harvesters produce the state's wild harvest oysters. This provided economic benefits to the oyster farmers and commercial fishers, as well as ecological benefits to Rehoboth and Delaware Bays.

"Because of the decreased demand, farmed oysters in the Inland Bays were going to grow too big for the restaurant market," explained Ed Hale, DESG aquaculture, fisheries and seafood specialist. "We used the rapid response funds from the National Sea Grant Program to purchase those oysters and ensure they went to good uses, while also collecting biological data."

**2 1/2** Delaware Tourism campaign focused on visitors within **—HOUR** drive of southern DE



- **1.5 million impressions**
- **200+ hotel bookings**
- **360,000 unique views**



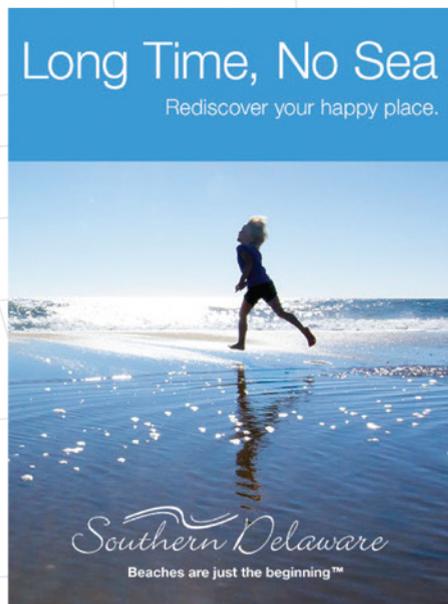
of the residents in Sussex County experience three or more of the 12 CDC social vulnerability risk factors.



## DELAWARE TOURISM INDUSTRY

Tourism is one of the two pillars of coastal Delaware's economy, along with agriculture, and typically generates \$2.1 billion annually in visitor spending while supporting 19,000 jobs. However, COVID-19 had a significant impact on this sector.

To support the struggling industry, Delaware Sea Grant supported a regional marketing campaign by the Southern Delaware Tourism Office to promote safe, timely travel back to coastal Delaware in a responsible manner. The digital campaign focused on visitors within a 2 1/2-hour drive of southern Delaware and directly resulted in 1.5 million impressions, more than 360,000 unique views, and more than 200 hotel bookings.



## CAPE COMMUNITY COORDINATION FOR COVID-19

Nearly one-third of Sussex County, Delaware residents experience three or more of the 12 CDC social vulnerability risk factors. These vulnerabilities were exacerbated by the COVID-19 pandemic. Response efforts revealed critical capacity shortages at the county and local levels, leading a group of volunteers to form the Cape Community Coordination for COVID-19 (CCC4COVID)—the only grassroots COVID-19 response coalition of its size and scope in Delaware. Delaware Sea Grant joined CCC4COVID to lend capacity to local response efforts.

With the help of DESG and others from the University of Delaware, CCC4COVID facilitated connections and coordination among nonprofit, faith, civic, business and social service organizations in the community. Through weekly meetings and emails, CCC4COVID connected different organizations in the community so that they could collaborate among themselves on COVID-19 relief responses.

One of the coalition's roles was to better coordinate on-the-ground COVID-19 response efforts among the organizations to try to avoid duplication, increase efficiency and close any gaps that exist—such as those of food distribution and emergency supplies to vulnerable populations.

Danielle Swallow, DESG coastal hazards specialist, helped with that coordination work and with expanding who is receiving help by extending the initial connections CCC4COVID had. For instance, Swallow regularly offers emergency preparedness training for older adults in Sussex County,

and she was able to connect various senior care organizations with United Way through CCC4COVID when United Way wanted to launch a program to check in on seniors.

Swallow also brought the Delaware and Federal Emergency Management Agencies and Sussex County into the group, and those groups were able to bring in the state's Division of Public Health and the Governor's Office. As a result, CCC4COVID informed the way the State conducts outreach to underserved communities in Sussex County, for instance converting a county bookmobile into a mobile vaccine bus to drive to where there is need and working with CCC4COVID to help minority populations over 65 lacking internet access or transportation sign up for and get to vaccine appointments.

The collaboration with the Delaware Emergency Management Agency (DEMA) has led to Swallow providing disaster recovery support in Sussex County more generally. Together with DEMA and the county, Swallow is also working on evolving CCC4COVID into a Community Organization Active in Disasters (COAD), a kind of permanent resiliency organization set up by networks of volunteers, emergency managers, community groups and others prepared to respond, each with their own expertise, during a crisis.

"I've opened doors of communication between the county and the coalition and I'm opening doors of communication between what the state is doing and the efforts they're directing in Sussex as it relates to our older adults," said Swallow. "This group has identified ways in which COVID disproportionately impacts marginalized communities in Sussex and has come up with ways to address some of the needs. In the end, we're going to have better capacity to plan for and respond to disasters."

# FEATURED RESEARCH

## Investigating the Feeding Habits of Sharks in the Delaware Bay

In the Delaware Bay, sandbar and sand tiger sharks sit atop the food chain. As apex predators, they play an important role in the Bay's ecosystem as they impact the food web directly through what they eat and indirectly through changing the behaviors of potential prey who want to avoid being eaten.



To better understand what these sharks eat and the resulting commercial and ecological ramifications, a DESG-funded team has set out to quantify the potential impact these sharks have on managed species in the Bay and figure out ways to improve ecosystem management. They are also examining recreational shark fishing, which is becoming an increasingly important component of the coastal economy.

Both sandbar and sand tiger sharks are listed as protected species by the federal government because of overfishing in the 1960s, '70s and '80s. While their populations appear to be rebounding, their rate of population increase is slow because of key life history parameters including a late age of maturity and lower ability to produce offspring relative to other species.

"Even though the sandbar sharks are coming back, recovery isn't expected until around the 2070s," said Aaron Carlisle, assistant professor in the UD College of Earth, Ocean and Environment (CEOE). "If we're going to be dealing with an increasing shark population, which is a sign of a good, healthy ecosystem, we need to figure out how to balance the impact they have with our needs and requirements to use marine resources in these fisheries."

