# 8th Symposium on the Ecology, Status, and Conservation of the Diamondback Terrapin


**October 11 – 13, 2019**
**Wilmington, North Carolina**

On behalf of the Organizing Committee and Diamondback Terrapin Working Group Officers, WELCOME to the 8th Symposium on the Ecology, Status, and Conservation of the Diamondback Terrapin! Our community of diamondback terrapin researchers and conservationists has grown steadily since the inaugural Workshop on the Ecology, Status, and Management of the Diamondback Terrapin (*Malaclemys terrapin*) was held at the Savannah River Ecology Laboratory in 1994. The 1994 Workshop was convened in response to growing concern about declining terrapin populations, with the goals of identifying threats to terrapin populations and producing recommendations for management agencies. The major findings and recommendations compiled from this Workshop (Seigel and Gibbons, 1995) have served as a springboard for numerous scientific investigations into the reproductive biology, growth, seasonal movements, and population dynamics of the diamondback terrapin. Additionally, education and outreach initiatives have introduced the charismatic diamondback terrapin to engaged citizens and students of all ages. The dedication of early advocates for diamondback terrapin conservation led to the formation of the Diamondback Terrapin Working Group in 2004.

While a great deal of progress has been made in the 25 years since the first Workshop, much remains to be done. The principle threats to terrapins have not been fully mitigated, and we have not yet achieved a full understanding of terrapin population status or regional variation in population trends. This Symposium provides us with the opportunity to share the results of our work, catch up with friends and colleagues, build new collaborations, and plan the way forward to insure there are healthy populations of diamondback terrapins in our coastal marshes for future generations. Thank you for being here, and we look forward to a great meeting!

Best Regards,

Amanda Williard, 2019 Meeting Organizer, DTWG Co-Chair

Organizing Committee:
Elizabeth Colhoun
Sarah Finn
Hope Sutton

DTWG Officers:
Christina Mohrman (Senior Co-Chair)
Amanda Williard (Junior Co-Chair)
John Maerz (In-coming Co-Chair)
Joe Butler (Treasurer)
Sarah Finn (Secretary)

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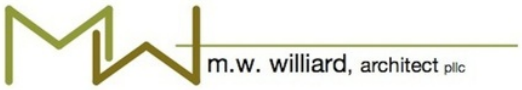










# Program at a Glance

## Friday, October 11

| | |
|---|---|
| 3:30 – 5:30PM | DTWG Business Meeting (*Palate, 1007 N Fourth St*) |
| 6:00 – 9:00PM | Welcome Social (*Front Street Brewery, Beam Room, 9 N Front St*) |

## Saturday, October 12

*All events at Hannah Block Community Arts Center, 120 S 2nd St*

| | |
|---|---|
| 8:00 – 9:00AM | Registration, Breakfast, and Welcome |
| 9:00 – 10:00AM | Plenary Talk |
| 10:00 – 11:30AM | Presentation Session – Population Status |
| 11:30 – 12:30PM | Presentation Session – Research I |
| 12:30 – 1:30PM | Lunch |
| 1:30 – 2:45PM | Presentation Session – Research II |
| 2:45 - 3:30PM | Presentation Session – Conservation I |
| 3:30 – 5:00PM | Poster Session |
| 6:00 – 9:00PM | Social and Reception<br>*2019 Terrapin Conservation Award*<br>*Best Student Oral and Poster Presentation Awards*<br>*Silent Auction to Support DTWG Grants Program* |

## Sunday, October 13

*All events at Hannah Block Community Arts Center*

| | |
|---|---|
| 8:00 – 8:30AM | Breakfast |
| 8:30 – 10:15AM | Presentation Session – Conservation II |
| 10:15 – 11:15AM | Discussion Groups<br>*Bycatch; Gulf Terrapin Conservation Plan; Education and Outreach; Population Surveys* |
| 11:15 – 11:45PM | Presentation of Discussion Group Findings, Concluding Remarks |

# Detailed Program

## Friday, October 11

| | |
|---|---|
| 3:30 – 5:30PM | DTWG Business Meeting (*Palate, 1007 N Fourth St*) |
| 6:00 – 9:00PM | Welcome Social (*Front Street Brewery, Beam Room, 9 N Front St*) |

## Saturday, October 12

*All events at Hannah Block Community Arts Center, 120 S 2nd St*

8:00 – 8:50AM Registration and Breakfast

8:50 – 9:00AM Welcome
Amanda Williard, DTWG Junior Co-Chair

9:00 – 9:45AM Plenary Presentation
**Mitigating Diamondback Terrapin Interactions With the North Carolina Blue Crab Fishery: Past, Present, and Future Challenges.**
Joe Facendola, Marine Fisheries Biologist, North Carolina Division of Marine Fisheries

9:45 – 10:00AM Break

10:00 – 11:15AM Presentation Session – Population Status
Session Chair: Christina Mohrman

10:00 **America's longest research study on diamondback terrapins (Malaclemys terrapin): Status and review**
Kristen Cecala, Whit Gibbons (Abstract DTWG-O4)

10:15 **Assessing the status of the diamondback terrapin (Malaclemys terrapin) in the Florida Panhandle**
Rick O'Connor, Molly O'Connor (Abstract DTWG-O7)

10:30 **Mangrove terrapins in the Florida Everglades**
Kristen Hart, Mathew Denton, Jacquelyn Guzy (Abstract DTWG-O16)

10:45 **Interpreting an apparent decline in a long-lived species**
Jacquelyn Guzy, B.J. Smith, Mathew Denton, Kristen Hart (Abstract DTWG-O15)

| | | |
|---|---|---|
| | 11:00 | **Ongoing status assessment for the diamondback terrapin in Florida**<br>Traci D. Castellón (Abstract DTWG-O21) |
| 11:15 – 11:30PM | | Break |
| 11:30 – 12:30PM | | Presentation Session – Research I<br>Session Chair: John Maerz<br>* Student Presenter |
| | 11:30 | **Examining movements of female northern diamondback terrapins (Malaclemys terrapin terrapin) using GPS and Ultra-Long-Range (ULR) radio telemetry methods**<br>Brian Williamson, Lisa Ferguson, Tyler Kovacs (Abstract DTWG-O12) |
| | 11:45 | **Staying Close to Home: Seasonality and Site Fidelity of an Insular Population of Texas Diamond-backed Terrapins as Determined by Acoustic Telemetry**<br>Mandi Gordon, Jenny Oakley, Dr. George Guillen (Abstract DTWG-O23) |
| | 12:00 | **Visual Head Counts: A Promising Method for Efficient Monitoring of Diamondback Terrapins**<br>*Patricia Levasseur, Chris Sutherland, Sean Sterrett (Abstract DTWG-O19) |
| | 12:15 | **Diamondback terrapin distribution and habitat utilization in southeastern North Carolina**<br>*Morgan Whitmer, Hope Sutton, Sarah Finn, Elizabeth Colhoun, Amanda Southwood Williard (Abstract DTWG-O20) |
| 12:30 – 1:30PM | | Lunch |
| 1:30 – 2:30PM | | Presentation Session – Research II<br>Session Chair: Leigh Anne Harden<br>* Student Presenter |
| | 1:30 | **Diamondback terrapin (Malaclemys terrapin) research in St. Joseph Bay and the Florida Panhandle**<br>*Daniel Catizone, Dr. Margaret Lamont, Dr. Christina Romagosa (Abstract DTWG-O14) |

1:45 **Effects of salinity on hatchling Malaclemys terrapin centrata growth, stress, and behavior**
John Maerz, Elizabeth A. Ashley, Andrew K. Davis, Vanessa K. Terrell, Connor Lake, Cady Carden, Lauren Head, Rebacca Choe (Abstract DTWG-O11)

2:00 **Increased frequency of multiple paternity in diamondback terrapins from a male dominated population**
*Megan Sporre (Abstract DTWG-O22)

2:15 **Experimentally Manipulating Life Histories Turtle Speed Ahead**
Willem Roosenburg (Abstract DTWG-O24)

2:30 – 2:45PM Break

2:45 - 3:30PM Presentation Session – Conservation I
Session Chair: Kathryn Craven

2:45 **Diamondback Terrapin Habitat Protection, Enhancement and Restoration**
Barbara Brennessel, Robert Prescott, William Allan (Abstract DTWG-O3)

3:00 **Ornate Diamondback Terrapins (Malaclemys terrapin macrospilota) in Cedar Keys National Wildlife Refuge, Florida: Five Years of Research and Student Training**
Benjamin Atkinson, Coleman Sheehy III (Abstract DTWG-O8)

3:15 **Preparing Undergraduates for Careers in Conservation: 15 Years of the Terrapin Educational Research Program of Savannah**
Jordan Gray, Kathryn Craven (Abstract DTWG-O10)

3:30 – 5:00PM Poster Session
* Student Presenter

**Diamondback Terrapin Population Distribution and Nesting Areas in Coastal Georgia**
* Grace A. Clements, J. D. Lambert, Joseph Butler (Abstract DTWG-P1)

**The effectiveness of various crab pot Bycatch Reduction Devices (BRDs) on reducing bycatch while maintaining blue crab capture efficiency at Barnegat Bay, NJ**
* Steven J. Holmberg, Jason Kelsey, John Wnek (Abstract DTWG-P2)

**Determination of the Dietary Habits of *Malaclemys terrapin* across the Barnegat Bay and Great Bay Estuaries, New Jersey**
* Belle M. Weimer, Jason Kelsey, John Wnek (Abstract DTWG-P3)

**Temporal Degradation of Crab pot Bycatch Reduction Devices in Dynamic Estuarine Systems**
* Eric J. McGivney, Jason Kelsey, John Wnek (Abstract DTWG-P4)

