

# COLLABORATIVE SCIENCE FOR ESTUARIES

WEBINAR SERIES

## Summary Points:

Technology has become an integral part of environmental education, however purchasing or producing technology can be very cost prohibitive. As part of a NERRS Science Collaborative Science Transfer grant, the Delaware, Guana Tolomato Matanzas, and Mission-Aransas National Estuarine Research Reserves (the clients) partnered with the University of Delaware Introduction to Software Engineering course (the consultants). As part of their coursework, students produced educational computer games that promote interactive, free-choice learning opportunities. In this webinar, Maggie Pletta, Education Coordinator from Delaware NERR, provided insights about the process that led to the selection of student-developed educational games installed in the three centers, including the benefits and challenges of working with students.

Maggie Pletta is the Education Coordinator at the Delaware National Estuarine Research Reserve (DNERR) where she is tasked with managing and leading K-12 fieldtrips and outreach, public programs, family events, and teacher professional development workshops. Prior to her position at DNERR she held positions at the National Park Service, NASA, Educational Non-Profits, and Delaware Department of Natural Resources and Environmental Control's Wetland Monitoring and Assessment Program. Her professional areas of interest include teaching people about estuaries and climate change, as well as reconnecting children with nature, and making science fun for all ages.



**Maggie Pletta**

*Delaware NERR*



## How to Update Reserve Visitor Centers and Create Workforce Ready Students at the Same Time

Date: Tuesday, March 12, 2019

Time: 3.00-4.00 (EST)



National Estuarine  
Research Reserve System  
Science Collaborative

# Poll Question 3: How would you describe your interest in today's topic? (check all that apply):

- Interactive games are/could be an option for my organization
- I'm interested in new ways to make science engaging
- The intersection of science, technology, art, and education is interesting to me
- I already know something about this project and want to learn more
- Other

## Summary Points:

### Results:

- Interactive games could be an option for my organization (27%)
- I'm interested in new ways to make science engaging (82%)
- Interested in intersection of science, tech, art & education (82%)
- I know something about this project and want to learn more (36%)



# How to Update Reserve Visitor Centers and Create Workforce Ready Students at the Same Time

MISSION \* ARANSAS



NATIONAL  
ESTUARINE  
RESEARCH  
RESERVE



## Summary Points:

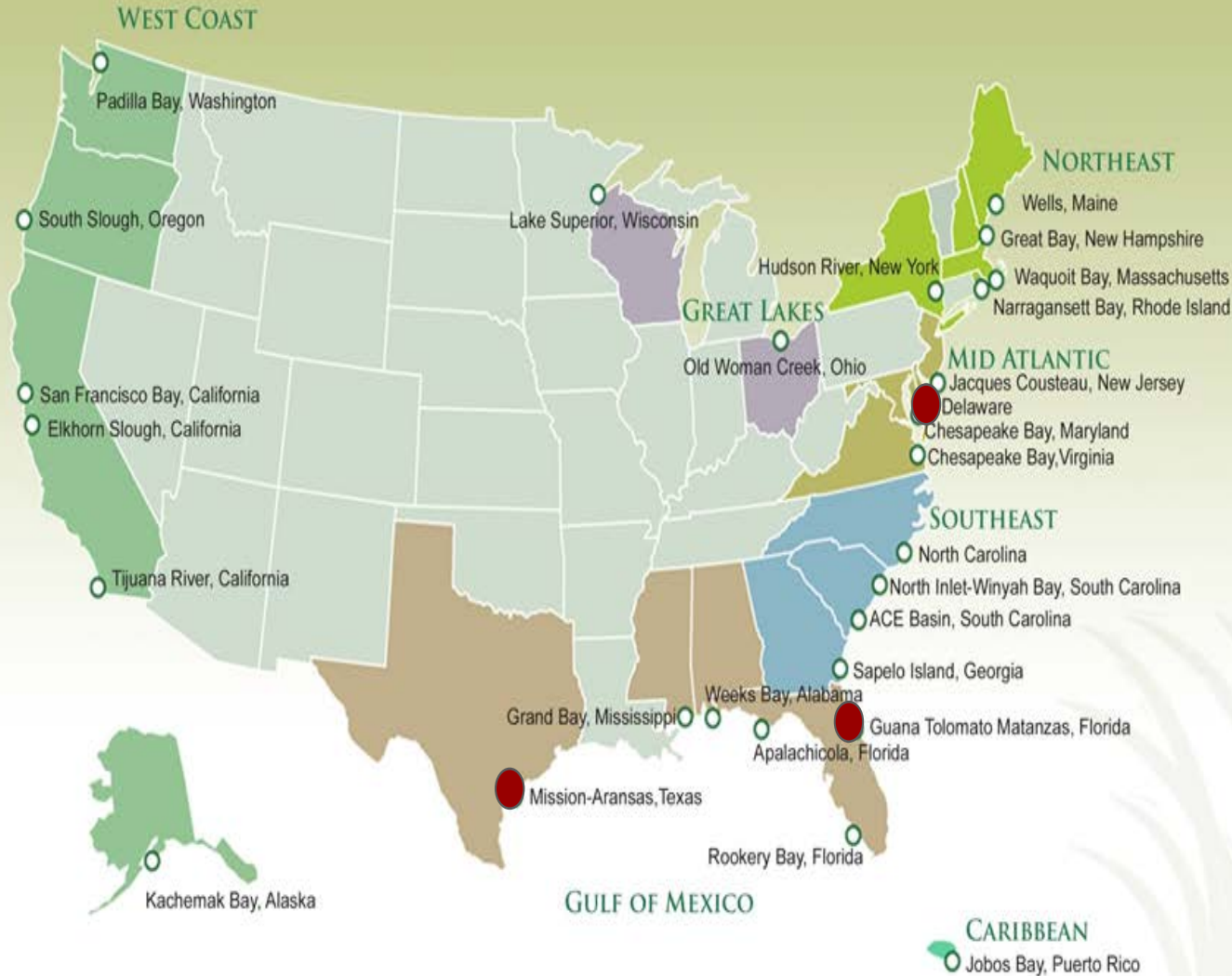
The Reserve system is a program creating a partnership between NOAA and a state entity. Each state is different; some partner with a University, some partner with a state agencies.