Carlisle leads a team of researchers on the study, collaborating with Ed Hale, DESG marine advisory specialist and assistant professor in CEOE; Dewayne Fox, assistant professor at Delaware State University; and Devon Scott, a CEOE graduate student. Camilla McCandless, of the NOAA Apex Predators Program, is also a collaborator.

The research relies on partners like the Delaware Department of Natural Resources and Environmental Control, which Scott has joined on monthly trawl surveys, documenting fish in the area to get an idea of the prey available to sharks.

The researchers employ stable isotope analysis as their primary research tool to examine these sharks' diets. This involves using the chemical composition of the animal's tissue to learn what it eats.

"It's an indirect estimate of what they're eating because everything they eat gets turned into new shark," said Carlisle.



*Carlisle and Scott prepare lines to catch sharks for research.*

To better understand its diet, researchers caught this juvenile shark and others pursuant to NMFS Permit #2020-FSC-025.



In addition to taking tissue and blood samples from larger sharks, the researchers will catch juvenile sharks and pump their stomachs to see what they have eaten.



As juveniles, sandbar sharks tend to eat a lot of blue crabs and a variety of fish: bunker, hogchoker, drums and croakers. As they mature, they move towards other fish prey species. Evidence outside of Delaware Bay suggests that they're consuming managed fish species.

"We're not allowed to harvest these sharks because they're protected, but they're consuming these prey species, which we have significant management interests in," said Hale. "In that sense, they're acting in a competing way towards a recreational angler."

Another goal is to better understand what the sharks are eating as they progress through their various life stages. This will help with stock assessments of managed prey species—which provide fisheries managers information used in the regulation of a fish stock—because the scientists will figure out how quickly certain species of fish will be consumed given the number of sharks of a certain age in an area.

The information gathered will be shared publicly and with the state and federal biologists involved in the natural resource management of these species.

"The whole idea is to try and get to a point where we are making useful connections for things like a stock assessment where we can help assess relative abundance," said Hale. "The goal for us is to generate meaningful information that can help the scientific process but also inform the public."



◀ The students record data about the captured bird, take measurements and examine the bird's physical condition.



## The Importance of Coastal Songbirds

In 1993, a group of community scientists, non-profit groups and state agencies looked at how migratory birds use coastal areas on the Delmarva Peninsula and in southern New Jersey. One of the goals was to see if coastal areas were more important than inland areas for migrating songbirds. The study showed that the highest densities of songbirds were situated along the coast and not further inland.

Now, with funds from Delaware Sea Grant, Delaware State University Professor Christopher Heckscher and a research team are looking to confirm the results of that study and expand upon it, trying to quantify just how important nearshore areas are for migrating songbirds who need to refuel on their journey. This will allow them to understand how important the areas and their birds are for local tourism economies, and how that could change because of sea level rise.

"The 1993 study suggested that the Delaware Bayshore was a critical stopover area on a global scale for these songbirds," said Heckscher. "We want to see if the birds are just coincidentally moving through on their way south or whether they are dependent on the Delaware Bayshore for refueling."

Sonja Kolstoe, a research economist for the United States Department of Agriculture (USDA) Forest Service who worked previously as a professor at Salisbury

University, and her undergraduate research assistant, Kelsey Poisal, are working to determine the economic benefits of coastal public lands as well as how sea level rise will alter coastal recreational opportunities in the future. Their work looks to understand how visitors to coastal public lands, including bird watchers, would change their travel plans if there were less of the Bayshore habitat because of forecasted sea level rise.

Heckscher and his graduate student, Aya Pickett, began the study in April 2020 on a marsh hummock in the Nature Conservancy Preserve in Milford Neck. They set up nets early in the morning before dawn—as the birds migrate at night and will put down in an area to rest just before dawn.

They banded any birds they caught with a United States Geological Survey (USGS) identification band and a unique band number. If the bird is later recaptured, the band indicates where the bird was first banded.

Both in the 2020 surveys and in a second round of banding this spring, Heckscher and Pickett took measurements, weighed the bird, and examined their fat and muscle content, both of which are indicators of their physical condition on migration.

Once they analyze the data collected, if they see a lot of underweight birds, that's an indicator that their location at

dawn is important, as they need to feed immediately. Finding healthier, heavier birds indicates the Delaware Bayshore is more of a coincidental stopover site.

If they recaptured a lot of birds, that indicates that the birds are sticking around in the marsh for a few days. If they did not get any recaptures, it shows that the birds are not necessarily using the habitat for a longer stopover period.



They also took feather samples to perform stable isotope analysis, which shows where a bird is migrating from.

"The stable isotope analysis shows us where that feather was grown, and these birds grow their feathers on their breeding ground," said Heckscher. "The feathers give us an idea of where the Delaware Bayshore fits in terms of connectivity and puts it in perspective in terms of geography. Are these songbirds coming from northeastern Canada, in Newfoundland or Nova Scotia, or are they coming from the upper Midwest somewhere?"

Whatever the data shows, Heckscher said the research will provide valuable additions to earlier studies.

"We're on the cusp of providing a really important piece of information to help preserve the overall biodiversity of our coastal areas," said Heckscher.

# HEALTHY COASTAL ECOSYSTEMS



## Educating Delawareans on Aquatic Invasive Species

**A**quatic invasive species disrupt normal ecosystem functions in Delaware and can cause extensive damage to the state's waterways. Flathead catfish, for example, have been found to feed on native fish including American shad, blueback herring and other species of significant economic concern such as blue crabs.

Invasive species compete with native organisms for limited resources and can permanently alter habitats by causing extinctions of native plants and animals, which results in significant economic impacts in addition to disrupting aquatic ecosystems.

To help inform recreational fishers, the general public and students of the dangers of invasive species, Delaware Sea Grant (DESG) developed a three-pronged informational approach on how to identify and what to do when encountering aquatic invasive species.

The project was funded by the Mid-Atlantic Panel on Aquatic Invasive Species and involved several of DESG's Marine Advisory Service specialists: Kate Fleming, who is the principal investigator for the project, Ed Hale, David Christopher and Chris Petrone.