**The Success Rate of *Malaclemys terrapin* Nests Based on Soil Composition, Moisture, and Organic Content in Barnegat Bay, NJ**
* Emma M. Riley (Abstract DTWG-P5)

**Cedar Run Dock Road, New Jersey: A model community diamondback terrapin conservation project**
John P. Wnek, Leslee Ganss, Teresa Brostow, Serena Celestino, Riley Nevil, Courtney Parks, Alaina Perdon, Sophia Piper (Abstract DTWG-P6)

**Diamondback Terrapin in Southeastern Florida**
* Jeffrey S. Herr, Nancy P. HO, Emily Dark, Jon Moore (Abstract DTWG-P7)

**An Analysis of a GPS System for Tracking An Analysis of a GPS System for Tracking Diamondback Terrapins**
Orena Y. Wong, Laura Francoeur, Alex Kanonik, Russell Burke (Abstract DTWG-P8)

**Population dynamics of Terrapin *Malaclemys terrapin terrapin* in a residential-estuary system**
* Courtney E. Parks, Wayne Rossiter, John Wnek (Abstract DTWG-P9)

**A Comparison of Methods for Surveying Diamondback Terrapin (Malaclemys terrapin) Populations in Tidal Creeks**
* Amanda L. Lyons (Abstract DTWG-P10)

**Obligately epizoic diatoms on manatees, sea turtles and diamondback terrapins**
Tom Frankovich, Randy Chambers, Matt Ashworth, Erin Rowley (Abstract DTWG-P11)

**Impacts of Projected Sea Level Rise on Diamondback Terrapin Nesting Habitats in Virginia**
Holly A. Funkhouser, Randy Chambers (Abstract DTWG-P12)

**Diamondback terrapin habitat enhancement in New Jersey: improving nesting opportunities**
Michelle Budd, Kathy Lacey, Lisa Ferguson, Brian Williamson, Emily Heiser, Ben Wurst, John Wnek (Abstract DTWG-P13)

**The Catlett Island terrapin population: 78 marks, no recaptures**
* Justin Mitchell, Abigail Belvin, Randy Chambers (Abstract DTWG-P14)

**Monitoring changes in diamondback terrapin road crossing activity in Southern New Jersey**
Lisa M Ferguson, Brian Williamson, Victoria Musumeci, Zachary Hulmes, Amanda Lillie, Addie Schlussel (Abstract DTWG-P15)

**Using novel radio telemetry methods to understand movements of head-started and wild juvenile northern diamondback terrapins in southern New Jersey**
Tyler Kovacs, Brian Williamson, Lisa Ferguson, Kirstine Grab, Sarah Kerr (Abstract DTWG-P16)

**Functional Ecomorphology in the Diamondback Terrapin (*Malaclemys terrapin*); the effect of head-starting on morphology and bite force**
* Kyra A. Reisenfeld, Dr. Eric McElroy, Dr. Willem Roosenburg (Abstract DTWG-P17)

**Estimating the heritability of morphological traits in head-started diamondback terrapins (*Malaclemys terrapin*)**
* Iwo P. Gross, Thane Wibbels, Matthew Wolak (Abstract DTWG-P18)

**Developing new monitoring capacity in a long-term, volunteer Northern diamondback terrapin (*Malaclemys terrapin terrapin*) conservation project**
Sarah Helmbrecht (Abstract DTWG-P19)

**Variation in individual somatic growth rate of diamondback terrapins (Malaclemys terrapin) inhabiting Kiawah Island, South Carolina**
Leigh Anne Harden, Stephen Midway, Megan Thomas, Whitfield Gibbons (Abstract DTWG-P20)

6:00 – 9:00PM Social and Reception
Hannah Block Community Arts Center

2019 Terrapin Conservation Award
Best Student Oral and Poster Presentation Awards
Silent Auction to Support DTWG Grants Program

## Sunday, October 13

Hannah Block Community Arts Center

8:00 – 8:30AM Breakfast

8:30 – 10:00AM Presentation Session – Conservation II
Session Chair: Randy Chambers

8:30 **Developing a Conservation Action Plan for Diamondback Terrapins in the Gulf of Mexico**
Tom Mohrman (Abstract DTWG-O17)

8:45 **Publish AND Perish: Is publication of diamondback terrapin locality data detrimental to the species?**
Joe Butler, George L. Heinrich, David Lambert (Abstract DTWG-O9)

| | | |
|---|---|---|
| | 9:00 | **Intense overhunting of diamondback terrapins in the late 1800's and early 1900's resulted in a drastic diminution of terrapin populations range-wide.**<br>Roger Wood (Abstract DTWG-O6) |
| | 9:15 | **Now you see them, now you don't: ghosts of the past haunt shallow water estuaries**<br>John Wnek, Emily Heiser, Teresa Brostow, Laura Versaggi (Abstract DTWG-O5) |
| | 9:30 | **Quantifying impacts of bycatch on diamondback terrapins (Malaclemys terrapin) in the Delaware Bay using citizen science**<br>Lisa Ferguson, Brian Williamson, Laura Chamberlin (Abstract DTWG-O13) |
| | 9:45 | **The Regulatory Petition Process: Hope for Keeping Terrapins Out of Traps?**<br>Elise Bennett (Abstract DTWG-O18) |
| 10:00 – 10:15AM | | Break |
| 10:15 – 11:15AM | | Discussion Groups |
| | | Fisheries Bycatch, Moderator: Amanda Williard |
| | | Gulf Terrapin Conservation Plan, Moderator: Tom Mohrman |
| | | Education and Outreach, Moderator: John Wnek |
| | | Population Surveys, Moderator: Sarah Finn |
| 11:15 – 11:45PM | | Presentation of Discussion Group Findings, Concluding Remarks |

# Abstracts

* Student presenter

## Plenary Presentation

**Mitigating Diamondback Terrapin Interactions With the North Carolina Blue Crab Fishery: Past, Present, and Future Challenges**

Facendola, Joe (joe.facendola@ncdenr.gov ) - North Carolina Division of Marine Fisheries

The issue of incidental capture of diamondback terrapins in the North Carolina blue crab pot fishery has been discussed by the North Carolina Division of Marine Fisheries during the development of each Blue Crab Fishery Management Plan since 1998. Any management actions required to mitigate terrapin mortality are often contentious within the crab fishing community and have yet to be enacted. In the Draft Amendment 3 of the Blue Crab Fishery Management Plan the Division of Marine fisheries proposes a framework by which multiple and discrete "Diamondback Terrapin Management Areas" would be created, in which all crab pots fished within would be required to use terrapin excluder devices. Multiple factors have been considered in developing this targeted bycatch reduction method, such as: water depth and distance from shore, terrapin presence or absence, dimensions of the excluder device, and the season which fishing occurs. The approach outlined in this framework is considered by the Division of Marine Fisheries to be most focused way to offer diamondback terrapin populations the greatest protection from bycatch mortality while having minimal potential impacts to the statewide blue crab pot fishery. Prior to any potential implementation of this terrapin bycatch mortality reduction strategy, the criteria outlined in the proposed framework must be approved by the North Carolina Marine Fisheries Commission. As the issue of terrapin bycatch remains highly debated among stakeholders in the blue crab fishery, the future of this management framework as well as that of diamondback terrapin populations in North Carolina remains largely unclear.

## Oral Presentations

**DTWG-O3**

**Diamondback Terrapin Habitat Protection, Enhancement and Restoration**

Brennessel, Barbara (brennessel_barbara@wheatoncollege.edu) - Wheaton College (Emerita), MA Audubon Wellfleet Bay Wildlife Sanctuary
Prescott, Robert - MA Audubon Wellfleet Bay Wildlife Sanctuary
Allan, William - MA Audubon Wellfleet Bay Wildlife Sanctuary, Eastham Conservation Foundation

With input from many agencies, organizations, and individuals, a regional conservation strategy for diamondback terrapins was completed for the Northeast in 2016. For Massachusetts, the following factors were identified, in order of importance, as threats to diamondback terrapins: predation, habitat loss/climate change, human disturbance and bulkheading. Various

organizations on outer Cape Cod have forged partnerships to address these threats. Over the past decade, Massachusetts Audubon Society at Wellfleet Bay Wildlife Sanctuary, working with Orleans, Eastham, and Wellfleet groups, has led the effort to acquire land, to create and restore nesting habitat, to develop protocols to optimize conditions as nesting sites and prevent road mortality, to protect nests from common predators, and to recruit volunteers to aid these efforts. In addition to nesting habitat, a major salt marsh restoration project in Wellfleet's Herring River Estuary has the potential to significantly increase nursery and foraging habitat for terrapins.

**DTWG-O4**

**America's longest research study on diamondback terrapins (Malaclemys terrapin): status and review**

Cecala, Kristen (kkcecala@sewanee.edu ) – University of the South
Gibbons, Whitfield- University of Georgia, Savannah River Ecology Laboratory

The longest ongoing study of diamondback terrapins (*Malaclemys terrapin*) began in the coastal salt marshes and tidal creeks bordering Kiawah Island, South Carolina, more than 35 years ago. In the early 1980s, terrapins were abundant in the Kiawah marshes, but dramatic population declines were reported over the next two decades as coastal development and crabbing activity expanded. However, recent sampling suggests a potential recovery that is spatially heterogeneous. We will discuss future research plans and directions based on previous findings and the current status of Kiawah's terrapin population.

