

Diamondback Terrapins as Catalysts for Estuarine Conservation:

Integrating Telemetry and Isotope Analysis to Advance Habitat Protection and Public Stewardship

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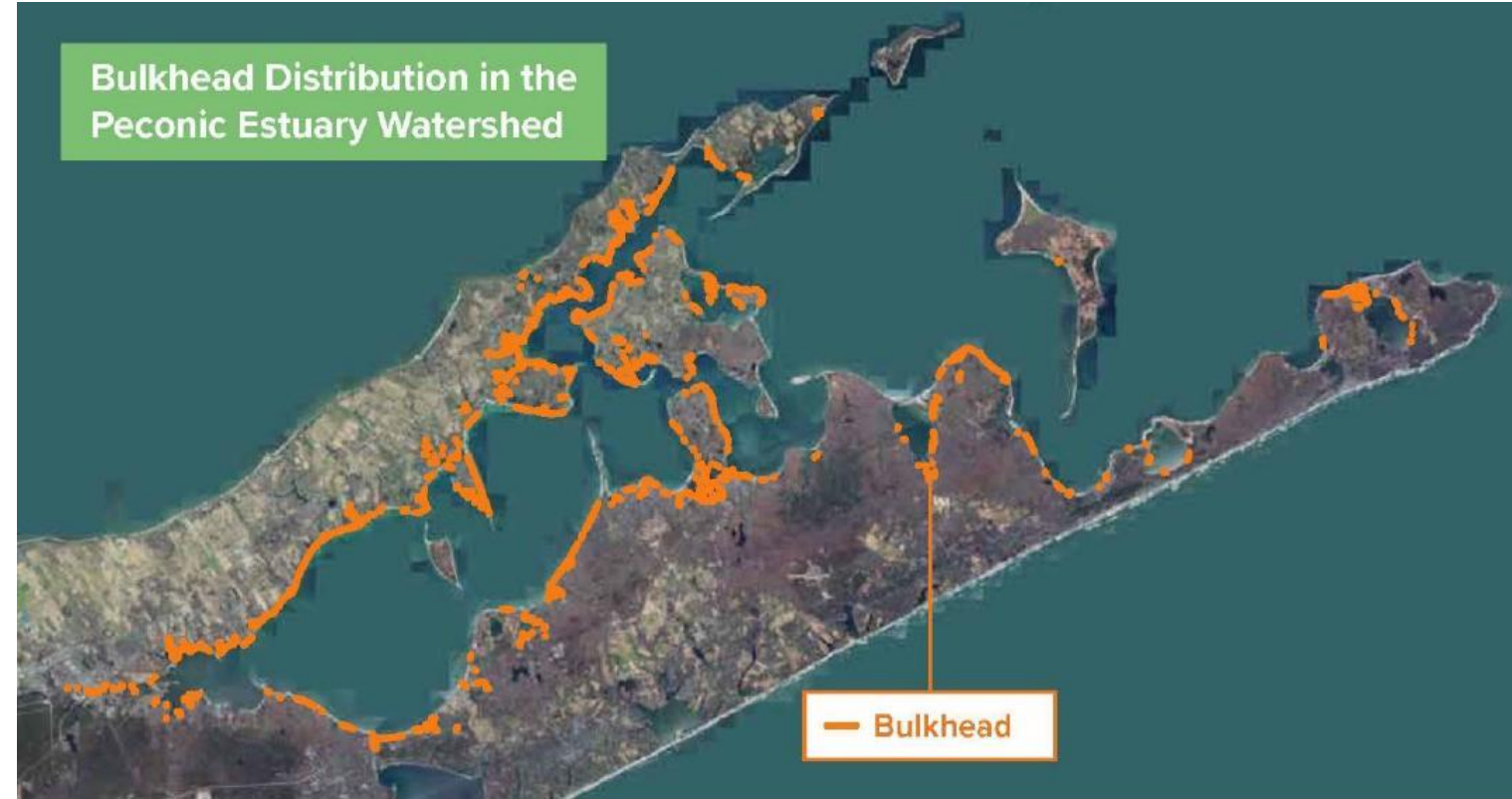
PEP Shoreline Management and Hardened Shoreline Structures

- Bulkheads
 - Rock Revetments
 - Docks
-
- Main impacts are loss of inter-tidal beach habitats



PEP 2016 Shoreline Inventory Results

- Overall, large increase in hardened shoreline linear footage from 2000 to 2016, particularly for bulkheads.
- The bulkhead length shows a possible 3-4 fold increase from 2000 to 2016.
- Sharp increase in shoreline structures post-Sandy as homeowners attempt to protect their properties.
 - Increases in storm frequency and intensity
 - Rising sea levels
- Ground-truthing recently confirmed high correspondence between aerial interpretation and presence of these hardened shoreline structures.



Importance of Intertidal and Beach Habitats

- Many species depend on healthy shoreline habitat for reproduction and foraging
- Without access to the intertidal zone and beaches, species such as horseshoe crab and diamondback terrapins are unable to nest and complete their life cycles
- Horseshoe crabs & diamondback terrapin are vulnerable to the 'intertidal squeeze'
- We tested if satellite telemetry technology can help identify and serve as a tool to help protect preferred spawning habitat for these important species and aid in shoreline management in the Peconic estuary.



Satellite Telemetry

- Tested by CCE in 2024 with horseshoe crab & diamondback terrapins
 - PEP funded pilot project (Mini-Grant program)
 - Collaboration with Dr. Russ Burke (Hofstra Univ.) & Seatuck (E. Nardone, J. Turner)
- Potential Benefits:
 - Battery may last 3-5 years for horseshoe crabs, and about 1-1.5 years for DBT
 - Broad spatial scale coverage
 - Pilot test on female horseshoe crab and terrapins to determine:
 - Nesting behavior and timing
 - Preferred habitats in Peconic
 - Movements and migrations (seasonally and potentially interannually)
 - Data to be used by the Horseshoe Crab Workgroup and the PEP's Shoreline Adaptation Initiative to help guide decisions regarding natural shoreline protection and conservation
- Potential Limitations:
 - Spatial accuracy (Argos tags have coarse spatial resolution)
- Pilot tested 2 types of satellite tags on HSC and DBT in 2024:
 - Wildlife Computers- Argos satellites
 - Smaller and lighter
 - Less accuracy (highest resolution is 150 - 250 m)
 - Lotek FastGPS
 - Increased spatial accuracy (<30 m)
 - Positions are acquired on both HSC & DBT when they surface.

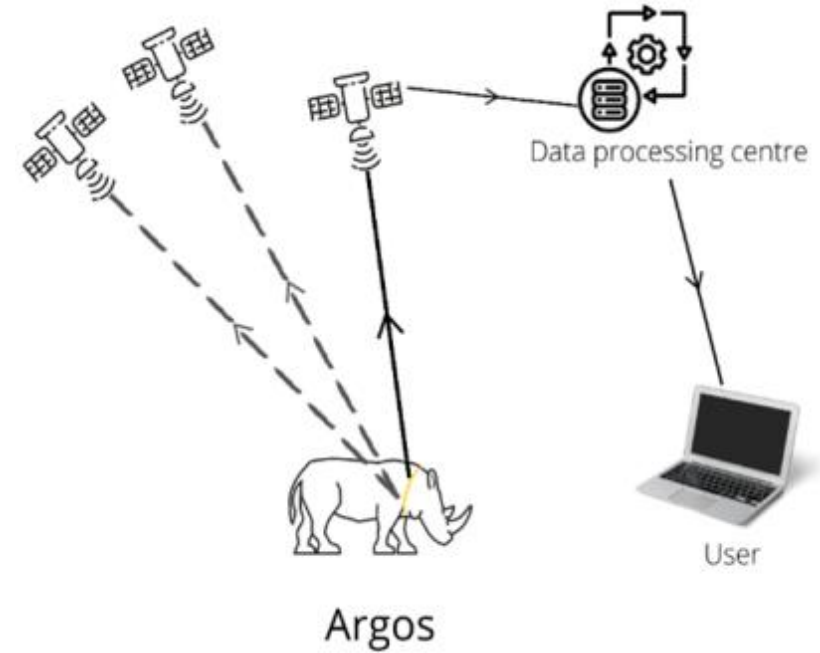
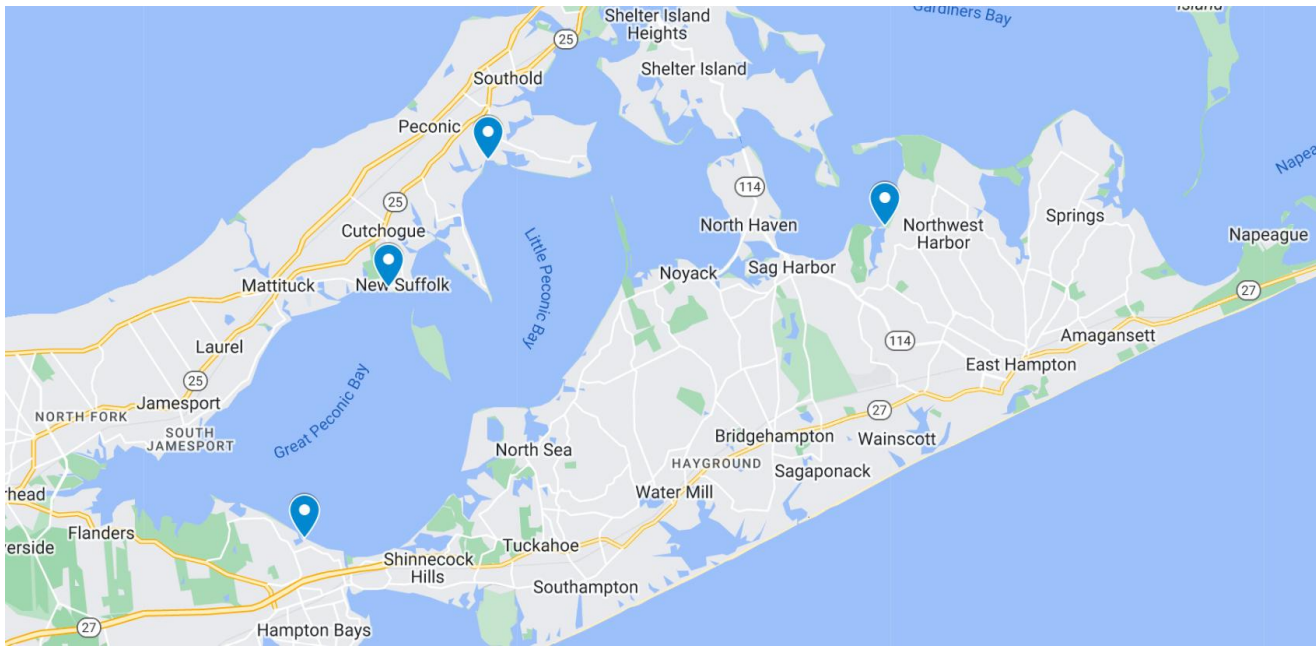