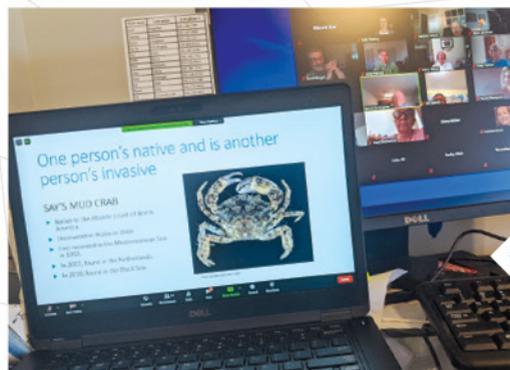
For recreational fishers, Hale recorded a presentation on aquatic invasive species that was distributed to local fishing clubs and Fleming sent them waterproof rack cards to hand out with information on invasive fish and how to report those invasive fish to local management agencies.

Developed by Fleming and DESG's Environmental Public Education Office, the rack card highlights three invasive fish—northern snakehead, flathead catfish and blue catfish—and also their similar looking counterparts bowfin and channel catfish. The card includes instructions on what to do if an invasive fish is caught. It is recommended to kill invasive species and not return them to the water—especially not to another area where they weren't caught. There is a QR code, email and phone number on the card where users can report invasive species to the Delaware Department of Natural Resources and Environmental Control (DNREC). A non-waterproof version of the card is stapled in the center of this report.

These cards were also distributed to state parks throughout Delaware as well as town parks in Milford, Seaford and Bethany Beach.

"People in the recreational fishing community and the general public need to be taught how to properly identify these species so that they don't misreport commonly mistaken species," said Hale. "They need to learn where to report sightings and how to properly and humanely euthanize these fish, so that they can help with invasive species management in local waterways."

Anglers have not been the only audience for DESG education, however. Christopher, DESG's education specialist, developed a high school lesson on Invasive Crabs in Delaware.



*Adult Asian Shore Crab impacts the native blue crabs and blue mussels commercial and recreational fishing industry.*



*Participants from Osher Lifelong Learning Institute attended the DESG invasive aquatic species session by live video conferencing.*

The lesson, which was partially designed by Catherine Czajka, a summer intern for DESG, focuses on the European Green Crab, the Asian Shore Crab and the Chinese Mitten Crab and was presented at a #75MinuteScience workshop on February 23, 2021.

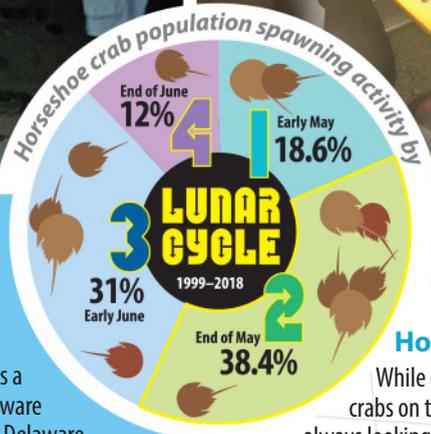
Darrick Sparks from the Smithsonian Environmental Research Center spoke and then Christopher presented the lesson.

"Teachers seemed to really like the lesson and using a Story Map allows them to share it easily with students who are learning from home during the pandemic," said Christopher.

In addition, DESG used the "15 Second Science" video series to address the problems posed by aquatic invasive species, and the program leveraged its relationship with the Osher Lifelong Learning Institute, with Hale, Christopher and Fleming presenting on invasive aquatic species to about 80 participants. The videos, story maps, fish ID card and more resources can be seen at [deseagrant.org/invasive-species](https://deseagrant.org/invasive-species).

Fleming said that it was great to be part of a collaborative DESG effort to inform Delawareans about the impacts of aquatic invasive species.

"This project came out of a brainstorming session between all of us," said Fleming. "We've been working together to build awareness and outreach related to aquatic invasive species in Delaware and it's been a great collaborative, team effort."



## The Count Must Go On



In a normal year, Delaware Sea Grant (DESG) enlists trained community volunteers to help count the number of horseshoe crabs on Big Stone Beach in Kent County during the months of May and June. The horseshoe crab spawning survey is a collaborative effort that has been taking place around the Delaware Bay since the 1990s with around 24 sites surveyed each year in Delaware and New Jersey. In Delaware, the Delaware Division of Fish and Wildlife (DFW) oversees the survey. Because of the pandemic lockdown, DESG could not bring together large numbers of volunteers, so DESG and its partner Delaware Wild Lands conducted the count with staff members, enabling the organizations to provide last year's data at Big Stone Beach and maintaining the continuity of the survey. Because the Big Stone Beach surveys were able to be completed without volunteers, it was one of the few sites other than those surveyed by DFW to be able to collect data last year. Counting the horseshoe crabs on the beach entails recording the number of male horseshoe crabs in comparison to the number of females, which helps managers who incorporate that male-to-female spawning ratio into models they use to set harvest limits.

## Horseshoe Crab Counting by Sonar

While data from the in-person counting of horseshoe crabs on the beach is vital to management efforts, DESG is always looking to invest in research that can improve the state of coastal and marine science, and in 2020, the program funded a project by Professor Art Trembanis of the University of Delaware College of Earth, Ocean and Environment to explore using sonar to count horseshoe crabs in nearshore waters. The part of the research funded by DESG used an Autonomous Surface Vehicle (ASV) with side-scan sonar to image shallow water just off the Bayshore south of Port Mahon. Trembanis' team then used machine learning with the resulting data to help count horseshoe crabs detected. The ultimate goal of the small project was to test the feasibility of the method and provide protocols for how to conduct similar surveys to resource managers and others seeking to improve the accuracy of horseshoe crab counts.

## Beach Clean-Ups

Coast Day was primarily a virtual event in 2020 (see story on page 13), but DESG organizers wanted to find ways to still encourage participants to get out in nature and take action for their local environment. One of the initiatives for #CoastDayOutside was to ask people to spend some time cleaning up a beach or an outdoor space near their home. Marine Advisory Service specialist Kate Fleming and MAS intern Catherine Czajka created a story map, unveiled at Coast Day 2020 for the first time and still available at <https://arcg.is/1zC8qT>, that interested people can use to find organized clean-ups happening up and down the state, from Wilmington to Fenwick Island.