**DTWG-O5**

**Now you see them, now you don't: ghosts of the past haunt shallow water estuaries**

Wnek, John (projectterrapin@gmail.com) – MATES Project Terrapin
Heiser, Emily – Conserve Wildlife Foundation of New Jersey
Brostow, Teresa – MATES Project Terrapin
Versaggi, Laura – MATES Project Terrapin

Abandoned or derelict crab pots, known as "ghost pots" can be found in high densities along the east and Gulf coasts of the United States. Ghost pots continuously capture species, which have long-term, negative ecological impacts on both the blue crabs that they target and the bycatch that incidentally become trapped. Crab pots are categorized as either commercial or recreational depending on their construction and purpose. In NJ, commercial crab pots (60 x 60 x 60 cm) are fitted with a rebar frame and contain at least one cull ring opening that allows for smaller crabs to escape. Recreational crab pots are usually shorter than 60 cm and lack rebar frames, making them lighter weight than commercial pots, and lack cull ring openings. When crab pots become lost or abandoned, they are difficult to locate, and making it more challenging is that they can move along the bottom during high wind events. To quantify movement, we set 12 crab pots, 6 commercial and 6 recreational types in a popular crabbing location with the greatest fetch at Barnegat Bay, NJ over 12 weeks. Our results indicated that the recreational pots moved significantly greater distances than the commercial pots and that there was less movement on sediment composed of a higher silt and lower sand percentage than that of predominantly sand.

This study also shows that crab pots can eventually make their way closer to shoreline areas where they may pose both a greater navigation threat and threat to bycatch, especially to diamondback terrapins.

**DTWG-O6**
**Intense overhunting of diamondback terrapins in the late 1800's and early 1900's resulted in a drastic diminution of terrapin populations range-wide.**
Wood, Roger (rogerwood41@gmail.com) – The Wetlands Institute

Half a century or more has subsequently been required for terrapin populations to recover to something perhaps approximating their former abundance in at least some parts of their range. During this recovery period, humans have drastically altered terrapin habitat in many ways including: developing largely uninhabited barrier beach islands into resort communities; filling in extensive tracts of salt marsh to build upon; polluting salt marsh creeks and rivers with toxic chemicals; and building numerous causeways across salt marshes. In recent times, considerable effort has been expended to mitigate to some extent human impacts upon terrapin populations. These efforts include: public education about and involvement in conservation activities; organizing road patrols on salt marsh causeways; head-starting hatchlings that emerge from undamaged roadkill eggs; use of terrapin excluders on commercial crab traps; and installation of terrapin barrier fences along shoulders of salt marsh causeways. In New Jersey several recent prosecutions of large-scale terrapin poachers may signify that current illegal exploitation of wild populations may once again threaten the long-term survival of terrapins. In southern New Jersey alone, more than 11,000 illegally harvested terrapins have been documented in recent years. Large-scale poaching may be occurring range-wide. If such poaching cannot be curtailed, terrapins may soon experience the same dramatic population crash that occurred back in the late 1800's.

**DTWG-O7**
**Assessing the Status of the Diamondback Terrapin (Malaclemys terrapin) in the Florida Panhandle**
O'Connor, Rick (roc1@ufl.edu) – Florida Sea Grant, University of Florida Extension
O'Connor, Molly – Roy Hyatt Environmental Center, Escambia County School District

In the management of the diamondback terrapin within its range, there has been a large data gap within the Florida panhandle. Research has shown that well trained citizen scientists can provide useful information, as well as valuable education on topics of interest. Since 2004, Sea Grant extension has trained volunteers from a variety of organizations to assess the status of this animal in this region. Volunteers have surveyed suitable beaches for terrapin nesting, assessed frequency of occurrence, relative abundance, and collected tissue samples for genetic analysis within the nine counties from this part of Florida. This presentation will provide an update on what has been discovered with the occurrence and nesting activity, as well as the number of volunteers educated in the project.

**DTWG-O8**

**Ornate Diamondback Terrapins (Malaclemys terrapin macrospilota) in Cedar Keys National Wildlife Refuge, Florida: Five Years of Research and Student Training**

Atkinson, Benjamin (BAtkinson@flagler.edu) - Dept. of Natural Sciences, Flagler College
Sheehy, Coleman III - Florida Museum of Natural History, University of Florida

In 2014 we began investigating a previously unstudied population of diamondback terrapins in the Cedar Keys National Wildlife Refuge. The refuge is situated on Florida's northern Gulf coast along the state's Big Bend area. We are conducting long-term markrecapture and ecological studies with the assistance of undergraduates and graduate students from Flagler College, University of Florida, Santa Fe College, and Florida Gulf Coast University. We also have included participants from the Doris Duke Conservation Scholars program. Over 125 undergraduate students have joined us, and these numbers continue to grow. We collect data on population size, demographic structure, morphometrics, habitat use, and diet of these resident terrapins. We have also analyzed mark-recapture data to examine site fidelity, body mass, and recruitment success/failure on a continental island during a three-year period that include pre- and post-Category 1 Hurricane conditions. The Florida Fish and Wildlife Conservation Commission designated our study site a "sentinel population," as the species is currently under listing review for state protection status. We will summarize results of our investigations to date, discuss implications for conservation, and outline long-term goals to utilize this refuge to continue training and inspiring future stewards of Florida's Gulf coast ecosystems.

**DTWG-O9**

**Publish AND Perish: Is publication of diamondback terrapin locality data detrimental to the species?**

Butler, Joseph (jbutler@unf.edu) – Biology Department, University of North Florida
Heinrich, George – Heinrich Ecological Services, Florida Turtle Conservation Trust
Lambert, David- University of North Florida Environmental Center

Diamondback terrapins sell in the pet trade for between $10 and $3000 each (depending on subspecies and color patterns). Further, terrapins are a valued commodity in the Asian food market with adults fetching $80 each. Even though diamondback terrapins were listed by CITES as Threatened in 2013 and several states have laws against unlimited harvesting, it seems reasonable that the scientific community would control the release of terrapin distribution data, thus limiting illegal collection and poaching. The dilemma is that this data would likely be critical to future researchers and habitat managers working with diamondback terrapins. Traditionally, data sharing among scientists has come with publication of data in appropriate journals which were less accessible to the public without a subscription. However, the advancements of the digital age have put most of this information only as far away as an internet search. So, should researchers publish this locality data and risk handing the information to unethical collectors? If it is not published in a scientific journal, there must be a repository for such data so others have access without the need to repeat surveys. Of course, such a repository must be available only to those who would use it honorably and therefore

would need to be managed appropriately in perpetuity. We will discuss what type of organization could serve as a repository for diamondback terrapin locality data.

**DTWG-O10**
**Preparing Undergraduates for Careers in Conservation: 15 Years of the Terrapin Educational Research Program of Savannah**
Gray, Jordan (jgray@turtlesurvival.org) – Turtle Survival Alliance
Craven, Kathryn – Department of Biology, Georgia Southern University

For the past 15 years, the Terrapin Educational Research Program of Savannah (T.E.R.P.S) has provided undergraduates with a unique opportunity to get involved in conservation efforts for the Carolina Diamondback Terrapin (*Malaclemys terrapin centrata*) in the Savannah, Georgia region. Participation has provided students with exposure to field and laboratory studies, educational outreach, captive husbandry, and the dissemination of information, including oral and poster presentations at the local, regional, and national level. The T.E.R.P.S. program began in 2004 at the Armstrong Campus of Georgia Southern University, utilizing a conservation model for *M. terrapin* developed by Dr. Roger Wood of Stockton College and the Wetlands Institute in New Jersey. Following this model, daily patrols of U.S. Highway 80's 10 km causeway connecting Wilmington and Tybee islands yielded opportunities for salvaging eggs from deceased female terrapins, medical transport for injured specimens, and identification of hotspots of movement and mortality. Eggs that were recovered from deceased and injured animals were incubated in the laboratory and hatchings were reared and released by student volunteers. Public outreach and awareness is a year-round pursuit for T.E.R.P.S. volunteers, who attend community festivals and visit local schools. Over the past 15 years, the program has continued to evolve; sustained by student and faculty involvement. Over 95 students have participated in the program as it continues to foster an interest and involvement in conservation, and prepares students for the next step in their careers. Numerous students have moved on to graduate school, or entered directly into the conservation work force.

**DTWG-O11**
**Effects of salinity on hatchling Malaclemys terrapin centrata growth, stress, and behavior**
Maerz, John (jcmaerz@uga.edu) – University of Georgia
Ashley, Elizabeth – University of Georgia
Davis, Andrew – University of Georgia
Terrell, Vanessa – University of Georgia
Lake, Connor – University of Georgia
Carden, Cady – University of Georgia
Head, Lauren – University of Georgia
Choe, Rebacca – University of Georgia

Carolina Diamond-backed terrapins reside in southeastern U.S. coastal salt marshes, ecosystems characterized by the competing influences of inland freshwater and marine environments. Terrapins are adapted to intermediate salinities yet frequently face saltwater-inundated marsh habitat exceeding 25 ppt. We investigated the effect of salinity on hatchling

terrapin growth and potential compensatory responses to increasing osmotic stress. We acquired 30 terrapin hatchlings from Skidaway Island, Georgia and randomly assigned each to one of five salinity treatments (1, 5, 10, 20, or 35 ppt). Over 75 days, we monitored behavior and appetite daily, regularly measured growth, and obtained ratios of heterophils to lymphocytes (H:L) from blood films to assess stress levels. Consistent with previous studies, prolonged exposure to high salinity significantly reduced hatchling growth. Hatchlings in 20 ppt and 35 ppt salinities exhibited anorexia and saltwater avoidance and were more likely to show freshwater-seeking behaviors. H:L ratios were higher among hatchlings in 20 and 35 ppt salinities, indicating stress reactions. Our findings suggest hatchling distribution and growth likely varies spatially depending on local salinity and freshwater access. The growth-limiting effects of chronically high salinity or limited access to freshwater could therefore increase hatchling mortality and be an important driver of spatial variation in Diamond-backed terrapin demography and abundance. However, when freshwater sources are available, compensatory behaviors may reduce growth-limiting effects. Terrapin recruitment is likely to be impacted as anthropogenic changes, including rising coastal salinities from climate change, increased human water use, and land development, alter freshwater inputs to coastal marshes.