Photo: Russ Burke



Five horseshoe crabs were collected in May 2024, tagged with satellite transmitters and button tags, and released at the same locations:

- Squires Pond, Hampton Bays (n=1)
- West Creek, Southold (n=1)
- South Harbor Park, Southold (n=2)
- Northwest Harbor County Park, East Hampton (n=1)



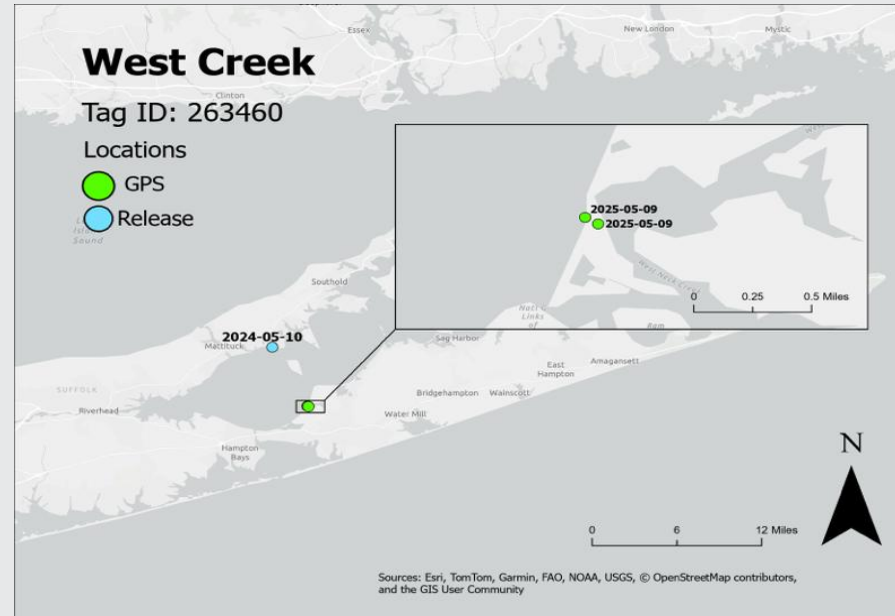
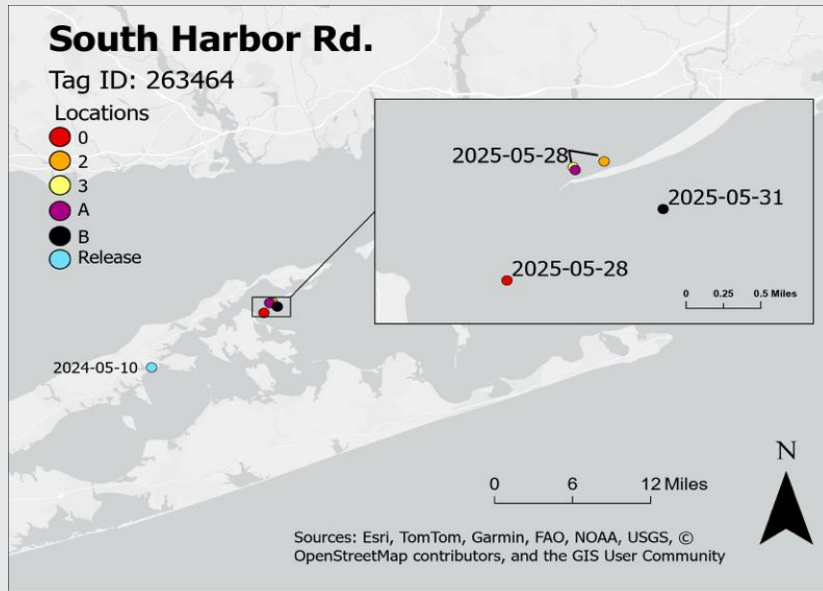
Horseshoe Crabs Detections in 2024 and 2025

- One of the five horseshoe crabs tagged in 2024, received an additional position in 2024 (Squires Pond).
- However, 3 of the 5 horseshoe crabs were detected again the following year (2025) during the spawning season: West Creek (Lotek), Northwest harbor (Lotek) and South Harbor Rd (WCI).
- The crab released at South Harbor Rd. with Argos (WCI) tags received 5 locations estimates in 2025. These 5 detections were in relative close proximity of one another (<1500m radius) and were close to a sand spit at Orient Beach State Park. This is plausible spawning habitat.
- Lotek FastGPS tags (West Creek and Northwest Harbor) yielded high resolution positions in 2025.



Species	Brand	Release Location	Tag ID	2024 Detection	2025 Detection
HSC	WLC	South Harbor Rd., Southold	263464	No	Yes
HSC	WLC	Squires Pond, Hampton Bays	263465	Yes	No
HSC	Lotek	South Harbor Rd., Southold	263458	No	No
HSC	Lotek	Northwest Harbor, East Hampton	263459	No	Yes
HSC	Lotek	West Creek, Southold	263460	No	Yes

Horseshoe Crab Detections- Spawning 2025



Horseshoe Crab Satellite Tags

- The horseshoe crab position data, while lower frequency compared to other species (as expected), provided useful information on an interannual basis.
- All 3 of the interannual tags detected were observed to have “estuary-level fidelity” the following year when spawning.
 - Potential for up to 5 years (or more) of annual returns during spawning.
- Information will be used by the Horseshoe Crab Workgroup and also for the Shoreline Management Model (VIMS).



Diamondback Terrapins



- Reliant on intertidal and beach habitats for nesting
- Vulnerable to shoreline hardening and development, habitat loss, bycatch, boat and vehicle strikes, predation, etc.
- Keystone species
 - Help regulate coastal ecosystems and maintain salt marsh and seagrass habitats by limiting overgrazing
- Can guide conservation policy and important management issues related to management of estuarine species and habitats
- Charismatic species
 - Ideal for outreach and education
 - Community science monitoring efforts
- Little is known about nesting behavior, home range, movement and use of various habitats within the Peconic Estuary

Satellite Telemetry Pilot Project June 2024

- Satellite telemetry tags have only recently been used on DBT
- PEP-funded pilot project (Mini-grant) in collaboration with Dr. Burke and Seatuck Environmental Association
- Collected & tagged nesting female terrapins in mid-June (n=4)
- Orient Beach State Park
- Released on the same day and at the same location
- Used Wildlife Computer Argos tags (spot tags)
 - At the time, this was the most suitable tag for terrapins (Lotek GPS tags were too large for DBTs & considerably more expensive given the small budget).
 - DBT surface breath and we avoided using a heavy tag to interfere with their behavior or health