# RESILIENT COMMUNITIES & ECONOMIES

## 2020 Knauss Fellows Learn to Work Remotely on Capitol Hill

Even amidst a global pandemic and having to learn a new job while working remotely, Samuel Fielding and Jennifer Joseph were able to gain valuable experience during their year on Capitol Hill as part of their Dean John A. Knauss Marine Policy Fellowships.



Fielding (above), a doctoral student in the University of Delaware's School of Marine Science and Policy, was placed with the U.S. Army Corps of Engineers in their Engineering with Nature Initiative. That initiative seeks to align engineering objectives, such as flood control or storm risk reduction, with natural processes.

"As a doctoral student in the marine policy program, my focus has been on coastal hazards and how communities address coastal hazards," said Fielding.

He conducted research on how to better incorporate natural infrastructure into the Army Corps planning process, and how to better account for the benefits of these projects, specifically expanding the typical cost-benefit analysis.

He also coordinated with other universities to set up partnerships for a new research center focused on natural infrastructure, and he conducted research that looked at the barriers and enabling factors behind the financing of these projects.

Fielding said it was beneficial to get exposure to federal agency work and that he was able to expand his contacts and network while also having the chance to contribute to some of the back-end work, such as preparing memos and technical notes, to help with the government workflow.

"I was able to get hands-on experience as to what the Army Corps does and all of the different actors involved in this field," said Fielding. "Being able to meet and talk with experts in the field and see how these projects take shape and get implemented was great."

"Part of my interest is looking at living shorelines and using nature to alleviate flooding and storm risk so this was complementary in its objectives to my academic interests."

During the fellowship, Fielding was involved with different projects that called upon his expertise in economics and social sciences. He



Joseph (left), who received her master of science in marine bioscience from UD, worked with the U.S. Fish and Wildlife

Service in their Congressional and Legislative Affairs Office. The office serves as the liaison between the Fish and Wildlife Service and Capitol Hill, with people in the office covering different programs.

Joseph worked in the fish and aquatic conservation program covering topics such as hatcheries, invasive species and the wildlife and sport fish restoration program.

She also worked with Science Applications, a science support program, which handles climate change work, at-risk species and pollinators among other topics, contacting congressional staffers and answering inquiries that came into the office.

During placement week, where fellows get matched with government agencies, Joseph had 16 interviews and chose this position because it allowed her to do a variety of tasks while also being exposed to high-level government work.

"I didn't know a lot about how Congress worked so this position was a steep learning curve, but everyone in my office was super nice and it was a really good fit for me," said Joseph. "I also thought this would broaden my career in getting exposure to both the federal government and Capitol Hill."

Joseph saw how bills move through Congress and how federal agencies help by providing guidance and expertise on specific topics. If a bill was specific to her section of the U.S. Fish and Wildlife Service, a congressional staffer might reach out for ways to improve the bill.

"I helped out with a couple of bills that were important to my programs on invasive species and the wildlife and sport fish restoration program," said Joseph. "I definitely got an introduction into congressional procedures and legislation writing."





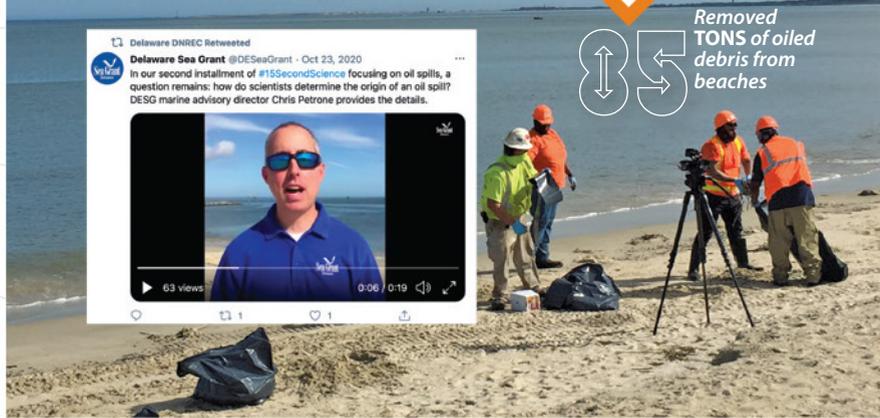
### Focus on the Coast—Offshore Wind



Delaware is undergoing a transition towards development of offshore wind and solar energy resources. While renewable energy brings the potential of green jobs, transition affects stakeholders in the tourism, fishing, and shipping industries. To help the public learn about and engage with the realities of offshore wind projects on the horizon, DESG worked with Bonnie Ram, associate director for strategic initiatives at the Center for Research in Wind (CRew) of the University of Delaware. Although in-person public meetings were impossible, DESG staff and Ram used a series of online sessions to engage community partners—local businesses, town governments, and individual citizens—to drive discussion about the Skipjack Wind Farm being planned by Ørsted off the coast of Ocean City, Maryland. The transmission cable to bring the power generated by the wind farm onshore was originally planned to make landfall at Fenwick Island State Park, prompting the public engagement sessions. That plan has since been withdrawn and a new interconnection site is being sought.

### Oil Spill Response

In October 2020, oil was reported washing up on Broadkill Beach, the beginning of a relatively small but still weeks-long response to a spill of unknown origin. The oil, which eventually totaled 215 gallons washed ashore, was cleaned up by the U.S. Coast Guard and the Delaware Department of Natural Resources and Environmental Control, which had to remove 85 tons of oiled debris from beaches from Bowers Beach to Assateague Island. Delaware Sea Grant provided support in several ways: funding quick-response research on whether the oil reached the seafloor of a 500-acre area off Broadkill Beach, launching a special seven-day series of “15 Second Science” videos to educate the public on frequently asked questions, connecting the public with agencies and resources to report oil and follow the progress of the oil spill, and answering questions from K–12 students and the media about oil spill impacts and how to help. Learn more about DESG’s role in oil spill response at [deseagrant.org/oil-spill](https://deseagrant.org/oil-spill).