**DTWG-O12**

**Examining movements of female northern diamondback terrapins (Malaclemys terrapin terrapin) using GPS and Ultra-Long-Range (ULR) radio telemetry methods**

Williamson, Brian (bwilliamson@wetlandsinstitute.org) – The Wetlands Institute
Ferguson, Lisa- The Wetlands Institute
Kovacs, Tyler – The Wetlands Institute

Telemetry studies are often the most effective approaches for addressing questions of home range size and habitat connectivity. We initiated a telemetry study of adult female northern diamondback terrapins in the saltmarshes of southern New Jersey in 2018 to enhance our knowledge of the local population gained through long-term mark-recapture research. Thirteen terrapins were equipped with prototype solar-powered GPS/ULR transmitters beginning in fall 2018. Transmitters attempted to acquire a GPS fix every 8 hours whenever the unit was not submerged; typically when the terrapin was basking. Accuracy of location data ranged from 4-8 m. These location data were transmitted via radio signal to a receiver over a range of 3-10 km. Data were successfully collected and transmitted by 11 of the 13 individuals tracked to date. Data collection and analysis is ongoing, however results show telemetered females move 0.4-4.6 km straight-line movement from their home creeks to nesting locations, nest up to 3 times per season, spend significant time in salt pannes, and are active mainly within small areas in narrow tidal creeks. Our results suggest GPS/ULR transmitters may be an effective method for the study of adult terrapin movements, and we plan to continue this work to fill gaps in our knowledge of terrapin ecology.

**DTWG-O13**

**Quantifying impacts of bycatch on diamondback terrapins (Malaclemys terrapin) in the Delaware Bay using citizen science**

Ferguson, Lisa (lferguson@wetlandsinstitute.org) – The Wetlands Institute
Williamson, Brian – The Wetlands Institute
Chamberlin, Laura – WHSRN Executive Office Manomet, Inc.

Diamondback terrapins face significant threat throughout their range from bycatch in crab traps. In New Jersey, the extent of this threat from crab traps is hard to quantify due to a lack of bycatch reporting. Historically, researchers have only been able to estimate impacts based on contents of derelict traps which, due to decomposition of terrapin remains, provide an incomplete picture of potential impacts. After receiving reports of numerous drowned terrapins along beaches of the Delaware Bay, where bycatch reduction devices are not required, we began work in 2017 to quantify the number of terrapin carcasses washing ashore through a citizen science program aimed at rescuing stranded horseshoe crabs (*Limulus polyphemus*). From late April–mid-July volunteers walked 20-22 bayshore beaches in NJ, covering approximately 27 km. Terrapin carcasses were classed by size, photographed, and relocated above the high tide to reduce resampling. Over two years, 440-521 small, 246-300 large, and 132 unknown-sized terrapins were documented on 17 beaches. To improve estimates for 2019, a subset of volunteers notched carcasses and recorded the number of newly marked and resighted carcasses. The number of terrapin carcasses will be estimated using closed capture models in MARK. Results are providing insight on potential impacts of crab traps on understudied terrapin populations in the Delaware Bay, and help us better understand spatial patterns in bycatch impacts that could inform future regulatory changes in NJ. The engagement of a new network of volunteers, partners, and communities with terrapin conservation has been a valuable outcome.

**DTWG-O14**

**Diamondback terrapin (Malaclemys terrapin) research in St. Joseph Bay & the Florida Panhandle**

*Catizone, Daniel (dcatizone@ufl.edu) – University of Florida
Lamont, Margaret – U.S Geological Survey
Romagosa, Christina – University of Florida

*Malaclemys terrapin* (Diamondback Terrapins) in St. Joseph Bay, and much of the Florida Panhandle, have been understudied. Starting in 2017, we began research in St. Joseph Bay trying to establish a baseline for the population inhabiting the bay. We collected and marked terrapins to get an estimate of their population size, as well as to begin looking at factors influencing terrapin presence/absence. Our observations indicate that *M. terrapin* within our study site remain in the water during high tide and during low tide utilize the exposed dry marsh bottom, with an apparent preference for cover underneath the wrack line. Preliminary results suggest a skewed sex ratio towards males and high site fidelity based off recaptures. We have established partnerships with St. Joseph Peninsula State Park, St. Joseph Bay State Buffer Preserve, St. Vincent National Wildlife Refuge, Eglin Air Force Base and the Florida Sea Grant to

expand the spatial scope of our project. In addition, we have deployed satellite tags on two *M. terrapin* to test the usefulness of this technology in assessing terrapin habitat usage and movement. Going forward we plan to continue our current monitoring and begin to examine *M. terrapin* movements and diet in the region.

**DTWG-O15**

**Interpreting an apparent decline in a long-lived species**

Guzy, Jacquelyn - Cherokee Nation Technologies
Smith, B.J. - Cherokee Nation Technologies
Denton, Mathew – Wetland and Aquatic Research Center, U.S. Geological Survey
Hart, Kristen – Wetland and Aquatic Research Center, U.S. Geological Survey

Long-term ecological studies are critical for providing insight into population dynamics and detecting population declines, particularly for species of conservation concern. However, spatiotemporal variation and logistical challenges make estimation of population declines difficult. We conducted a capture-mark-recapture (CMR) study of mangrove diamondback terrapins (*Malaclemys terrapin rhizophorarum*) within Big Sable Creek, Everglades National Park, Florida. We used an 18-year dataset (2001 to 2019) within a CJS model incorporating year, sex, hurricane occurrence and sampling effort to estimate survival. Annual survivorship estimates were high from 2001-2003 for both sexes (91-97%) and variable from 2006-2014 (79-95%). We found support for a negative influence of hurricanes, with model-estimated survival for 2006 exhibiting a decline (females: 79%, males: 86%). Beginning in 2015 survival estimates exhibited a steeper decline (females: 61%, males 73%), and dropped to below 20% in 2018, although estimates for 2017-2018 are unreliable. Reasons for this apparent population decline are unknown, therefore we created a population projection matrix and used model-estimated annual survival to simulate terrapin population size. We then generated several competing scenarios of low survival at various age classes to attempt to reproduce a simulated decline similar to that observed from our data. A scenario where no reproduction occurred after 2010 provides estimates of abundance that match simulated annual population size and may indicate that a drastic drop in recruitment could be responsible for the apparent decline in survival. We discuss alternative reasons for this apparent decline and highlight difficulties common to long-term studies that may influence how declines are interpreted.

**DTWG-O16**

**Mangrove terrapins in the Florida Everglades**

Hart, Kristen – Wetland and Aquatic Research Center, U.S. Geological Survey
Denton, Mathew – Wetland and Aquatic Research Center, U.S. Geological Survey
Guzy, Jacquelyn – Cherokee Nations Technology Solutions

Estimates of species-specific demographic parameters (i.e., survival rates, abundance, etc.) are necessary for population modeling efforts that are often used to assess endangerment. However, for many species of conservation concern, such as Diamondback terrapins (*Malaclemys terrapin*), demographic parameters for discrete population units are lacking. Ample morphological, behavioral, and reproductive information has been collected for

terrapins living in temperate salt marsh habitats, but comparatively little is known about mangrove terrapins. Analysis of an 18-year capture-mark-recapture (CMR) data set (N=779 marked individuals) on mangrove terrapins in Big Sable Creek, Everglades National Park revealed a 49% overall mean detection rate and ~1:1 sex ratio (45% female/55% male) with 98.7% 'adult' animals in the sampled population. Capture numbers were relatively high for fourteen years (2001 through 2014), after which annual decreases in captures occurred, despite consistently high effort in the study site. For this remote population of mangrove terrapins that experienced two major hurricanes in the 18-year period, limited recruitment may be the cause of apparent declines in capture numbers. Future work examining movement of individuals captured both within and outside of the focal area for the CMR study is planned.

**DTWG-O17**
**Developing a Conservation Action Plan for Diamondback Terrapins in the Gulf of Mexico**
Mohrman, Thomas (tmohrman@tnc.org) – The Nature Conservancy

Diamondback terrapins in the Gulf of Mexico are exposed to the same suite of threats (in varying degrees) as all terrapin populations throughout their range; however, they have been understudied compared to terrapin populations in other parts of the range. In recent years, the occurrence of large- scale events in the Gulf such hurricanes, freshwater diversions, the Gulf oil spill and large-scale coastal restoration projects have highlighted a need for a comprehensive terrapin management plan for resource managers, conservationists, academics, educators, and other stakeholders. The Nature Conservancy and Diamondback Terrapin Working Group recently received an award from the Gulf of Mexico Alliance, a partnership of the five Gulf States that works to collaboratively increase the environmental and economic health of the region, to develop a Gulf Terrapin Conservation Action Plan. This presentation will outline the steps of developing the Conservation Action Plan, the process, overall project goals, objectives and anticipated outcomes. The presentation is also intended to identify experts in the Gulf of Mexico region (and beyond) who can contribute to this project.