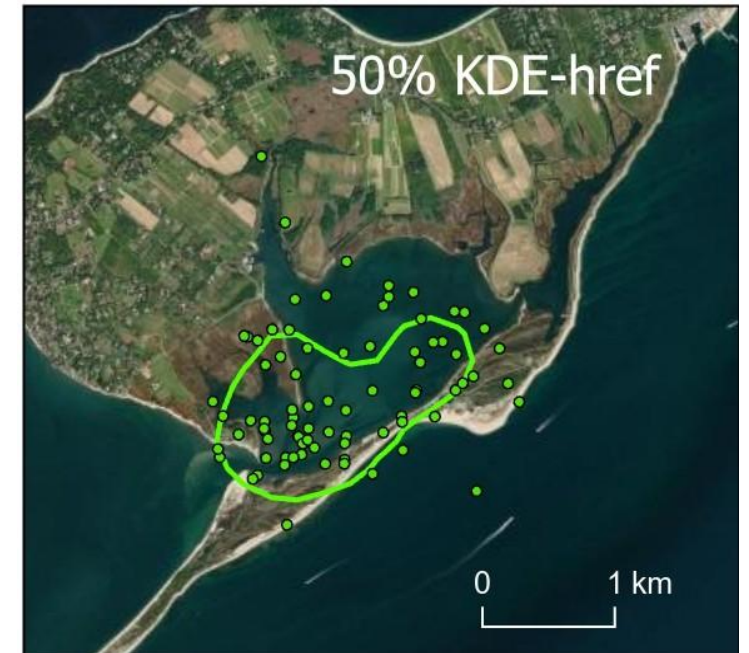
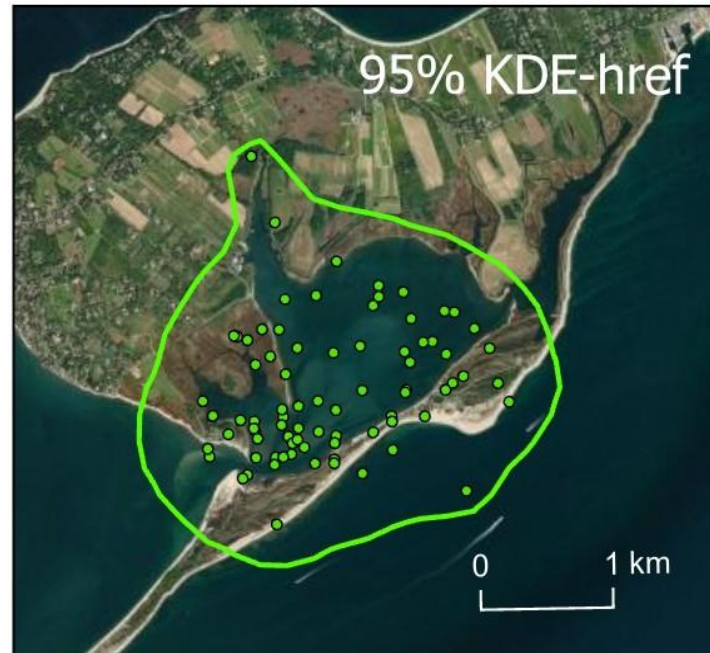
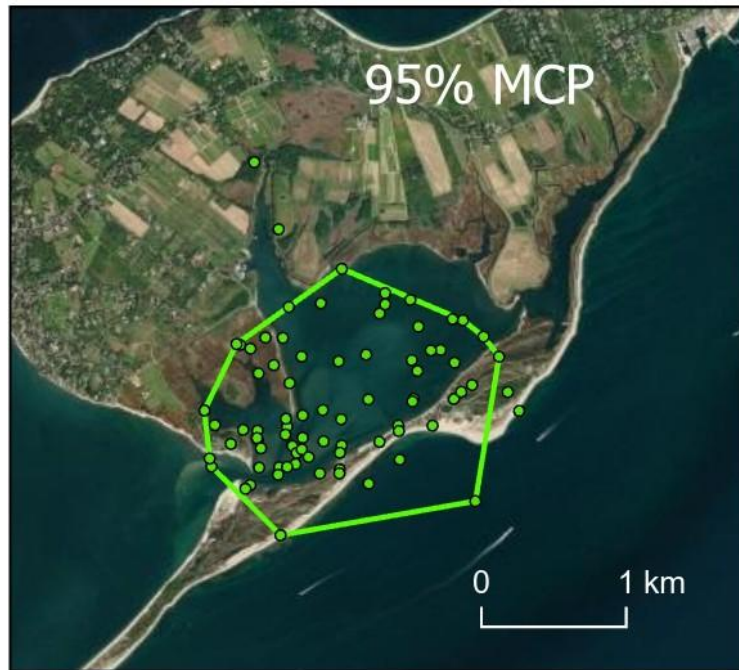
Diamondback Terrapin Argos Satellite Tag Pilot Study 2024



Diamondback Terrapin Home Range Estimates

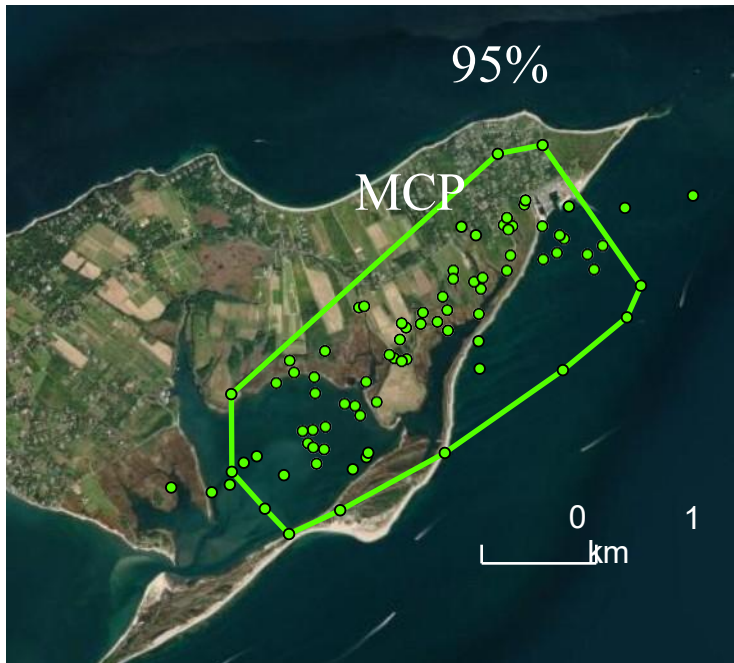
Argos Tag 263461

Home Range maps from Hough 2025, for boundary Filtered SSM daily mean locations- 95% MCP, 95% KDE-HREF, 50% KDE-href.



Diamondback Terrapin Home Range Estimates Argos Tag 263462

Home Range maps from Hough 2025, for boundary Filtered SSM daily mean locations- 95% MCP, 95% KDE-HREF, 50% KDE-href.



Diamondback Terrapin Argos Satellite Study 2024

- Argos satellite tags proved effective at tracking the daily and seasonal movements of terrapins at Orient State Park
- High resolution temporal coverage
- Home Range estimates with habitat use showed larger home range than anticipated

Results of this study submitted to BMC Zoology: Hough, K., Sclafani, M. and R. Burke (submitted): Quantifying movements and home ranges of an estuarine turtle: the effects of urbanization boundaries.

- Some potential overlap of eelgrass beds, however, the Argos satellite tags error radius in this small system made it difficult to make strong inferences about the use of eelgrass. The Argos tags and better suited for larger areas than Orient (e.g. Jamaica Bay).
- Can we use FastGPS tags on terrapins to evaluate fine-scale movements?