Removed  
TONS of oiled  
debris from  
beaches



Use the smartphone cradle for capturing photos

#CoastSnapDE

### CoastSnap

Residents and visitors to the Delaware beaches can contribute to a DESG-funded research project relying on community scientists to document the changes in three key locations along the shoreline. Created by the University of New South Wales in Australia, the CoastSnap research program uses smartphone cradles installed at specific points on a beach so people can take photos from the exact same place and upload them. Researchers then assemble the many photos from different people and different times but the same vantage point to build an understanding of how the beach is changing due to processes such as storms, human activities and other factors. Delaware’s three sites—at Broadkill Beach, Herring Point in Cape Henlopen State Park, and the south side of Indian River Inlet—will allow DESG researchers to study three different kinds of shorelines and their unique influences. Learn more about the program and how to participate at [deseagrant.org/coastsnap](https://deseagrant.org/coastsnap).



# SUSTAINABLE FISHERIES & AQUACULTURE

150

American shad caught in Brandywine Creek demonstrates juvenile and adult shad are using newly available habitat.



## Research Shows Wilmington Dam Removal Provided New Shad Habitat

Delaware Sea Grant's Ed Hale conducted seine net surveys of Wilmington's Brandywine Creek every two weeks through the late summer and early fall of 2020, engaged by a coalition of groups supporting the removal of the waterway's dams up to the Pennsylvania border.

The main non-profit spearheading the work, Brandywine Shad 2020, wants to restore the creek as spawning habitat for the anadromous American shad (*Alosa sapidissima*), which lives much of its life in the ocean but returns to freshwater habitat along the East Coast to spawn. Juvenile shad grow in the rivers and creeks from Florida to Nova Scotia, protected from marine predators when they are at their most vulnerable, before heading out to sea.

For centuries, the dams between the creek's confluence with the Christina River and the Pennsylvania state line have effectively confined any shad to the small section of creek below West Street, where the first dam blocked passage upriver. After Brandywine Shad 2020 removed the first dam in Fall 2019, the group wanted to evaluate the impact on fish movement.

Hale, DESG's aquaculture and fisheries specialist, worked with Dewayne Fox at Delaware State University to develop a comprehensive proposal to study the life cycle of American shad in the Brandywine Creek, a plan that convinced project leaders he was the right choice for the project. Funding and timing constraints meant for 2020 the research was directed at just one life history stage, intended to determine the effectiveness of removing the first dam by seeking juvenile shad in the section of creek previously blocked off.

American  
shad



With Hale leading the effort and aided by a DESG intern, Brandywine Shad 2020 started fishing, enlisting supporters, community members, and Simeon Hahn, a member of the Delaware Sea Grant Advisory Council and an official at the National Oceanic and Atmospheric Administration's National Ocean Service, Office of Response and Restoration. Their first trip out they caught a few adult shad, which was fantastic, but not proof that the newly opened section of creek served as a juvenile nursery.

On the second sampling event, at the end of July, they caught more than 150 juvenile shad and consistently caught juvenile shad in the follow-up seining as well, demonstrating how important this habitat was to multiple life history stages of American shad. It doesn't prove shad are spawning in the newly open section of creek, although it is likely and Hale plans to return to conduct a spawning survey in the future. But the 2020 research does show at a minimum that juvenile and adult American shad are using the habitat newly available to them.

Increasing scientific data on American shad could help surrounding states make decisions about how to manage the fishery.

"The reestablishment of a native, natural, well-performing ecosystem is essentially the goal, and capturing juvenile shad there at that location is suggesting that is on track and that removing the dam is actually beneficial to the wild ecosystem," Hale said. "So we're opening up available habitat. We're seeing juvenile progeny. We are essentially documenting what could result in population rebuilding or recovery."



## New Demonstration Oyster Farm

Although visits by the public were suspended in 2020, Fisheries, Aquaculture and Seafood Specialist Ed Hale and DESG intern Jake Mathews used the summer to create a demonstration oyster farm in the boat basin of the University of Delaware's Hugh R. Sharp Campus in Lewes, home to DESG's Marine Advisory Service (MAS). The effort converted a shallow and mostly unusable section of the harbor into an easily accessible space for members of the public and people with an interest in aquaculture to see up close the kinds of equipment necessary to raise oysters. The demonstration farm includes longline cages, floating cages, and stacked tray cages. All three are often used by oyster farmers working in Delaware's aquaculture industry in the Inland Bays, and while the specifics vary, each tool promotes the growth of oysters to market size while protecting them from predators. In the future, the demonstration farm should provide a useful teaching tool for DESG and may become a stop on public tours of the campus.



*DESG Intern Jake Mathews sits in a kayak with a few floating cages setting up equipment used to raise oysters at the farm.*



## Sharing Expertise With Others

Along with partners from industry and academia, Hale, Mathews, and DESG's other aquaculture specialist and Delaware State University faculty member Dennis McIntosh spoke in multiple venues throughout the year, bringing their expertise to seafood industry professionals and the interested public alike. A project to shed light on sturgeon mortality involving Hale was presented at the American Fisheries Society meeting, while general talks on fisheries management and on oyster farming were part of the first ever virtual Coast Day (more on page 13). Hale also recorded a lecture on invasive fish that was distributed to many fishing clubs throughout the state to help make anglers aware of not only what fish to watch for, but why they are a problem.



UNIVERSITY OF DELAWARE  
EARTH, OCEAN &  
ENVIRONMENT

## New Faculty Appointment

In Fall 2020, Hale earned a joint appointment in the University of Delaware's College of Earth, Ocean and Environment. As an assistant professor in the School of Marine Science and Policy (SMSP), Hale will continue in collaborative research efforts and extension activities, as well as provide academic advisement and teaching. With the appointment, a first for DESG, Hale will be able to advise graduate students, broadening the research capacity of SMSP and DESG in fisheries science. Hale also teaches "The Oceans" as part of the Associate in Sciences Program overseen by UD's College of Arts & Sciences.



*Photograph taken prior to the COVID-19 pandemic.*

# ENVIRONMENTAL LITERACY & WORKFORCE DEVELOPMENT



## Virtual Education About the Real World

Much of Delaware Sea Grant's work to help improve environmental literacy in the state centers around in-person activities: field trips, classroom visits, professional development for teachers in workshops and conferences. In a year when all in-person events stopped, DESG had to find creative ways to continue to provide support for students and teachers as well as offer new kinds of programming for members of the public.