**DTWG-O18**
**The Regulatory Petition Process: Hope for Keeping Terrapins Out of Traps?**
Bennett, Elise (ebennett@biologicaldiversity.org ) – Center for Biological Diversity

Crab-pot mortality is one of the greatest threats facing diamondback terrapins across their range, with active pots and inactive "ghost pots" capturing and drowning terrapins in numbers that threaten the viability of local populations. Together with habitat degradation, sea-level rise, trafficking for the pet trade, and other threats, crab-pot mortality may also contribute to declines rangewide. Bycatch reduction devices (BRDs) can significantly reduce the number of terrapin mortalities in blue crab traps while having minimal effect on the number of crabs captured. Yet, commercial and recreational crabbers have not widely adopted these devices on a voluntary basis, and only a few states within the terrapin's range require their use. Each state in the U.S. has a unique "wildlife trust doctrine" that endows it with the power and duty to protect wildlife for the benefit of the people, and nearly every state within the terrapin's range has exercised this power to ban commercial harvest, resulting in a conservation benefit for the

species. State administrative procedure acts provide a petitioning process for the public to request this type of regulatory action. Such petitions—supported by robust, current scientific information and the will of the scientific community and the public—can kickstart conservation action to address crab-pot mortality. Presenting the State of Florida as ground for initiating future action, I will discuss the legal and advocacy tools at hand to address the threat of crab-pot mortality across the species' range.

**DTWG-O19**

**Visual Head Counts: A Promising Method for Efficient Monitoring of Diamondback Terrapins**

*Levasseur, Patricia (plevasseur@umass.edu) – University of Massachusetts Amherst
Sutherland, Chris – University of Massachusetts Amherst
Sterrett, Sean – Monmouth University

Determining the population status of the diamondback terrapin (Malaclemys terrapin spp.) is challenging due to their ecology and limitations associated with traditional sampling methods. Visual counting of emergent heads offers a promising, efficient, and non-invasive method for generating abundance estimates of terrapin populations across broader spatial scales than has been achieved using capture–recapture, and can be used to quantify determinants of spatial variation in abundance. We conducted repeated visual head count surveys along the shoreline of Wellfleet Bay in Wellfleet, Massachusetts, and analyzed the count data using a hierarchical modeling framework designed specifically for repeated count data: the N-mixture model. This approach allows for simultaneous modeling of imperfect detection to generate estimates of true terrapin abundance. Detection probability was lowest when temperatures were coldest and when wind speed was highest. Local abundance was on average higher in sheltered sites compared to exposed sites and declined over the course of the sampling season. We demonstrate the utility of pairing visual head counts and N-mixture models as an efficient method for estimating terrapin abundance and show how the approach can be used to identifying environmental factors that influence detectability and distribution.

**DTWG-O20**

**Diamondback terrapin distribution and habitat utilization in southeastern North Carolina**

*Whitmer, Morgan (mnw6061@uncw.edu) – University of North Carolina Wilmington
Sutton, Hope – North Carolina Coastal Reserve & National Estuarine Research Reserve
Finn, Sarah – North Carolina Wildlife Resources Commission
Colhoun, Elizabeth – North Carolina Coastal Reserve & National Estuarine Research Reserve
Williard, Amanda – The University of North Carolina Wilmington

Diamondback terrapins (Malaclemys terrapin) inhabit salt marshes, sounds, and estuaries on the east coast of the United States, and exhibit habitat overlap with several species of sea turtle. Both terrapins and sea turtles are threatened by anthropogenic factors, such as fisheries interactions, in inshore habitats. For terrapins, habitat loss and incidental bycatch in crab pots have contributed to population declines throughout their range. Conservation status and protections for terrapins are designated on a state-by-state basis, as they are not federally listed as threatened or endangered. In the state of North Carolina, the diamondback terrapin is

listed as a Species of Special Concern, yet little has been done to identify and monitor the existing populations or the effects of fisheries interactions and other threats on those populations. The primary goals of this study are to 1) identify areas of relatively high terrapin abundance in southeastern North Carolina, and 2) evaluate environmental variables associated with areas of high terrapin abundance. The North Carolina Coastal Reserve and the North Carolina Wildlife Resources Commission implemented a citizen science initiative beginning in 2014 to address the lack of data on terrapin distribution in southeast North Carolina. The annual Terrapin Tally engages volunteers to assist in the collection of population data through kayak-based visual surveys. Participants use a smart phone app to document terrapin sightings, as well as locations of crab pots, along designated paddling routes. We will use Terrapin Tally data to identify areas of relatively high terrapin abundance, and conduct habitat characterization studies within these areas. Specifically, we will conduct vegetation and benthic invertebrate surveys and document abiotic conditions (i.e. sediment type, tidal influence, salinity) in order to characterize the habitats in which terrapins are found. We will use species distribution models to describe the patterns in terrapin abundance that we observe and make predictions regarding the distribution of terrapins based on habitat characteristics. Our study will contribute to terrapin conservation by 1) identifying areas for long-term population monitoring, and 2) generating data on terrapin distribution and habitat utilization that may be used for risk assessment and to inform development of appropriate management strategies to protect terrapins.

**DTWG-O21**

**Ongoing status assessment for the diamondback terrapin in Florida**

Castellon, Traci (traci.castellon@myfwc.com) – Florida Fish and Wildlife Research Institute

Florida represents 20% of the diamondback terrapin range, and is home to five subspecies, with three endemics. We are conducting a status assessment to determine if criteria for state-listing as Threatened are met. This involves 1) mapping sightings to assess range contractions (> 9,000 mapped to date), 2) mark-recapture studies to assess population sizes, 3) a literature review on magnitudes of recent and projected habitat losses (e.g., from sea level rise), and 4) collection of tissue samples (> 750 collected to date) for genetic analyses. The latter will include population-level genetics where possible, and range-wide assessment of subspecies, as the current classification is challenged by recent genetic studies. This classification is critical because subdivision below the species level creates smaller groupings with greater likelihood of triggering listing. The distribution of sightings mapped to date does not suggest a range contraction, and the large number of sightings (n > 9,000) negates listing at the species level based on terrapin numbers, although other criteria may still be met (e.g., projected habitat losses). If genetically differentiated subspecies or management units are identifiable, each will be assessed based on geographic ranges (delineated by locations of genetic breaks), recent and projected habitat losses within these ranges, whether numbers are low enough to trigger listing (< 10,000 individuals), and whether populations are at risk due to isolation. The last two criteria will be informed by mark-recapture efforts (ours and our partners), and by genetic estimates of effective population sizes and measures of gene flow.

**DTWG-O22**

**Increased frequency of multiple paternity in diamondback terrapins from a male dominated population**

*Sporre, Megan (sporrema@g.cofc.edu) - Texas A&M University at Galveston

Variation in the incidence of multiple paternity in conspecifics is common; caused by differences in rates of mate encounter. Compared to clutches with a single sire, clutches with multiple sires show increased hatchling success and genetic diversity. Past parentage studies have shown interspecific variation in the occurrence of multiple paternity under a range of female biased diamondback terrapin populations. The frequency of multiple paternity in a male dominated diamondback terrapin population from Charleston, South Carolina was determined by amplifying eight microsatellite loci in 102 mothers and 106 clutches of *Malaclemys terrapin*. Thirty-seven clutches (35%) showed evidence of multiple paternity, and 50% of females who laid more than one clutch showed evidence of sperm storage. Fathers did not contribute to clutches equally, and the primary father sired between 50 to 89% of offspring in a single clutch. Studies of parentage analysis are important for species whose reproductive behaviors are hard to view *in-situ* and may help to provide information on female mate choice and reproductive success.

**DTWG-O23**

**Staying Close to Home: Seasonality and Site Fidelity of an Insular Population of Texas Diamond-backed Terrapins as Determined by Acoustic Telemetry**

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Oakley, Jenny – University of Houston- Clear Lake
Guillen, George – University of Houston- Clear Lake

As critical saltmarsh habitat declines and severe weather events (hurricanes, drought, etc.) become more frequent, it is important for resource managers to understand how species of greatest conservation need are utilizing available habitat. In highly urbanized bays, such as Galveston Bay, available marsh habitat is limited or declining and Diamondback terrapin (*Malaclemys terrapin*) populations exist in more isolated areas than other populations along the Gulf and Atlantic coasts. To determine seasonality and site fidelity of an insular population of terrapin, an acoustic array was installed using Vemco acoustic receivers. From March 2009-April 2014, 39 terrapin (33 female; 6 male) were fitted with V13-1H transmitters. Transmitters were detected every year and, across all years, every month. Over 62 consecutive months of monitoring, 9 showed no detections (Jan 2010; Sep 2011, Nov 2012-Feb 2013; May 2013; Jan-Feb 2014), all correlated with major weather events. Across all years, transmitters were detected at all stations from March-May and October-November, indicating periods of peak aquatic activity coincident with mating and nesting seasons. Critical aquatic habitat utilized include seagrass, open water, emergent marsh, and shallow oyster reef. Our results suggest that this Galveston Bay population is utilizing aquatic habitats year round, especially the female cohorts. This contrasts with populations in more northern latitudes where winter dormancy is prevalent and suggests that Galveston Bay may contain critical year-round habitat for Texas

terrapin. Resource managers should take this into consideration when developing action plans as this may vary from other populations throughout the species range.

**DTWG-O24**
**Experimentally Manipulating Life Histories Turtle Speed Ahead**
Roosenburg, Willem (roosenbu@ohio.edu) – Ohio Center for Ecological and Evolutionary Studies, Ohio University

The turtle's iconic life history of long life, delayed maturity, and high adult and low juvenile survival guides conservation efforts in most populations. Head-starting, long considered a way to enhance and boost recruitment within populations, also changes the shape and trajectory of growth. Providing a resource rich, warm environment during the first eight – nine months of life significantly changes the shape of the growth curve relative to their wild counterparts that do not change in size during this same time period. The acceleration in growth can decrease the age of first reproduction of female terrapins by two or more years. We explore how changing the life history traits of growth and age of first reproduction affect the population growth rate. Furthermore, we evaluate the conservation potential of using head-starting as a tool to restore and supplement threatened diamondback terrapin populations.