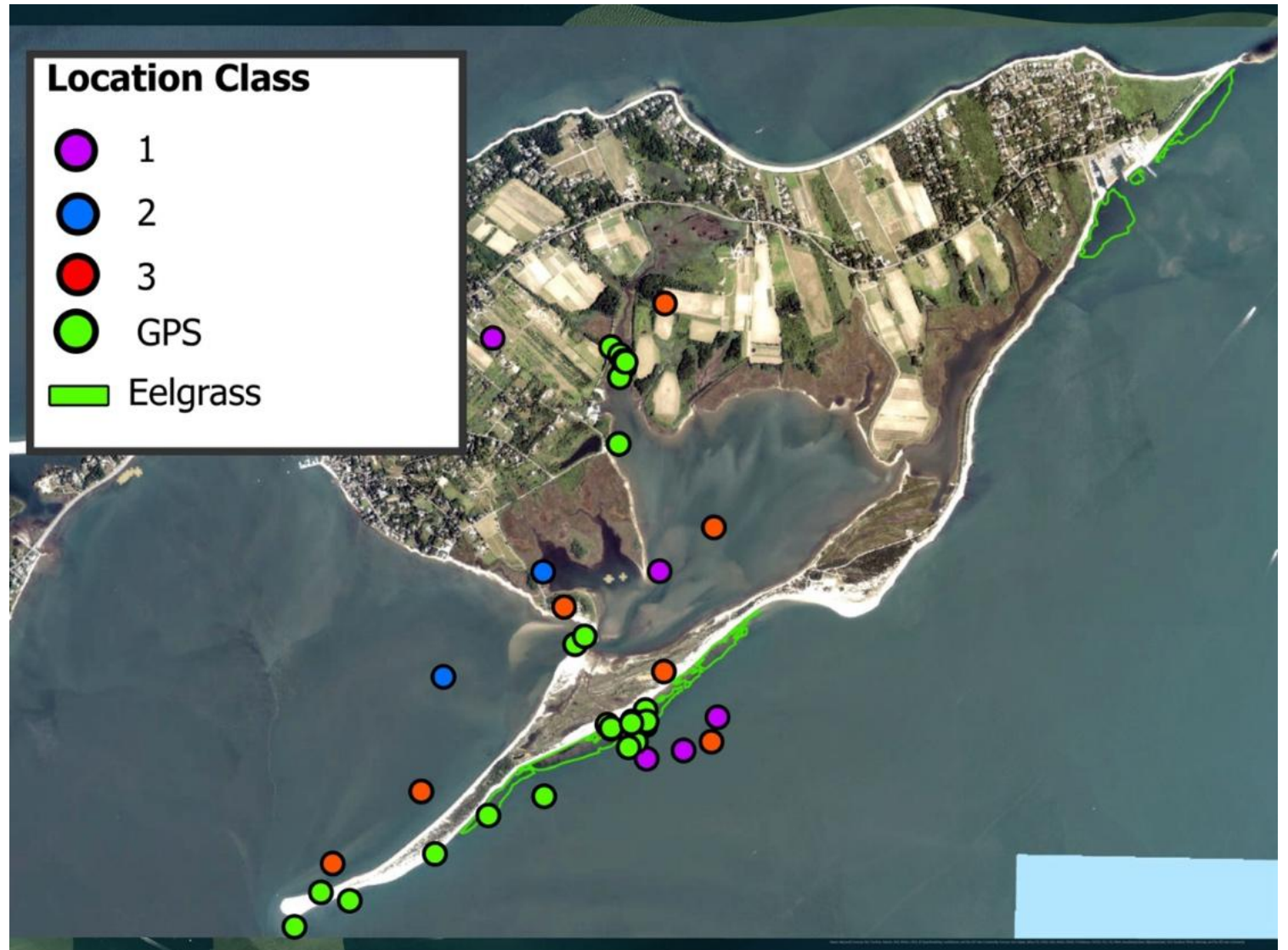
FastGPS Satellite Tag- 2025



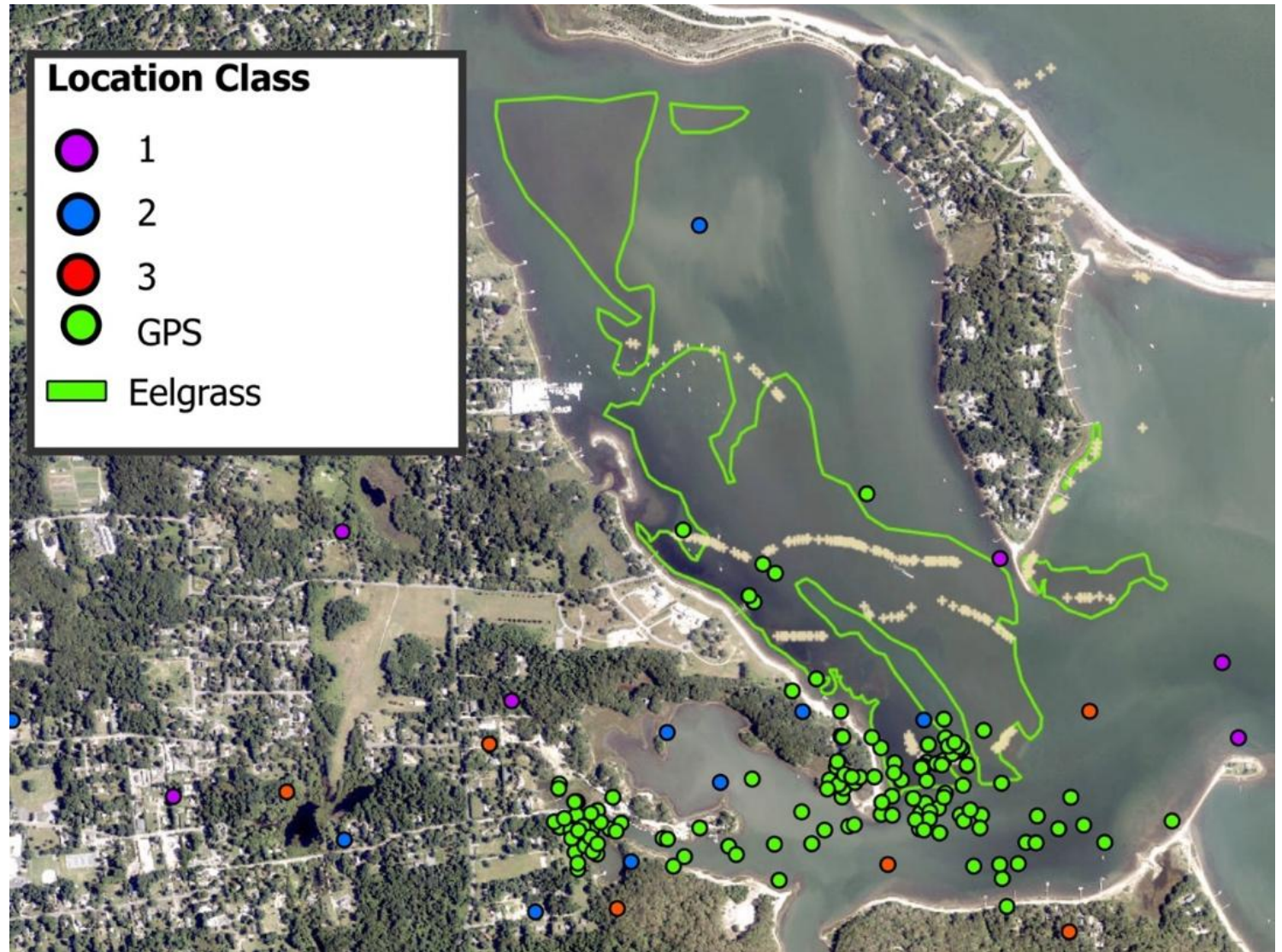
- Tested in 2025 on a diamondback terrapin at Orient Beach State Park
 - Tags have become smaller and light enough for a large DBT
 - “Ginger” was tagged with the Lotek FastGPS Satellite tag on July 1, 2025
 - Collaboration with Seatuck

- Benefits of FastGPS Satellite Technology:
 - Excellent spatial accuracy (<30 m). Frequent & highly accurate location fixes
 - Small and light enough to use on female DBT
 - Helps confirm the accuracy of 2024 satellite telemetry data
 - Higher spatial resolution provides improved understanding of behavior and habitat use at considerably smaller spatial scales
- Potential Limitations:
 - Shorter battery life and requires several satellites to acquire a position estimate.

- Improved position estimates with GPS vs Argos tags
- Nested again after tagging, then moved from the Peconic Bay side into Long Beach Bay (Narrow River Rd.) possibly to nest again
- Ginger's movement data shows an apparent spatial overlap with eelgrass beds near Orient Beach State Park



- Ginger moved over to Coecles Harbor, Shelter Island ~ 1 week after Tagging in Orient
- Spent the majority of the summer months in Shelter Island (Congdon's Creek)
- Spatial overlap with eelgrass beds near Coecles Harbor, Shelter Island
- DBT are likely utilizing eelgrass habitat for foraging and other behaviors



Movement on: 2025-07-04 00:03





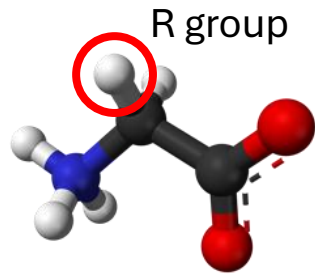
Project Design

- Complimentary monitoring methods
 - Satellite telemetry (FastGPS tags)
 - Stable isotope analysis of amino acids
 - Quantify and identify DBT resource and habitat use
 - Compare habitats with & without eelgrass present
- Evaluate eelgrass beds, beach and salt marsh habitat use
 - Orient Beach State Park- Eelgrass present
 - No eelgrass (e.g. Broad Cove)
- Development of community science initiatives
 - Education & outreach
 - Work with DEC Submerged Aquatic Vegetation Coordinator & NYS Parks and other stakeholders (e.g. Peconic Land Trust) for monitoring of eelgrass and DBTs
 - Conservation of DBT & their habitats

Amino Acids: The Building Blocks of Proteins

Non-Essential Amino Acids

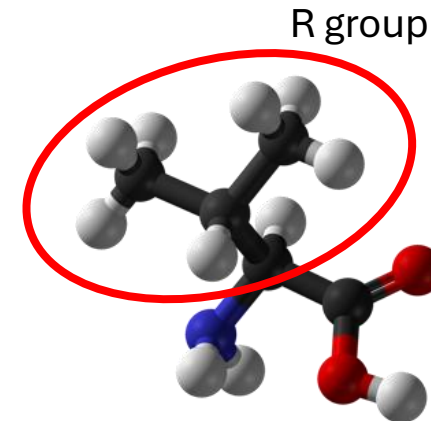
- Can be synthesized by all organisms



Glycine
non-essential amino
acid

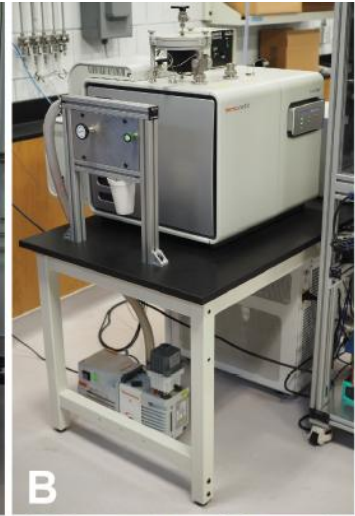
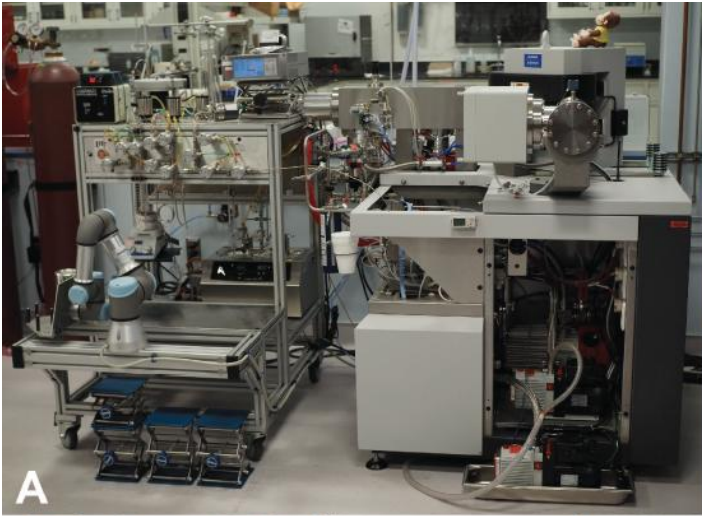
Essential Amino Acids

- Can only be synthesized by autotrophs or heterotrophic bacteria and fungi.
- Animals must acquire them in their diet OR from their symbiotic gut microbes