As with much of the education world in 2020, often that involved moving activities online. Two big events in particular were critical for DESG staff—one a new initiative building on past success and the other with a 40-year history as a science festival.

The Maryland-Delaware Climate Education Assessment and Research (MADE CLEAR) Project conducted successful teacher workshops at a local scale for several years, and the response from teachers convinced DESG and partners to continue the program in 2019, even though MADE CLEAR funding had finished. With so much interest from classroom teachers



in ways to help their students understand climate change, DESG and partners decided to try a larger approach in 2020 and began planning the Mid-Atlantic Climate Change Education Conference (MACCEC).

Although it could not be held at Goucher College in Towson, Maryland as planned, the MACCEC convened formal and non-formal educators virtually for three days in June to learn about the latest trends in climate change education. The conference offered four session tracks: Environmental Justice & Climate Change, Climate Change in the Classroom, Climate Change & Estuaries, and Individual & Community Level Climate Change Solutions.

Maryland, New Jersey, Pennsylvania, and Virginia Sea Grant programs also supported the conference along with other National Oceanic and Atmospheric Administration agencies in the region.

While MACCEC was a new event, an expansion of something that had worked at a smaller scale, the other big event DESG took virtual in 2020 was well known on a large scale throughout Sussex County. The annual Coast Day festival has been held by DESG and the University of Delaware's College of Earth, Ocean and Environment on its Lewes campus since 1977. Thousands of people attend to enjoy lab tours, cooking demonstrations, science lectures, exhibitors and more.



Some of the regular experiences of Coast Day moved to a virtual format relatively easily. The lectures, for instance, not only functioned largely the same online as in person, they were shortened and more topics were offered. Other standard offerings had to be canceled. There seemed little reason to hold a crab cake cook-off, for instance, when no one could smell or taste the entries.

But the virtual format allowed for some innovation too. One of the most popular attractions at Coast Day every year are the touch tanks showing local fish to attendees up close. Rather than assume such an experience wouldn't be possible virtually, DESG created a virtual touch tank by filming the seining and trawling trips to catch the animals and created segments on each species, described by Marine Advisory Service specialists. The virtual touch tank not only maintained a staple of Coast Day in an online format, it's still available today at [deseagrants.org/virtual-touch-tank](https://deseagrants.org/virtual-touch-tank).

Environmental literacy efforts extended well beyond these two events, however. Various members of the Marine Advisory Service (MAS) used Zoom throughout the year to reach directly into classrooms, whether the students were in-person or online.

"As informal educators and university staff, we were trying to do everything that we possibly could to support classroom teachers," said MAS Director Christopher Petrone. "They were forced into this remote learning scenario, had a short period of time to turn their entire curriculum around, and so it was incumbent upon us informal educators to support those teachers however we could."

## Delaware Sea Grant Offers Online Oceanography Merit Badge



Since 2012, Delaware Sea Grant has offered a hands-on oceanography merit badge course. When the COVID-19 pandemic meant that was no longer possible, DESG shifted the experience online.

David Christopher, DESG education specialist, and Chris Petrone, director of DESG's Marine Advisory Service, who are both oceanography merit badge counselors, filmed a lot of the in-field components to show the students things like how to test turbidity—the clarity of a fluid based on the amount of sediment and phytoplankton—and other water quality parameters.

While the content of the merit badge course was the same, Christopher spread the class out by posting videos the scouts could watch anytime and had live Zoom sessions on Saturdays totaling about three hours of content. The program was offered virtually four times, reaching 66 scouts from across the country.



David's kitchen turned into a science lab for online teaching about water density.

**EXPERIMENT**

Land Snail



## Mollusk Research Internship at Delaware Museum of Natural History

Courtney Crowe, an environmental engineering student at Delaware Technical Community College, took Delaware Sea Grant's first Green Infrastructure Program at the college in 2019, gaining exposure to a variety of green building techniques through hands-on experience. Aware of what DESG had to offer, she then applied for an internship that the program sponsored at the Delaware Museum of Natural History in its Collections and Research Division. There, Crowe helped create an annotated and georeferenced check list of marine and estuarine mollusks found in Delaware by using the museum's existing mollusk collection (the 10th largest cataloged collection in North America), downloading digital data, and collecting new specimens at Pickering Beach in Kent County and the C & D Canal Conservation Areas in New Castle County. During her internship, conducted over the summer of 2020, Crowe reported to the museum's curator for the mollusk collection, Elizabeth K. Shea, a former Dean John A. Knauss Marine Policy Fellow through the National Sea Grant Program.

Tiny mollusk photo approximately five times actual size. Common name small spot Punctum minutissimum (L. Lea, 1841)

**BE PREPARED FOR A DISASTER**  
 ✓ Make an Emergency Plan  
 ✓ Make a Kit  
 ✓ Stay Informed

**HORSESHOE CRABS**  
*(Limulus polyphemus)*  
 Females often arrive to spawning beaches with a male attached to her shell, but unattached satellite males will also succeed in fertilizing some of her eggs.

**PROTECT CRAB POTS PROTECT CRABS**  
 Lost pots kill blue crabs, diamondback terrapins, and other local animals. Follow these tips to safeguard your pot and keep these animals safe.

- 1. AVOID HIGH TRAFFIC AREAS**  
 where crab pot lines could be severed or dragged by passing boats.
- 2. USE LINE THAT SINKS**  
 Float line is more vulnerable to being cut by passing boats.
- 3. STORE GEAR OUT OF THE SUN**  
 to minimize deterioration. Avoid using old line, which is more likely to break apart when in use.
- 4. USE WHITE BULLET FLOATS**  
 to mark your crab pots. Alternatives like beach bottles and bumpers can be punctured and sink.
- 5. ADD WEIGHT**  
 to your pot in areas with currents to prevent displacement.
- 6. KNOW YOUR CRABBING SPOT**  
 Lines should be just long enough to account for changing tides. Aim for 1/3 longer than the water's depth.
- 7. MAKE A TENDING PLAN**  
 Be aware of tidal changes and check the weather forecast before heading out.
- 8. MARK YOUR SET LOCATIONS**  
 Use a GPS to record the locations of your crab pots for easy recovery.
- 9. LOOK AROUND**  
 A displaced pot may not be too far away. Search in the vicinity before giving up.
- 10. TEND FREQUENTLY**  
 to reduce bycatch. In Delaware it's required to check your pot at least once every three days, but more frequent checks can minimize mortality.