## Poster Presentations

**DTWG-P1**
**Diamondback Terrapin Population Distribution and Nesting Areas in Coastal Georgia**
*Clements, Grace (grace1clements@gmail.com) – University of North Florida
Lamber, J.D. – University of North Florida
Butler, Joseph – University of North Florida

One of the primary goals of the main conservation body of terrapins, The Diamondback Terrapin Working Group (www.dtwg.org), is to identify the remaining terrapin nesting locations and populations so they can be appropriately managed and studied in the future. The overarching goal of our current project is to survey the entire coastline of Georgia for the presence of diamondback terrapins and their nests. During the past four years the UNF Terrapin Team has completed about 60% percent of the state and collected nearly 1500 terrapin records. We are continuing the surveillance in 2019 in the southernmost county, Camden; then in 2020 we will complete the research in the northernmost county, Chathman. Diamondback terrapins are the only North American turtle to prefer brackish water habitats and will be one of the first species to be affected by sea level rise. They face other anthropogenic challenges such as drowning in crab traps and shoreline hardening. We maintain that it is imperative to locate and map current populations, so these challenges can be monitored in the future. We use a 16 foot Carolina skiff to navigate into rivers and creeks searching for evidence of terrapin presence. Capturing a live terrapin is not necessary, however we do occasionally. Most of our evidence is found in the form of surfacing terrapin heads, intact and depredated nests, terrapin

remains, live terrapins, and crawls (trails). We are creating ARCGIS maps that illustrate geolocations reflecting our findings, and aid future researchers.

**DTWG-P2**

**The Effectiveness of Various Crab Pot Bycatch Reduction Devices (BRDs) on Reducing Bycatch While Maintaining Blue Crab Capture Efficiency at Barnegat Bay, NJ**

*Holmberg, Steven (stevenholmberg17@gmail.com) – Marine Academy of Technology and Environmental Science
Kelsey, Jason – Marine Academy of Technology and Environmental Science
Wnek, John – Marine Academy of Technology and Environmental Science

Every year millions of organisms are captured unintentionally in crab pots as bycatch. In order to mitigate crab pot bycatch, bycatch reduction devices (BRDs) have been designed to allow crab pots to fish blue crabs without unintentionally catching other organisms. There are a few variations in BRD designs that have been debated. While BRDs are known to reduce bycatch, namely diamondback terrapin (*Malaclemys terrapin*), misconceptions still surround them that are known to reduce both bycatch and blue crab captures and size of crab captures. Sixteen crab pots were fished at Barnegat Bay, NJ over the course of twelve days between July 24 and August 8, 2018. Four of the sixteen crab pots had New Jersey Standard BRDs (NJ), Maryland Standard BRDs (MD), South Carolina Prototype BRDs (SC), and control pots without BRDs. The main purpose of conducting this study was to determine the most effective BRD design that successfully reduces bycatch while also maintaining the highest crab capture and crab sizes. In NJ, the minimum legal recreational crab size for capture is 4.5 inches (11 cm) and commercially, 4.75 inches (12 cm). The results indicated that the larger NJ standard BRD size showed no difference from the control pots in terms of crab size and catch per unit effort (CPUE). Bycatch was only present in the control pots (N=10). Therefore, to reduce bycatch capture and maintain crab capture effort, it is recommended that any BRD type effectively reduces bycatch, and that the smaller BRD designs (MD and SC) captures larger crabs as compared to the control pots.

**DTWG-P3**

**Determination of the Dietary Habits of *Malaclemys terrapin* across the Barnegat Bay and Great Bay Estuaries, New Jersey**

*Weimer, Belle (bweimer.asrcs@gmail.com) – Marine Academy of Technology and Environmental Science
Kelsey, Jason – Marine Academy of Technology and Environmental Science
Wnek, John – Marine Academy of Technology and Environmental Science

Diamondback terrapins (*Malaclemys terrapin)* are an indicator species of the health of salt marsh systems throughout the east and Gulf coasts of the United States. The species is known to feed on numerous faunal species and thought to consume some floral species in estuarine systems such as Great Bay and Barnegat Bay, NJ. To determine terrapin diets in these two adjacent estuarine systems, stomach contents of captured terrapins, from multiple sites, in both the Great Bay and Barnegat Bay, were collected by way of a non-invasive digestive purging technique. Subjects were held for 24 hours in a specified quantity of filtered freshwater as part

of a mark-recapture program and then released the following day back to the same capture location. Purge samples collected were filtered using straining and vacuum filtration techniques, massed and analyzed for taxa present. The data suggests that there are dietary differences between estuarine systems, that there is preference in prey across individuals, and that there is no significant difference in dietary composition between gender or gravid and non-gravid females. It was also noted that terrapins from Barnegat Bay (i.e. Sedge Island and Cedar Run Dock Road, Manahawkin) shared a similar diet. This study is the first of its kind in determining terrapin feeding habits in the Great Bay-Barnegat Bay complex, N.J.

**DTWG-P4**

**Temporal Degradation of Crab pot Bycatch Reduction Devices in Dynamic Estuarine Systems**

*McGivney, Eric (ericperson12@gmail.com) – Marine Academy of Technology and Environmental Science
Kelsey, Jason – Marine Academy of Technology and Environmental Science
Wnek, John – Marine Academy of Technology and Environmental Science

Bycatch is a problem for all fisheries throughout the world. It is estimated that as much as 40% of our overall catch, is considered bycatch. To reduce bycatch, methods employed can be effective; however, they must be maintained. In the blue crab (Callinectes sapidus) fishery, bycatch reduction devices (BRDs) are employed on crab pots. Some of these include cull rings, escape panels, and terrapin excluders, made of several different types of material that have mixed expected performance outcomes. This research compared plastic and metal BRDs and their fasteners in three fixed salinity regimes to mimic estuarine systems and to determine the rate of degradation. Over a 6 month period, the metal BRDs showed the greatest breakdown, while the plastic devices showed the least. In terms of fasteners, the metal hog rings showed little breakdown, contrary to their purpose of releasing escape panels as they corrode. This allows them to retain escape panels, which can result in prolonged capture of bycatch if the crab pots become abandoned or lost.

**DTWG-P5**

**The Success Rate of Malaclemys terrapin Nests Based on Soil Composition, Moisture, and Organic Content in Barnegat Bay, NJ**

*Riley, Emma (emmariley709@gmail.com) – MATES Project Terrapin

The Diamondback Terrapin (*Malaclemys terrapin)* is a native turtle species to the east and Gulf coasts of the United States. Terrapins nest on shoreline areas along Barnegat Bay and hatchlings emerge from the nests, then make their way to salt marshes. These nesting habitats are at risk of various threats, many of which can be attributed to human disturbance, such as dredging. Dredging involves digging up soil from beneath the ocean floor and depositing it in areas to rebuild the shoreline. The conditions of this soil may be drastically different from that of the soil previously found in those nesting areas; could this variation in soil condition possibly affect the success of terrapin nests in those areas? To answer this question, soil samples from several nests on North Sedge Island were collected and tested for soil composition, moisture potential, and organic content using an Ohaus Gravimetric Kit, Ohaus MB23 Soil Moisture

Analyzer, and a standard benchtop muffle furnace. Nest success rate data was collected throughout the months of August and September, then compiled to later run comparative statistics between the soil conditions and the nest data. It was concluded that nests with more sand had a higher success rate; however organic content and moisture did not vary greatly between nests and seemingly did not affect the success rates. This study indicates that these nests are in fact affected by differences in soil quality and by altering soil in common nesting habitats, it could harm the terrapin population.

**DTWG-P6**

**Cedar Run Dock Road, New Jersey: A model community diamondback terrapin conservation project**

Wnek, John (projectterrapin@gmail.com) – MATES Project Terrapin
Ganss, Leslee – Cedar Run Terrapin Project
Brostow, Teresa – MATES Project Terrapin
Celestino, Serena – MATES Project Terrapin
Nevil, Riley – MATES Project Terrapin
Parks, Courtney – MATES Project Terrapin
Perdon, Alaina – MATES Project Terrapin
Piper, Sophia – MATES Project Terrapin

Diamondback terrapin habitats have been in decline throughout their range. In order to maintain terrapin populations management practices have been employed throughout many states that address terrapin nesting, hatchling head starting and habitat preservation. As a vulnerable species that live in estuaries where there are high densities of human populations, terrapin conservation practices must employ community efforts. At Barnegat Bay, NJ, diamondback terrapins are found in high density patches, some of which are located within waterfront communities. One such area, located on Cedar Run Dock Road (CDR) is a 1.5 km stretch of marsh with human development just south of the highest density, coastal housing development, Beach Haven West, New Jersey. The roadway includes a high-use public boat ramp, and a speed limit that is higher than recommended speed limits in most residential areas in NJ. Terrapin nesting densities at CDR rival some of the highest densities in coastal New Jersey. The CDR community has adopted strategies to protect terrapins including homemade signs, res-usable lawn signs, and two areas were filled with sand to include new terrapin nesting habitat. There is an active road encounter survey conducted by residents.

**DTWG- P7**

**Diamondback Terrapin in Southeastern Florida**

*Herr, Jeffrey S. (jherr2013@fau.edu) – Florida Atlantic University
Ho, Nancy – Coastal Biology Incorporated
Dark, Emily – Florida Department of Environmental Protection- Indian River Lagoon Aquatic Preserves
Moore, Jon – Florida Atlantic University

The Florida East Coast Diamondback Terrapin is found from St. Johns Country to Biscayne Bay. While studies in the early 1980s reported a large population of terrapins in the northern IRL, by 1993 this population was shown to be experiencing a severe decline. Brevard Zoo and Florida Fish and Wildlife Conservation Commission is studying populations in the northern Indian River Lagoon (IRL) system, but very little is known about terrapin populations further south along the east coast. Southeastern Florida is heavily developed, and much of the coastal habitat suitable to terrapins has been irreparably damaged. It is possible that terrapins have been extirpated from Palm Beach and Broward Counties, although they have been found in the southern IRL and in Biscayne Bay. Our goal for this project is to increase the knowledge base on diamondback terrapins in southeastern Florida. We are conducting searches for terrapins in the southern IRL, as well as locations with suitable habitat farther south. Within the IRL system, terrapin movement and habitat utilization will be monitored using acoustic telemetry. We will be collecting genetic material for an ongoing state-wide genetics survey, diet will be determined using fecal samples, and fecundity will be examined in these far-south populations. With this data we will be able to establish much-needed baseline information on current terrapin populations in southeastern Florida.