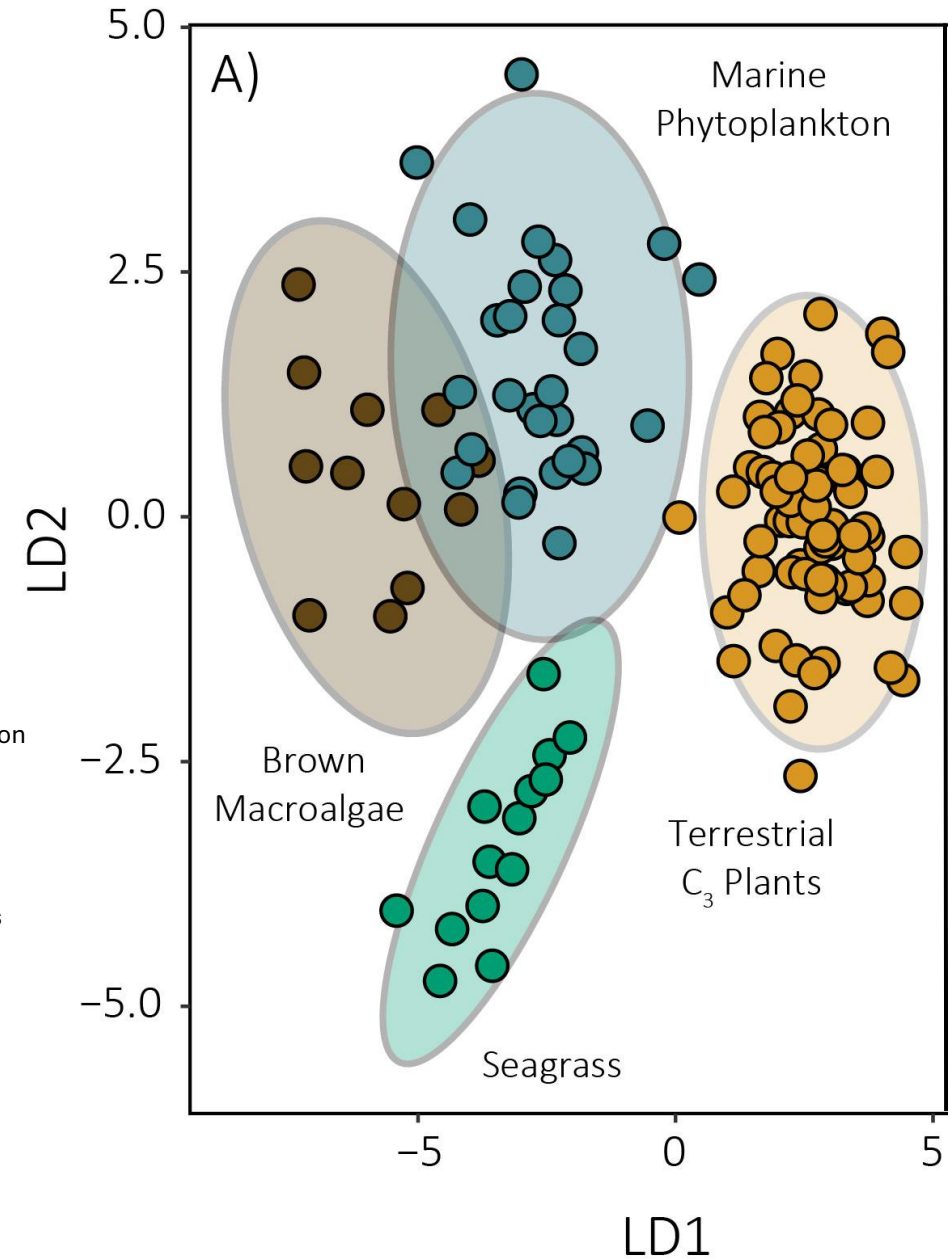
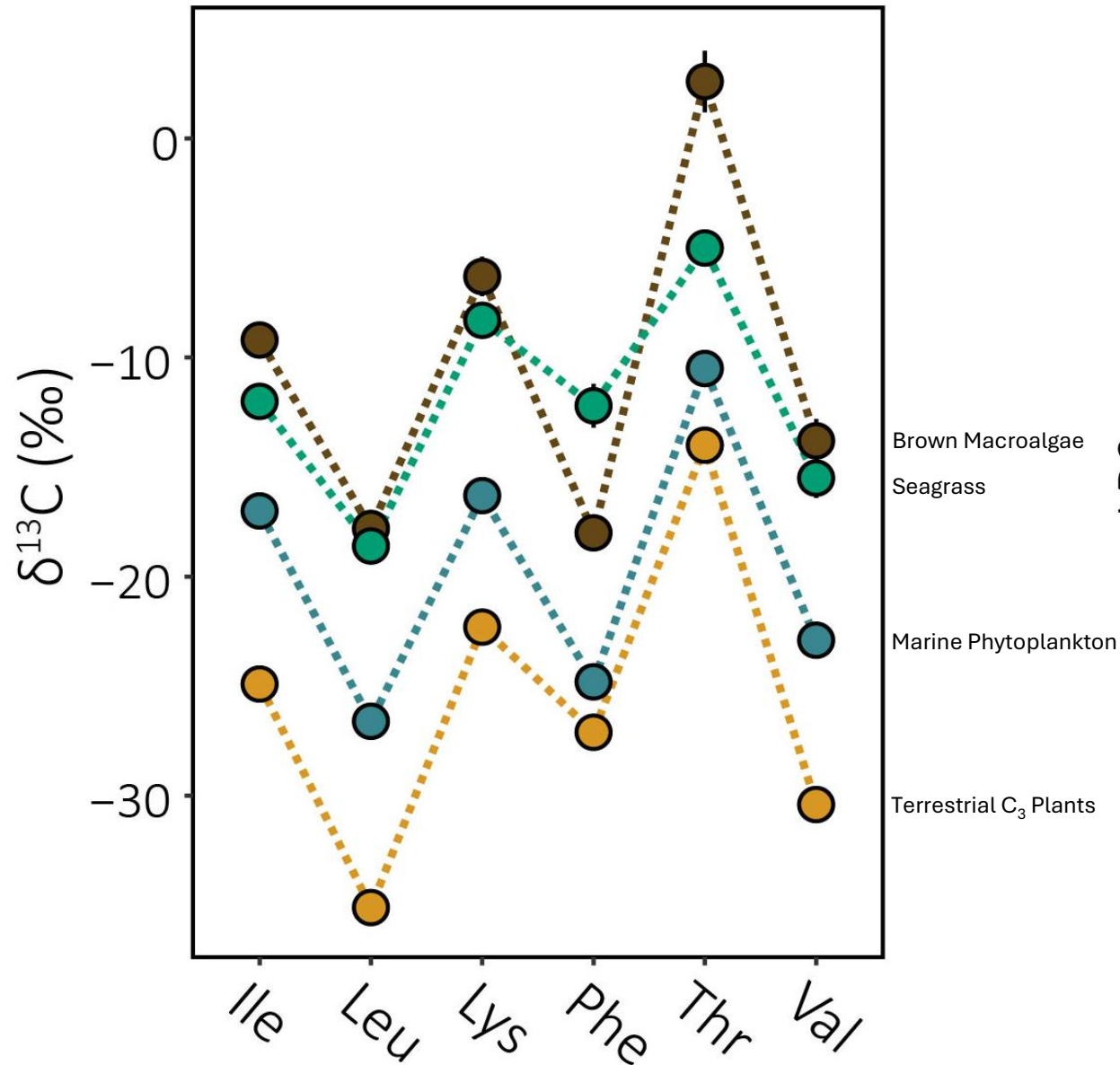