**REDUCE GHOST FISHING IN LOST POTS**

- Install cull rings to allow for non-target species to escape.
- Install turtle bycatch reduction devices on all funnel entrances to minimize the potential for diamondback terrapins to enter your pot.

**85** OLLI students took the 4-week DESG course

## Marine Advisory Service Continues Partnership with OLLI



Delaware Sea Grant created a new four-week course for the first-ever University of Delaware Osher Lifelong Learning Institute July term, which was created in response to the COVID-19 pandemic. This course, entitled "Water Sciences Grab Bag," had 85 participants and included presentations on topics such as emergency preparedness, Delaware's aquatic invasive species, marine debris, and the Delaware State Marine Animal, horseshoe crabs.

A modified version of the 2019 course, "Science of the Delaware Coast," was offered virtually in Fall 2020 and attracted 61 students from throughout the state. While the online format meant DESG's original approach using field trips and lab work wasn't an option, feedback from participants was still very positive, and the digital option allowed more people to participate.

"Everyone who took the class told me how remarkable the speakers were and how much they enjoyed hearing about UD's research," said Moshier. "Our members feel more a part of UD through this initiative."



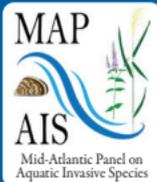
# Report **INVASIVE** Fishes of Delaware Online

Invasive species invade habitats beyond their native, historic range. Their presence can have serious economic and ecological impacts.



[bit.ly/reportinvasivefish](https://bit.ly/reportinvasivefish)

Report invasive fish to the Delaware Division of Fish & Wildlife online or by email or phone.



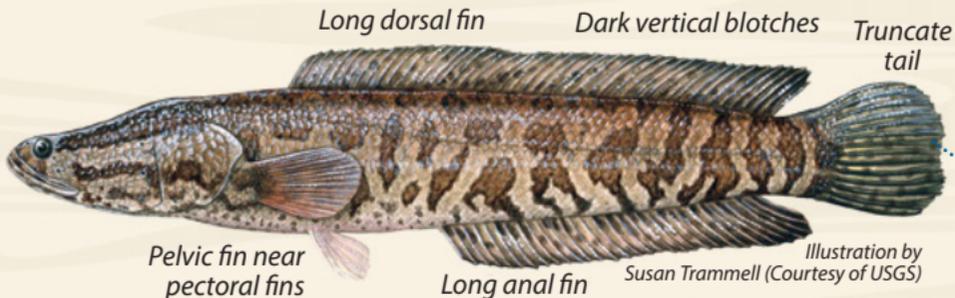
email: [DNRECFisheries@delaware.gov](mailto:DNRECFisheries@delaware.gov) phone: 302-739-9914

**It is best to Kill INVASIVE Fish, not release them**

- In the water where caught or any other body of water.
- On land because it may be able to move back to water.

## **INVASIVE** Northern Snakehead (*Channa argus*)

Eat and out-compete local sport fishes like largemouth bass.



## **NATIVE** Bowfin (*Amia calva*)



**Look-Alike Alert  
Can Be  
Misidentified**

**Not Invasive—Please Release**

*Fishes not drawn to scale.*

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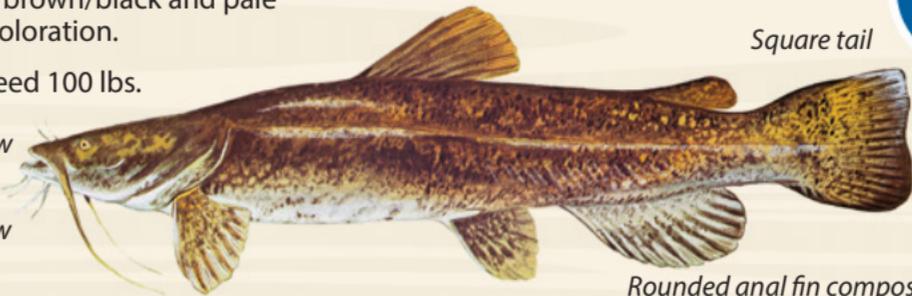
7

**INVASIVE Flathead Catfish (*Pylodictis olivaris*)**

Mottled brown/black and pale yellow coloration.

Can exceed 100 lbs.

Lower jaw extends beyond upper jaw



Square tail

Rounded anal fin composed of fewer than 30 rays

**INVASIVE Blue Catfish (*Ictalurus furcatus*)**

Often pale blue, but can be white, dark blue or black.

Can exceed 100 lbs.



Forked tail

30-35 rays along flat edged anal fin



Delaware's invasive catfishes eat already struggling native fishes like American Shad, Alewife and Blueback Herring.

**Anglers, You Can Help!**

If you catch one of these invasive species, follow these best practices for healthy ecosystems:

- DO kill it → DO take a photo → DO report it to:

Delaware's **INVASIVE Fish Tracker**



[bit.ly/reportinvasivefish](http://bit.ly/reportinvasivefish)

**INTRODUCED Channel Catfish (*Ictalurus punctatus*)**

Olive brown to gray color, often has dark spots.

Rarely exceeds 30 lbs.

Non-Native but Not Invasive



Forked tail

24-29 rays along curved anal fin

Look-Alike Alert Can Be Misidentified

Fishes not drawn to scale.

Catfish illustrations by Duane Raver Jr.

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# 2021 READERSHIP SURVEY

(on the reverse side of this card)

[deseagrant.org/survey](http://deseagrant.org/survey)

**#CoastDayOutside**  
Check out page 8 for more details!

## YOUR CHANCE TO WIN!

Complete the brief survey and mail to be entered to win the coastal prize package valued at over \$200. Or you can enter online at [www.deseagrant.org/survey](http://www.deseagrant.org/survey).