**DTWG-P8**

**An Analysis of a GPS System for Tracking Diamondback Terrapins**

Wong, Orena (orenawong@gmail.com) –Hofstra University
Francoeur, Laura – The Port Authority of NY & NJ, JFK International Airport
Kanonik, Alex – American Littoral Society
Burke, Russell – Hofstra University

Improved understanding of diamondback terrapin movements would be valuable to our understanding of their ecology and conservation. Previous movement studies have been conducted using mark-recaptures, string trailers, VHF telemetry, and sonic tags, all of which have limited precision and duration. We have begun a study using terrapin ES200 trackers to collect GPS data on diamondback terrapin populations at JFK International Airport and Jamaica Bay Wildlife Refuge. These trackers are understood to have improved precision obtaining GPS locations, and improved duration of several years. These waterproof trackers were designed with water sensors to collect data every 8 hours if a terrapin is partially out of water. January 2018 – August 2019, six ES200 trackers were placed in 3 fixed locations to collect GPS data. The intention of this preliminary study is to observe the accuracy and precision of these trackers. Analyzing this data will help to determine effectiveness of the tracking system, as well as identify factors that can affect GPS location accuracy. Pairs of ES200 trackers were secured onto plexiglass and attached to a stable structure, with exposure to environmental conditions. With a total of 3 pairs of ES200 trackers being placed in 3 different locations. Two pairs were secured at the water's surface on docks that simulate similar conditions of diamondback terrapins. One pair was secured onto a structure completely out of water, but also exposed to environmental elements. These results will be used to adjust current methods and improve the data analysis of diamondback terrapins.

**DTWG-P9**

**Population dynamics of Terrapin Malaclemys terrapin terrapin in a residential-estuary system**

*Parks, Courtney (par8575@student.waynesburg.edu) – Waynesburg University
Wnek, John - MATES Project Terrapin
Rossiter, Wayne – Waynesburg University

The northern diamondback terrapin, *Malaclemys terrapin terrapin,* is an indicator of the health of a salt marsh system. Along coastal southern New Jersey, there are expanses of salt marsh systems engulfed by human development. One such system, Cedar Run Dock Road (CRDR), displays a high density of *M. t. terrapin* activity, and can provide valuable insights into patterns of *M. terrapin* occurrence during the nesting season (late May to early August). CRDR terrapin capture data from three consecutive years of hoop trapping and road encounters reveal the overall growth, health, and population size within a residential-estuary system. The dynamics of the system indicate that human development, resource availability, and tidal period influence *M. t. terrapin* population size and health. Better understanding how these factors influence terrapin behavior and population will inform the next steps taken in addressing the declining terrapin populations in places where salt marsh habitats interface with human development.

**DTWG-P10**

**A Comparison of Methods for Surveying Diamondback Terrapin (*Malaclemys terrapin*) Populations in Tidal Creeks**

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Diamondback terrapins are known to inhabit coastal ecosystems, but within these ecosystems they prove challenging to sample due to their primarily aquatic life history. In 2016, 2017, and 2018, researchers at The Wetlands Institute in Stone Harbor, NJ performed a mark-recapture project to explore terrapin population composition in two tidal creeks. The 2016-2017 study, which used modified commercial crab traps to capture turtles, suggested a population that was female-biased ($\chi_1^2$=35.02, p<0.01), included mostly smaller terrapins (90% <13cm carapace length), and demonstrated a consistently low recapture rate (<4.0%). To evaluate the accuracy of these trends, the study was continued in 2018 utilizing a fyke net in addition to prior trapping methods. Results obtained using the net, which remained deployed through multiple tide cycles and possessed a wide mouth permitting entry to larger terrapins, demonstrated a less biased sex ratio ($\chi_1^2$=0.06, p=0.81), a greater proportion of large terrapins (39% >13cm carapace length), and substantially higher recapture rate (19.0%) and catch per unit effort (CPUE). These results indicate that the fyke net is a more optimal method for surveying terrapin populations in tidal creeks and suggest that population composition as sampled by modified crab traps is not representative of actual population composition. This has inspired an ongoing project to expand our knowledge of the Stone Harbor, NJ population using novel molecular techniques. Genetic samples from roadkilled terrapins and recovered eggshells will be analyzed to provide a proxy for male terrapin biodiversity, demonstrating whether noninvasive genetic sampling from eggshells can further elucidate population characteristics.

**DTWG-P11**

**Obligately epizoic diatoms on manatees, sea turtles and diamondback terrapins**

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Obligately epizoic diatoms have been described from the skin of cetaceans for the last 100 years. Throughout the 20th century, these communities were only known from whales and the diatom genera observed (i.e., *Bennettella*, *Epipellis*, *Plumosigma*, *Tursiocola*, *Epiphalaina*, and *Tripterion*) were collectively known as the "whale diatoms". Since 2012, diatomists have discovered new, but similar, obligately-epizoic diatom communities on manatees and sea turtles. New *Tursiocola* species have been described along with several species representing new genera (*Poulinea*, *Chelonicola*, and *Medlinella*) most closely related to *Tripterion*. Interestingly, most all of the epizoic species exhibit host-specificity to particular vertebrate groups or host species. The one exception is the epizoic species *Achnanthes elongata* which has been observed on sea turtles, manatees, and most recently diamondback terrapins where it is a dominant taxon. Morphological differences between *A. elongata* populations growing on manatees, sea turtles, and diamondback terrapins are so far not evident, though molecular analyses indicate significant genetic differences between different host populations. Diatoms have been sampled from the carapaces of diamondback terrapins captured in salt marshes in New Jersey and Virginia and from a mangrove estuary in Cocoa Beach, Florida. These diatom communities are described and compared with similar communities observed on manatees and sea turtles sampled from the Florida and Georgia coasts.

**DTWG-P12**

**Impacts of Projected Sea Level Rise on Diamondback Terrapin Nesting Habitats in Virginia**

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Diamondback terrapins face a variety of ecological and human pressures. As an estuarine species reliant on the availability of optimal nesting sites, the effects of climate change and sea level rise are important to consider when determining appropriate conservation methods for terrapins. We focused on the potential impacts of sea level rise on diamondback terrapin nesting locations along tidal shorelines in Virginia. Utilizing GIS and maximum entropy modeling (MaxEnt), spatial data were edited and analyzed to determine optimal nesting habitats and how these locations will change as rising sea level forces land use shifts. The analysis determined that essential nesting habitat factors include: distance to beaches, distance to core habitat (the marsh habitat terrapins occupy when not nesting), salinity, and placement of roads. Using this information, we created a model displaying the current distribution of terrapin nesting habitat throughout Virginia. Then, we projected the location of future terrapin nesting habitat in 2030, 2050, 2075, and 2100 in response to sea level rise. Not surprisingly, future terrapin nesting habitat will shrink and change locations across Virginia shoreline. With this information,

conservation efforts can be focused on the current terrapin nesting habitat most threatened by rising waters.

**DTWG-P13**
**Diamondback terrapin habitat enhancement in NJ: improving nesting opportunities**
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Diamondback terrapin nesting areas throughout their range are in decline. Terrapins are synonymous with estuaries and salt marsh systems; however, coastal areas are among the most developed in the United States. This leads to reductions in terrapin habitat, especially nesting areas that are susceptible to erosion and flooding. In coastal New Jersey, there has been an increase in the number of projects to enhance terrapin nesting areas. Terrapin conservation groups are working with municipalities and local residents to provide better nesting opportunities. In lower Cape May, the Wetlands Institute is working on habitat enhancement; On Long Beach Island, the Terrapin Nesting Project is working with residents as part of a "Natural Nest" program; and at Barnegat Bay, Project Terrapin and the Conserve Wildlife Foundation of New Jersey are creating "Turtle Gardens" along the barrier island and mainland shoreline. With the results of climate change, coupled with increased development, nesting habitat enhancement projects will become increasingly important for the survival of terrapins across their range.

**DTWG-P14**
**The Catlett Island terrapin population: 78 marks, no recaptures**
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We initiated a study of the population structure and nesting of Diamondback Terrapins in the Catlett Islands in the York River, a tributary to Chesapeake Bay in southeastern Virginia. During our initial survey of the waters around the island, we came across a single derelict crab pot with 30 dead terrapins. From May 30 to July 26, 2019, we fished five baited pots modified with chickenwire chimneys to give trapped terrapins access to air. Three pots were clustered in one shallow embayment and two were placed in a second embayment ~0.5 km away. Throughout the period of research, 78 turtles were caught, with no recaptures. Capture rates were similar in both embayments. Of the terrapins captured, 35 were females and 43 were males. Age ranged from 2 years to 9+ years, and carapace length ranged from 6.7 cm to 20.6 cm. Five terrapins were found with leg or foot injuries, and one was found deceased with a wound to its neck. No active terrapin nests were found in the Catlett Island complex, but many predated

nests were found on the single, small nesting beach nearest the trapping sites. Given the large number of terrapins drowned in a single derelict pot and the absence of any recaptures in our study, we suspect the population is sizable. We were unable, however, to find a large nesting beach nearby that might be used successfully by females in the population.