Valine
essential amino acid

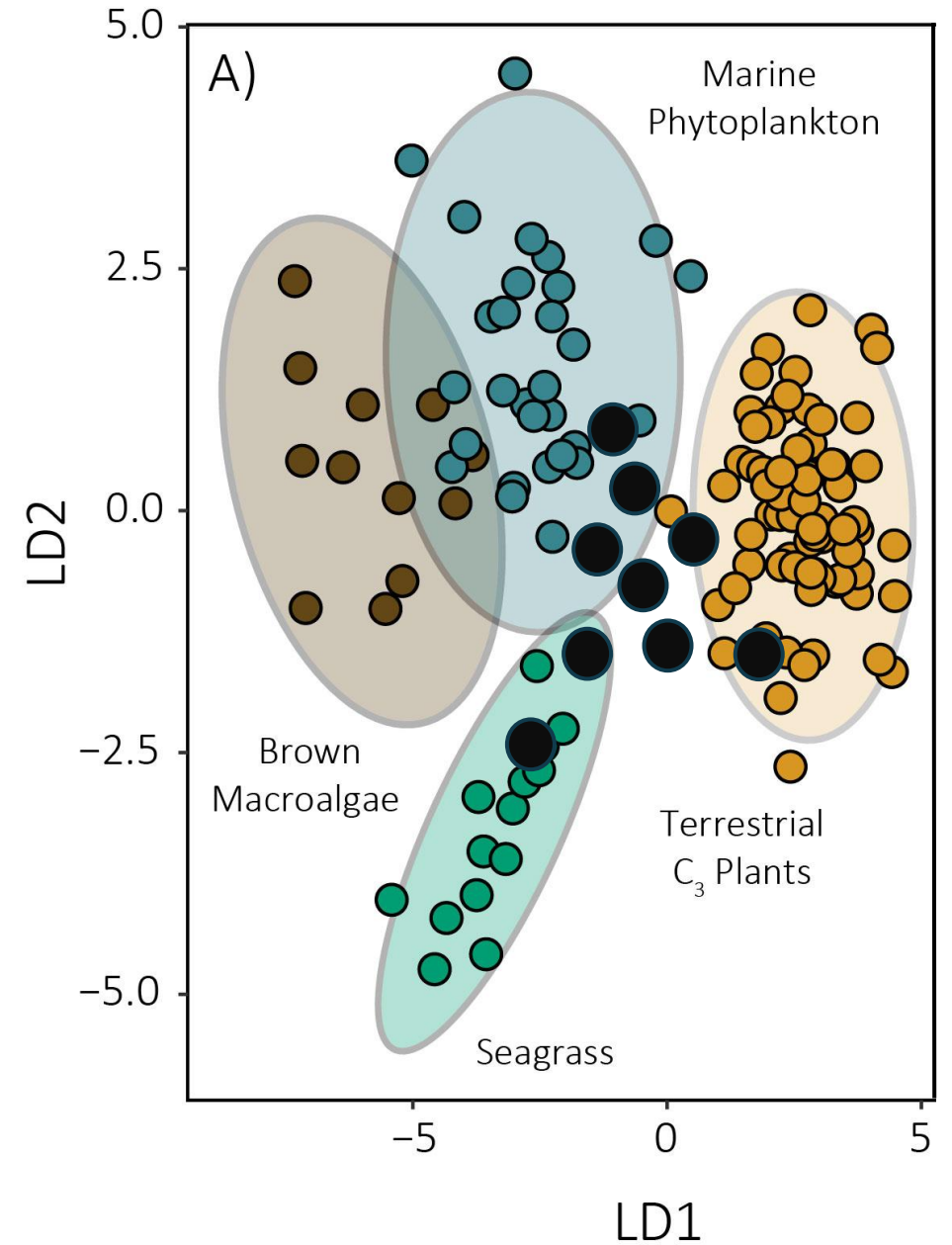
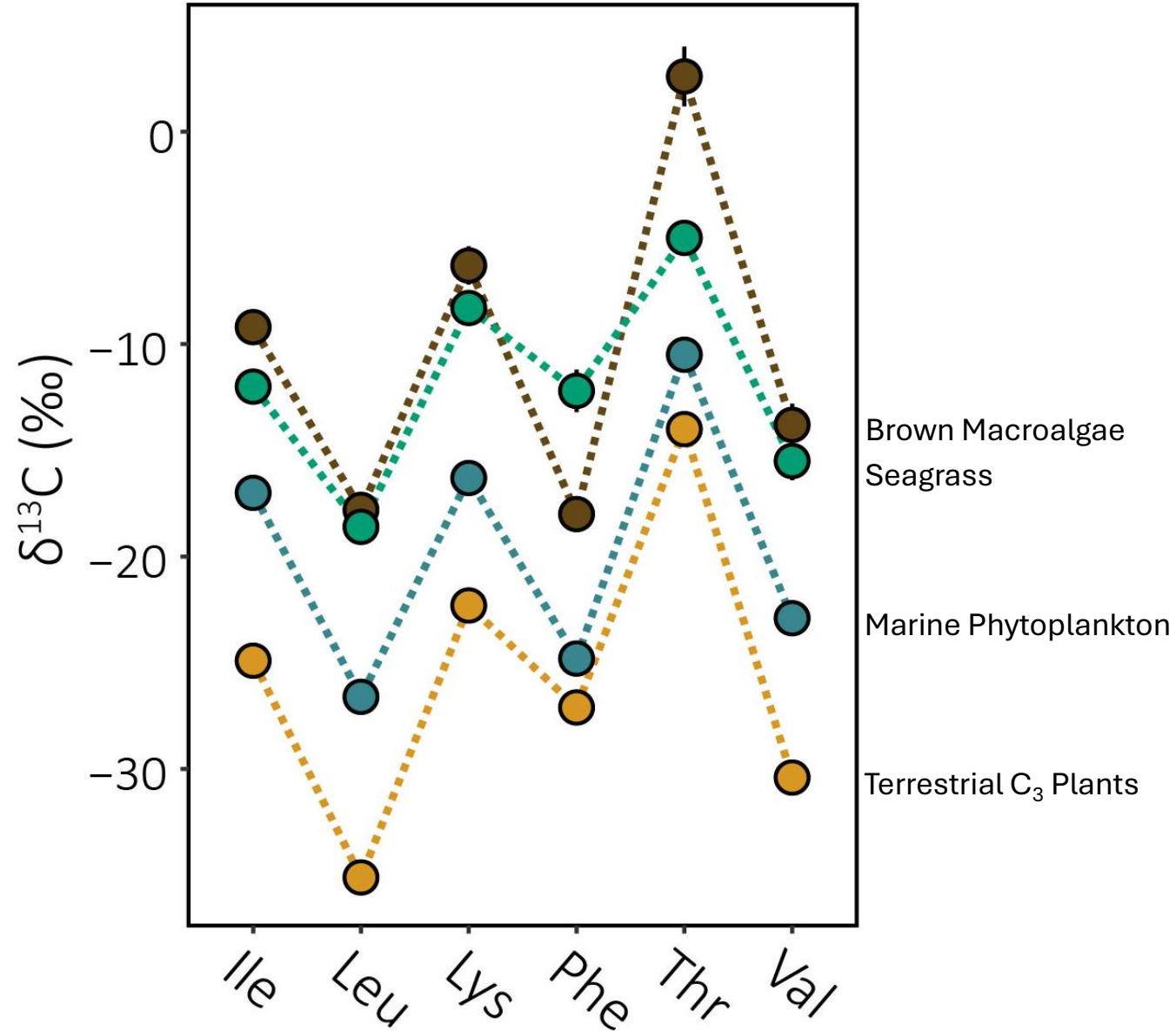
Stony Brook Stable Isotope Facility (PIs Henkes, Shipley, Smiley)



Carbon isotope fingerprinting of essential AAs

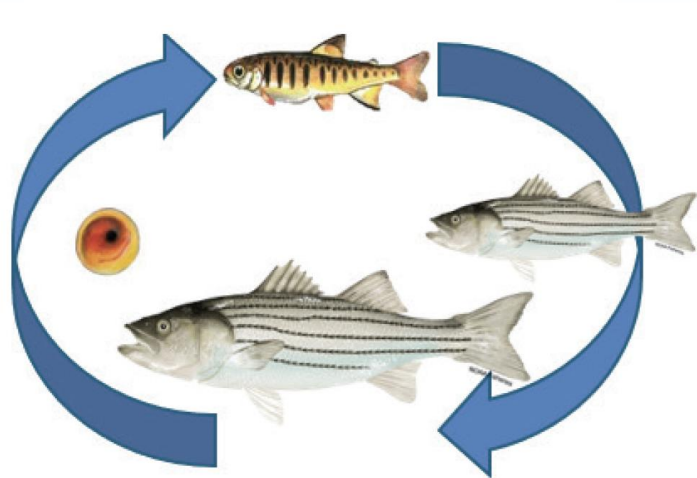


Carbon isotope fingerprinting of essential AAs



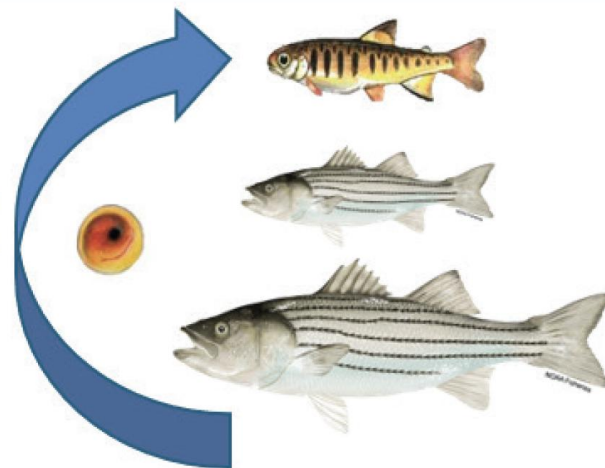
Marine contingent

Freshwater Estuary Marine



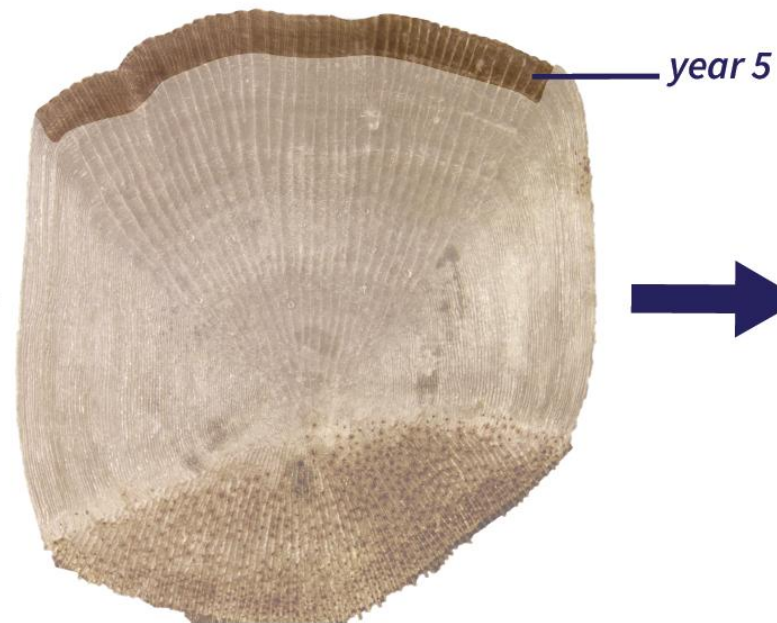
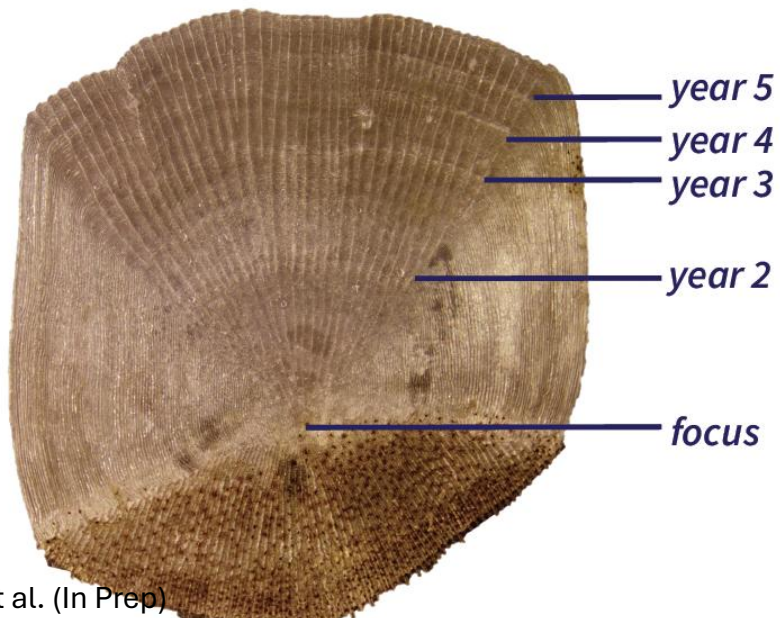
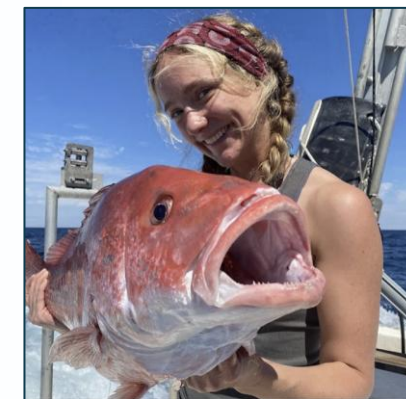
Estuarine contingent