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PLACE  
STAMP  
HERE

DELAWARE SEA GRANT COLLEGE PROGRAM

## REPORTER

University of Delaware  
Environmental Public Education Office  
222 South Chapel Street, Suite 102  
Newark, DE 19716-3530

1. Do you use Delaware's bays, beaches or coastal areas for recreation or pleasure?  Yes  No
2. When compared to 10 years ago, do you think the health of our coastal and marine resources are:
  - Much better
  - Somewhat better
  - About the same
  - Somewhat worse
  - Much worse
  - Don't know
3. Which broad issues affecting Delaware's coast are most important to you? *(Check your top three choices.)*
  - Safe and sustainable seafood supplies
  - Vibrant and economically sustainable coastal communities
  - Communities resilient to coastal storms and hazards
  - Healthy coastal ecosystems
  - Climate change and/or sea level rise
  - Environmental literacy for all age groups
4. If Delaware Sea Grant could help to solve one major coastal problem in Delaware, what should it be?

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5. After reading this issue of *Reporter*, which actions, if any, do you plan to take within the next six months? *(Check all that apply.)*
  - Read more about environmental issues
  - Attend an environmental event
  - Take part in a Sea Grant workshop, lecture or seminar
  - Visit **www.deseagrant.org**
  - Visit DESG on YouTube, Facebook, Instagram or Twitter
  - Other *(Please specify):* \_\_\_\_\_

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6. How would you rate the overall quality of this report?
  - Excellent
  - Very Good
  - Average
  - Good
  - Poor

Comments or suggestions:  
 \_\_\_\_\_

7. How would you prefer to receive future issues of this report?
  - Print
  - Printable PDF
  - Website
  - Online video digest
8. What is your age?  Under 20  20–29  30–39  40–49  
 50–59  60–69  70 +
9. Is your occupation directly/indirectly related to Delaware's coastal environment?  Yes  No
10. May we contact you about future Delaware Sea Grant activities?
  - Yes, by mail
  - Yes, by email
  - Yes, by phone
  - No thanks
11. Other comments or suggestions:

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Name \_\_\_\_\_

Address \_\_\_\_\_

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City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

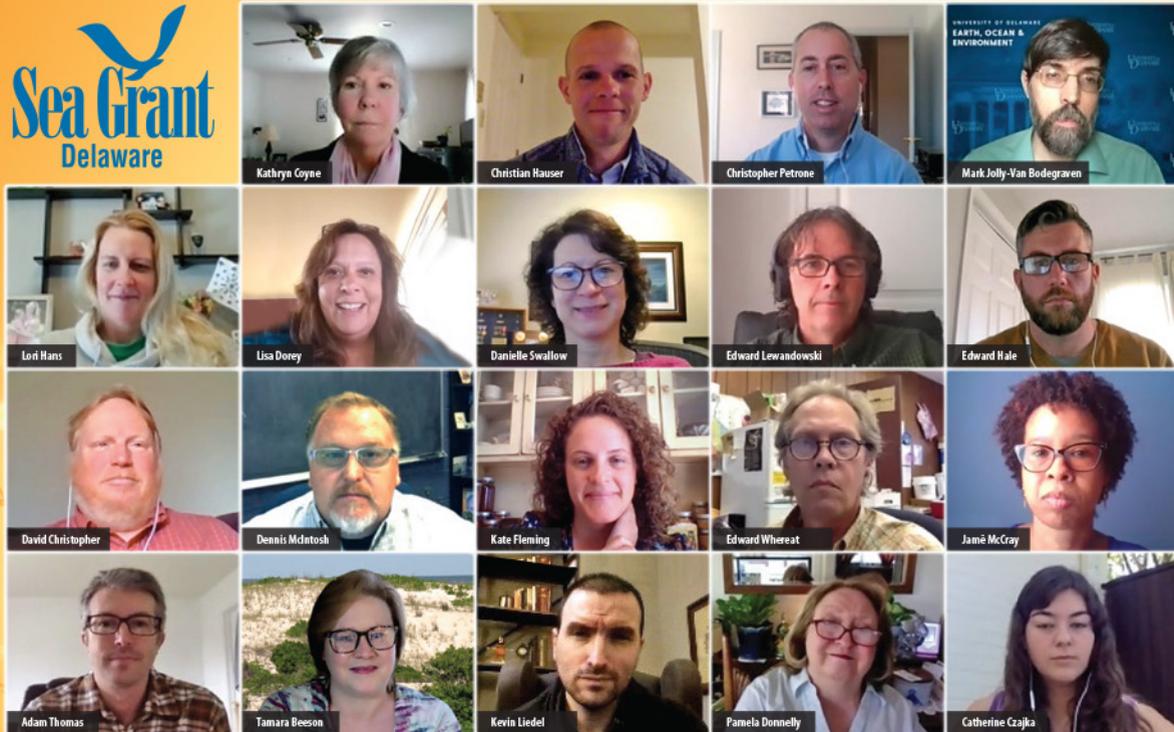
Daytime Telephone \_\_\_\_\_

I would like to subscribe to Delaware Sea Grant's e-newsletter.

*(Provide email address)* \_\_\_\_\_

The Delaware Sea Grant (DESG) College Program helps people wisely use, manage and conserve our state's valuable marine and coastal resources. We do this through an integrated program of research, education and outreach built upon active partnerships with state and federal agencies, local businesses, nonprofit organizations and community members.

DESG is one of 34 Sea Grant programs nationwide, in every coastal and Great Lakes state, as well as Guam and Puerto Rico. The National Sea Grant Program was created by Congress in 1966 and is part of the National Oceanic and Atmospheric Administration.



*Whether educators, communicators or extension agents, DESG staff and the researchers supported by the program conduct their work on local issues within the four focus areas of the National Sea Grant College Program:*

**HEALTHY COASTAL ECOSYSTEMS**

Protecting and restoring Delaware's environment and the valuable natural resources it provides

**SUSTAINABLE FISHERIES AND AQUACULTURE**

Advancing sustainable commercial fishing in Delaware's waters and fostering local aquaculture

**RESILIENT COMMUNITIES AND ECONOMIES**

Helping Delaware communities prepare for a changing environment and economy

**ENVIRONMENTAL LITERACY AND WORKFORCE DEVELOPMENT**

Training and supporting the next generation of environmental and scientific leaders