**DTWG-P15**

**Monitoring changes in diamondback terrapin road crossing activity in Southern New Jersey**

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Road mortalities caused by collision of vehicles with female diamondback terrapins (*Malaclemys terrapin*) emerging from wetlands to nest pose a serious threat to populations. From 2014-2019 data on terrapin crossings have been collected along a 38-mile route transecting Atlantic barrier islands and marshes in Cape May County, NJ. Several conservation strategies including barrier fencing, dynamic signs, habitat enhancement, and digital data collection were implemented during this time, allowing for study of crossing activity and risk related to spatial, temporal, and road condition factors. Over the six-year period 5,797 (689-1,238/yr) nesting terrapins were documented on the transect. The total number of mortalities and live encounters on the transect increased by year, however trends varied spatially within the transect and with conservation strategies. For example, permanent barrier fencing installed during a causeway reconstruction project reduced the number of crossing by 78.3% (83 to 18 terrapins) and the percentage of mortalities by 28.7% (78 to 12 terrapins). The overall trends are also partially explained by improved documentation of encounters with the transition to digital data collection, particularly for live encounters; the percentage of live encounters (30.0-52.6%/yr) also increased over the period while the percentage of dead encounters (70.0-47.4%/yr) decreased. A focused study of another causeway found significantly more terrapin crossing during morning rising and falling tides. Together with hot spot analyses, these results are helping direct site and time specific conservation strategies, monitoring, and outreach to reduce the threat of roads to terrapin populations.

**DTWG-P16**

**Using novel radio telemetry methods to understand movements of head-started and wild juvenile northern diamondback terrapins in southern New Jersey**

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The habits and behavior of juvenile northern diamondback terrapins (*Malaclemys terrapin terrapin*) remain a gap in our knowledge of the life history of this species. In addition, the movements and behavior of head-starter terrapins post release are understudied but are important information to evaluate the effectiveness of head-starting as a conservation tool. In 2018 and 2019, we conducted a study of wild and head-started juvenile terrapin movements in southern New Jersey salt marshes using radio telemetry techniques. Battery-powered radio transmitters were attached to 36 head-started juvenile terrapins, and 6 wild juveniles. Head-started terrapins were released at two locations in the study area, while wild terrapins were released at point of capture. To detect transmissions from these tags, a main receiver antenna and grid of 20 solar-powered receivers were deployed in a 100-m grid throughout the saltmarsh. Locations of animals within the grid were approximated by averaging coordinates of nodes detecting them, as well as relative signal strength received by each node. Telemetered juvenile terrapins were also tracked using a hand-held antenna for finer scale data collection on habitat and behavior and to estimate error of node-estimated locations. Preliminary results suggest juveniles spend time buried in mud near small tidal creeks. The extent of movements varied by individual, with some dispersing from release locations continuously and others appearing to eventually settle in a defined area. Radio telemetry studies in a saltmarsh environment remain challenging, but continuing this work will increase our understanding of terrapin natural history and inform continued conservation efforts.

**DTWG-P17**

**Functional Ecomorphology in the Diamondback Terrapin (Malaclemys terrapin); the effect of head-starting on morphology and bite force**

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Head-starting describes the captive rearing and care of animals through their juvenile life stage, followed by release into their native habitats. The goal of head-starting programs is to avoid high mortality of hatchlings and thus increase the population size of juveniles. *Malaclemys terrapin* populations are declining throughout their range due to increased nest predation, road mortality, habitat loss, commercial harvest for food, and bycatch in crab pots (Dorcas *et al.*, 2007) and as such, *M. terrapin* was selected for a head-starting program in the Chesapeake Bay. However, survivorship of head-started *M. terrapin* individuals is lower than wild individuals (Jenkins, 2018). Physiological performance may effect an individual's ability to gain resources

(Elnitsky and Claussen, 2006; Herrel *et al.*, 2002), and therefore reduce survivorship. Bite force is one physiological performance measurement that is effected by diet and corresponding head and body morphometries (Herrel *et al.*, 2018; Marshall *et al.*, 2012). Head-started *M. terrapin* are fed a soft pellet diet, which may yield individuals with reduced bite force that are unable to forage on the hard-shelled prey accessible to them upon release. Bite force, head, and body morphometries were collected from *M. terrapin* across all ages on Poplar Island, MD. Bite forces were correlated to body and head size to determine their effect across ontogeny. We aim to evaluate if bite force and morphometries are different in head-started *M. terrapin* and therefore explain the reduced survivorship of released individuals.

**DTWG-P18**

**Estimating the heritability of morphological traits in head-started diamondback terrapins (Malaclemys terrapin)**

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The magnitude of character evolution in response to a selective pressure is determined by the trait heritability. Reintroduction strategies like head-starting, that involve extended captivity in controlled laboratory settings, offer an opportunity to study the genetic component of phenotypic variation produced in the laboratory setting. Here, we present heritability estimates of morphological traits in a head-started turtle species: 1st generation laboratory-reared diamondback terrapins (*Malaclemys terrapin*). In 2017 and 2018, gravid female terrapins were captured at Cedar Point Beach (Mobile Co., AL), and oviposition was induced. Eggs were collected and incubated at the University of Alabama at Birmingham. The resulting hatchlings from both cohorts were raised individually in identical lab conditions in preparation for a joint release in Fall 2019. We measured body mass and standard head, shell, and tail dimensions of all individuals. We estimated trait heritabilities and evolvabilities based on a full-sib design using a linear mixed model to control for study design-induced variation in age within and among collection years. Further lab-based evaluation of heritability and genotype-by-environment correlations could shed light on how relaxed selective pressures in benign, captive environments can affect the post-release viability of head-starts and their offspring.

**DTWG-P19**

**Developing new monitoring capacity in a long-term, volunteer Northern diamondback terrapin (*Malaclemys terrapin terrapin*) conservation project**

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Diamondback terrapin (*Malaclemys terrapin)* are protected in Rhode Island as an endangered species. The 75-acre Doug Rayner reserve, adjacent to Hundred Acre Cove, Narragansett Bay, was established for its value as Northern diamondback terrapin (*Malaclemys terrapin terrapin*) nesting habitat. It is the site of a long-term, volunteer nesting population study and conservation project of the Barrington Land Conservation Trust. *M. t.* terrapin nest in the upland habitat, the majority of observed nesting occurring in two large, adjacent sandy areas;

additional nesting occurs in smaller areas of un-wooded upland habitat. Surveys of hatchlings of this population were conducted by the author in response to the project's interest in investigating hatchling brumation and emergence behavior and habitat use. Surveys were conducted during the spring of 2018, the late summer and fall of 2018, and the spring of 2019. Survey methods were changed at the beginning of the 2018 spring season due to lack of labor. Spring observations of hatchlings were sparse but hatchlings were observed in both the upland nesting habitat and at the marsh line. Some clutches remained wholly or partly un-emerged as of the end of the 2018 nesting season surveys. Spring 2019 survey findings indicated that over-wintering in the nest may be an alternate brumation strategy within this population. Hatchlings counted during surveys in each season were measured; carapace lengths were analyzed by standard deviation from the mean. The results of these analyses indicate possible influences of over-wintering habitat, as well as of nest relocation, on hatchling size. Yearly fall and spring hatchling surveys should be added to the long-term monitoring study in order to better understand the life history of this population, to inform land management and conservation activities, and to involve project members in these efforts on an ongoing basis. The long-term nesting population study has produced a yearly numeric estimate of nesters based on newly-observed and returning nesters counted during each season. A reliable overall population estimate has yet to be developed; the assumed estimate has previously not been in conformance with typical ratios of adult females to males nor with high levels of hatchling and juvenile mortality. Visual head-count in-water surveys were conducted by the author during the summers of 2017 and 2018. Planned surveys to net, mark, and collect demographic data in 2018 were cancelled due to lack of labor. While observed individuals were predominantly nesting females, smaller terrapin were also observed. The predominance of nesting females counted during surveys can be assumed to be due to their greater level of observable activity at the surface of the water near nesting habitat. Nesting female *M. t. terrapin* observed in One Hundred Acre Cove during the 2018 nesting season were repeatedly observed to simultaneously engage at the surface of the water in a behavior that could involve the use of chemoreception. This observed behavior provides an interesting direction for future investigations.

**DTWG-P20**

**Variation in individual somatic growth rate of diamondback terrapins (Malaclemys terrapin) inhabiting Kiawah Island, South Carolina**

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Turtle life history traits—e.g., body size, age at maturity, and somatic growth rate—vary by individual, sex, and environment (among other factors). When modeling turtle somatic growth, it is important to consider factors that may influence growth. Long-term capture-mark-recapture studies lend themselves to studying somatic growth in turtles due to the repeated measurements of individuals over time. We examined somatic growth patterns of philopatric diamondback terrapins on Kiawah Island, South Carolina using a long-term dataset. Using a

hierarchical 3-parameter von Bertalanffy we estimated individual growth of 44 female and 36 male terrapins captured 3–17 times between 1983 and 2019. Sex and habitat (four tidal creeks) were included as second-level model effects. Mean maximum asymptotic size estimated at $L_\infty$= 173.4 mm for females and $L_\infty$= 104.4 mm for males, with mean growth coefficients estimated as *K* = 0.28 for females and *K* = 0.61 for males. Growth variability among individuals was greater in females than males, which may be linked to sex-specific differences in reproductive effort and has implications for differential reproductive success. Habitat was a significant factor for female growth, but not male growth. Understanding how terrapin somatic growth varies within a population may inform habitat quality, as well as population health and vulnerability. Our results may also provide more detailed information for demographic models and can serve as a comparison for other terrapin populations.

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