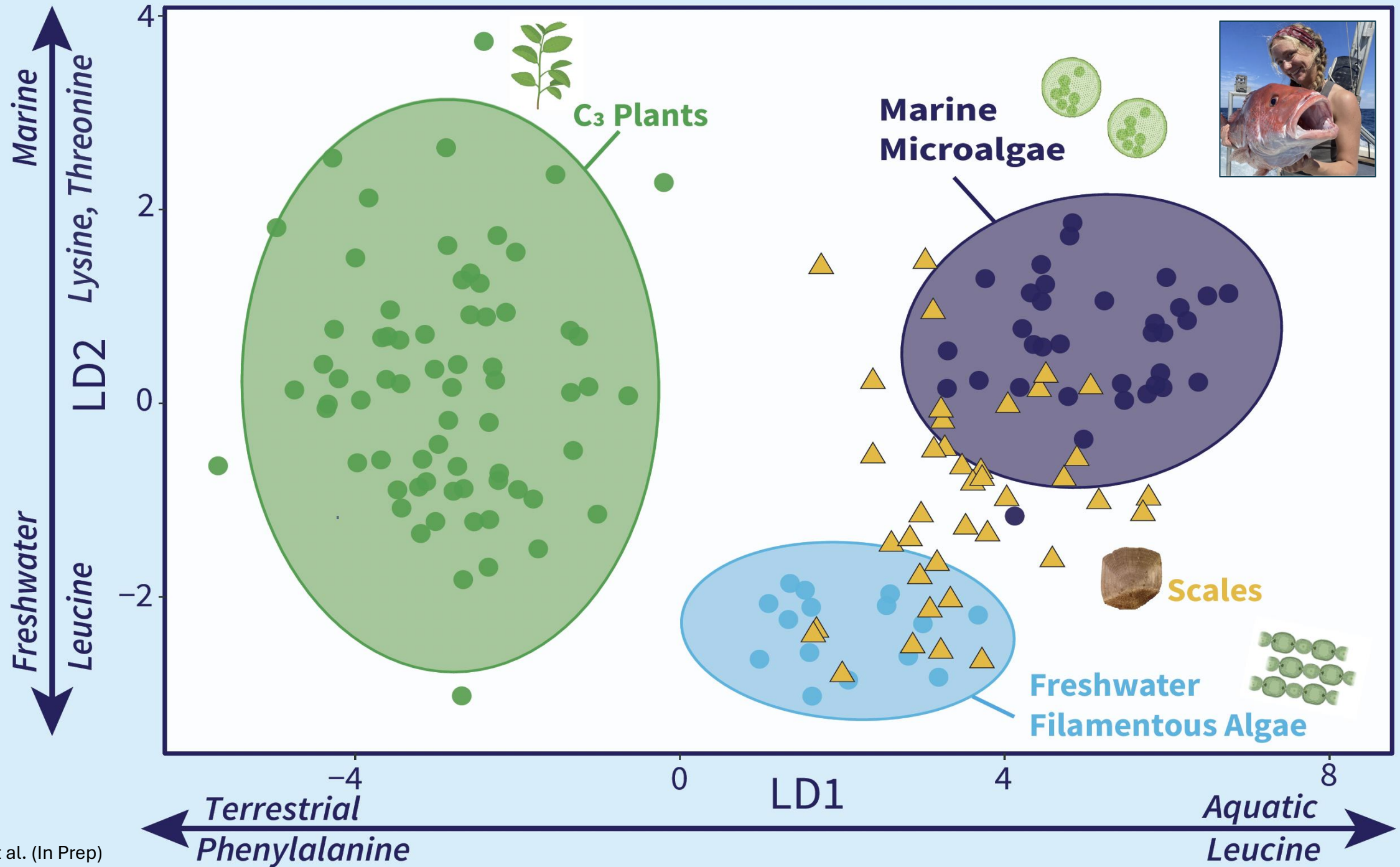
Freshwater Estuary

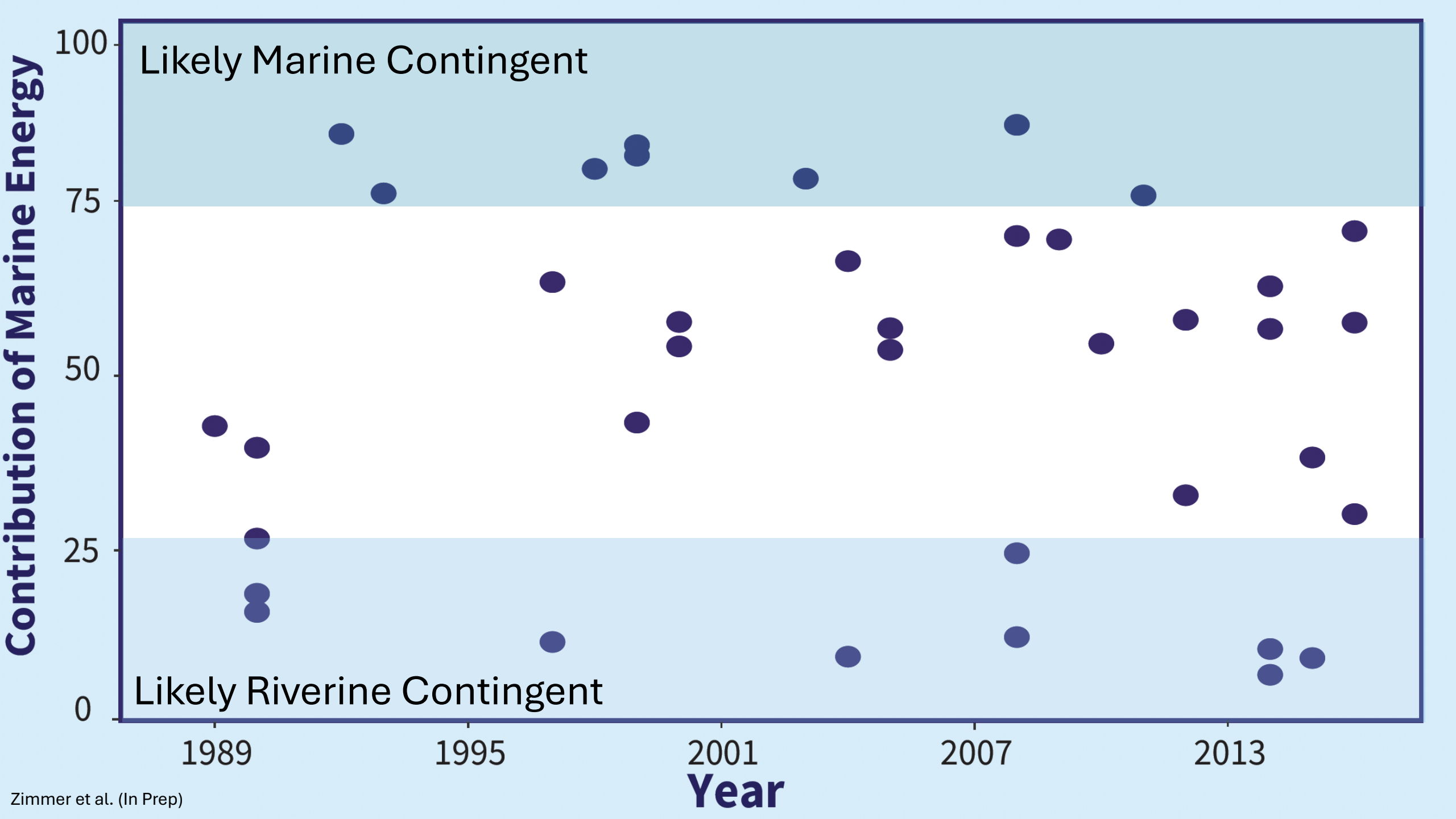


Freshwater contingent

Freshwater







Likely Marine Contingent

Likely Riverine Contingent

1989

1995

2001

2007

2013

Year



PEP CCMP

- Data collected from this project will help PEP achieve the actions outlined under PEP's CCMP goals by providing important data on habitat utilization by diamondback terrapins, a keystone and sentinel species.
- **Relevant CCMP Goals:**
 - ***Resilient Communities Prepared for Climate Change***
 - ***Healthy Ecosystem with Abundant, Diverse Wildlife***



CCMP Goal:

Resilient Communities Prepared for Climate Change



Action 10: Incorporating climate change considerations into new and existing projects of PEP and partner organizations



Action 11: Providing tools and assistance to local government to mitigate and adapt to the impacts of climate change



Action 12: Mitigate climate change through coastal ecosystem management



Action 14: Increase public awareness of anticipated impacts of climate change on the Peconic Estuary and practical ways to mitigate and prepare for them



CCMP Goal:

Healthy Ecosystem with Abundant, Diverse Wildlife



Action 23: Conduct scientific studies to expand understanding of the Peconic Estuary ecosystem and support ecosystem-based management



Action 24: Review and update data for rare, protected and endangered species in the Peconic Estuary to support the development of protection strategies



Action 27: Facilitate spatial planning of the Peconic Estuary to help mitigate resource-use conflicts and ensure the protection of critical habitats.

Anticipated Impacts:

- Increased understanding of resource and habitat use of terrapins within different habitats; including eelgrass, salt marsh, open water habitats and intertidal beaches.
- Improved understanding of nesting female terrapin behavior, movement, and diet in habitats with and without the presence of eelgrass.
 - Quantify potential benefits of eelgrass habitats for DBTs
- Develop a framework for community educational science initiatives with terrapins and their habitats in coordination with PEP, partnering organizations, and stakeholders.
- Data from this project will form the basis of terrapin and habitat conservation efforts within the Peconic Estuary including the Shoreline Management Model (VIMS), dredging policy, mooring fields, eelgrass protection and restoration, etc.)



Acknowledgements

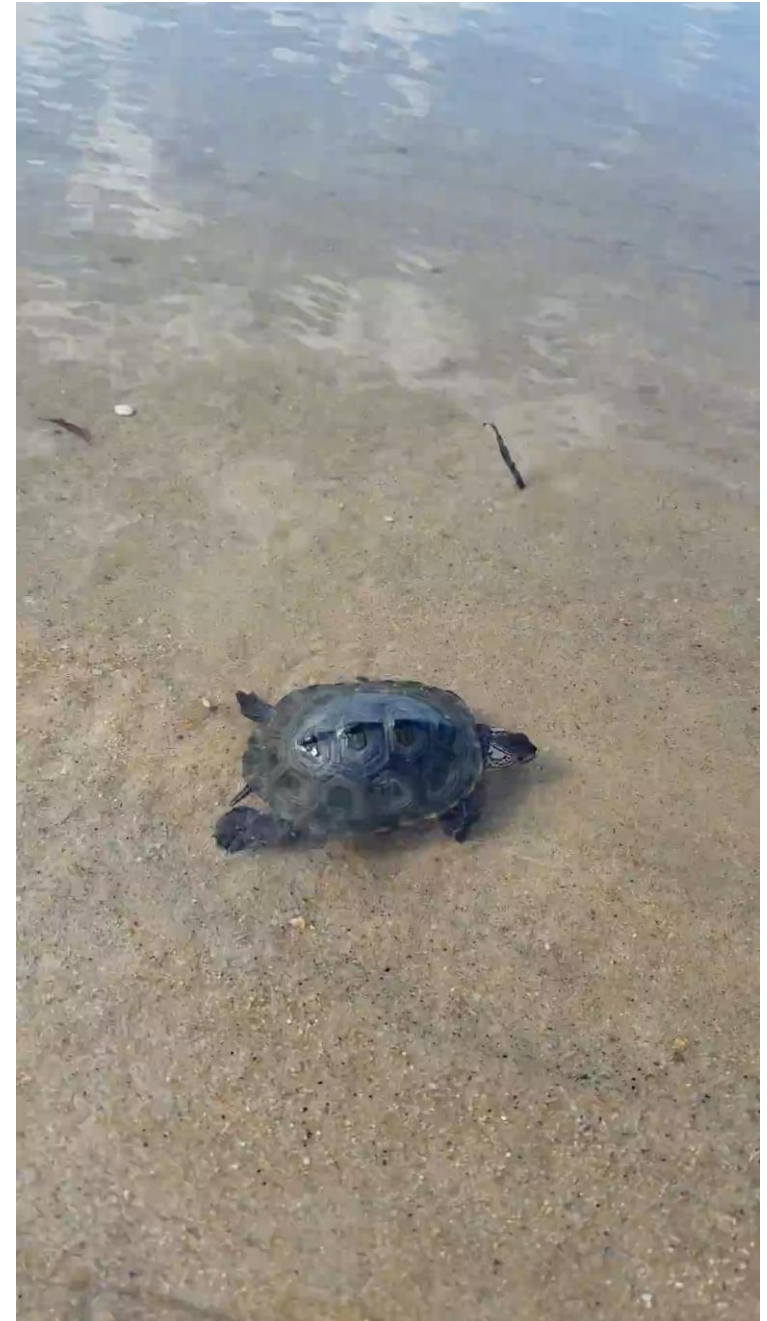
Peconic Estuary Partnership (mini-grant)

Russel Burke (Hofstra Univ.)

Enrico Nardone (Seatuck Environmental)

Kaitlin Morris, Stephen Havens, Joe Costanzo (CCE)

Jennifer Murray and NYS Parks Staff @ Orient



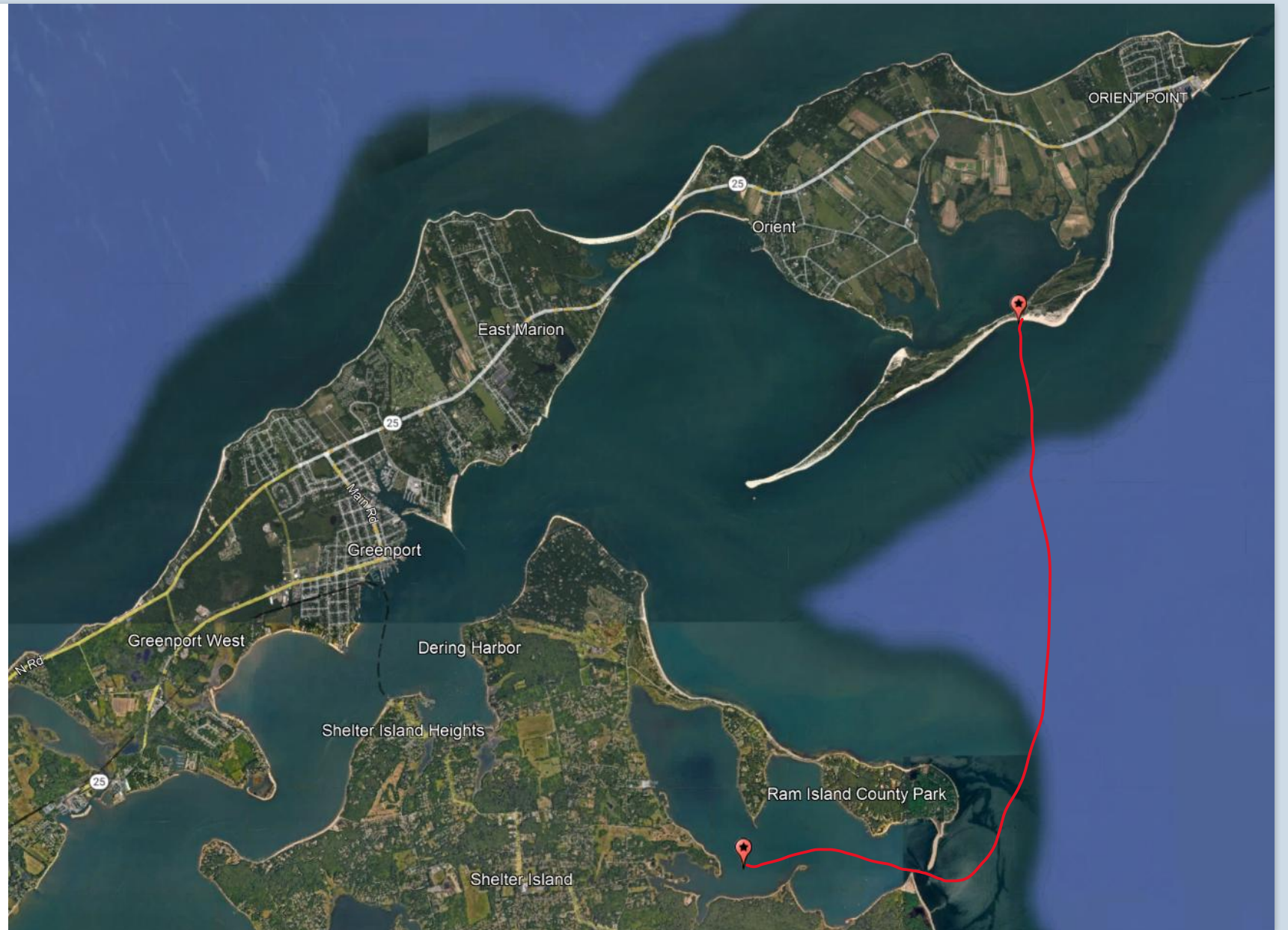
more photos and videos to add if you want



Diamondback Terrapins



- Ginger was captured, tagged, and released at Orient Beach State Park
- Traveled to Coecles Harbor, Shelter Island





- **Figure 14.** Map showing the error radius of Argos locations in each of the two bays, OBSP and Jamaica Bay. The green circle indicates LC 3 with a radius of 250m. Yellow circle indicates LC2 with a radius of 500m. Red circle indicates LC 1 with an error radius of 1500m. Figure taken from Hough 2025.