# National Estuarine Research Reserve System

**Vision** – Healthy estuaries and coastal watersheds where coastal communities and ecosystems thrive.

**Mission** – To practice and promote coastal and estuarine stewardship through innovative research and education, using a system of protected areas.



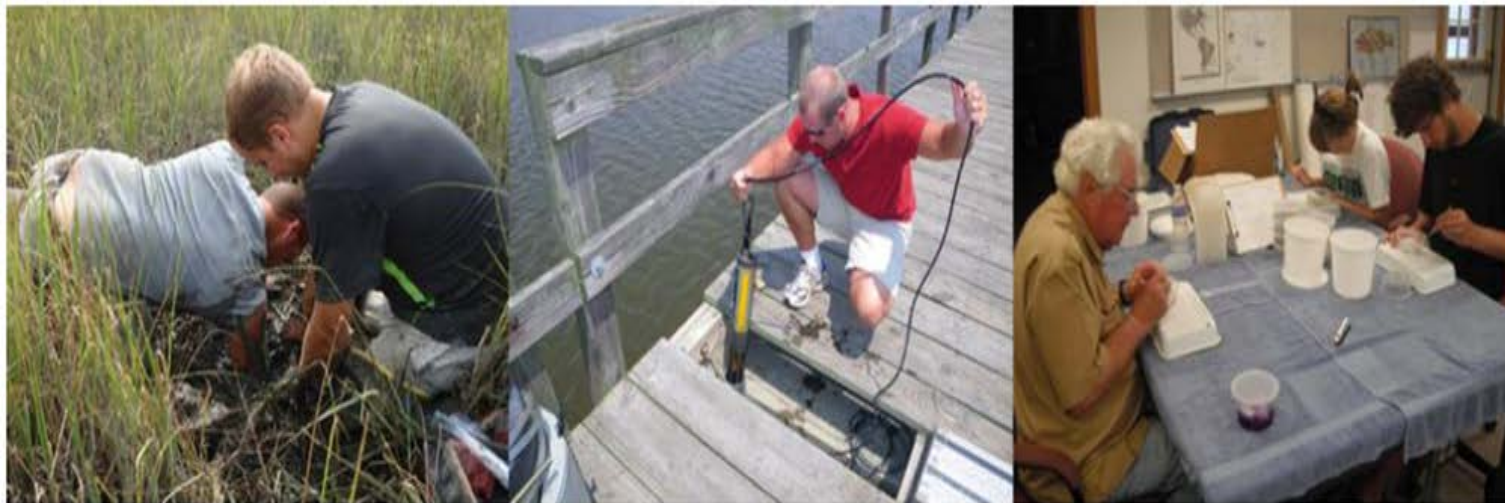


## Summary Points:

There are 29 reserves across the country. The three that were involved in this project were Delaware, Guana Tolomato Matanzas (GTM) in Florida, and Mission-Aransas in Texas.



# Research and Monitoring



*Provide observations, data and tools to understand  
the past, present and future of our coastal areas*

## Summary Points:

There are four main components in each reserve, which allow national priorities to be explored at multiple scales and to reflect local interests. The four areas are: research and monitoring; stewardship; education and outreach; and the coastal training program (CTP).

The research and monitoring component focuses on long-term data collection in areas such as water quality and weather. Every reserve collects the same kinds of data using the same equipment and procedures as part of the system wide monitoring program (SWMP), which allows comparisons across the system.

In addition, each reserve also develops discrete projects that reflect the interests of the research coordinator and their science staff.





## Summary Points:

# Stewardship

The next component of reserve practice is stewardship, which includes areas such as habitat management and restoration, and how to best manage our resources. Activities include restoration and enhancement of native plants for habitat, and understanding the impact on native species.



*Promoting stewardship of our estuarine and coastal resources*



## Summary Points:

The third component of reserve practice relates to education and outreach, which includes engagement with kindergarten- through college-level students, stewardship and outreach in the classroom, public programs and events, and professional development for teachers.

# Education and Outreach



*Advancing environmental literacy through  
education and outreach*





## Summary Points:

The coastal training program component of reserve practice focuses on providing decision makers with technical and training assistance for climate change and environmental issues.

# Coastal Training Program



*Supporting decision makers who need accurate,  
timely information about their changing  
environment*



# This project...

## Title: Undergraduates Develop Job Skills by Creating Interactive Software for Reserve Visitors

This project will support the development of new, innovative visitor displays at three national estuarine research reserves. The visitor's centers at the Guana Tolomato Matanzas, Mission-Aransas, and Delaware National Estuarine Research Reserves currently have hands-off exhibits with limited interactive components. The reserves will partner with students at the University of Delaware to produce gesture controlled, educational computer games that promote interactive, learning opportunities. The experiential games will be designed for use on interactive screens that will be available for public use in each reserve's exhibit hall. Participants will be able to freely navigate through different experiences, providing them with a better understanding that an estuary is a dynamic place upon which plants, animals, and people depend, and that everyone plays a part in shaping the past and protecting the future. This project will provide communities with relevant, accessible science while offering civic-minded solutions and resources that encourage participants to take conservation-based action promoting ecosystem resilience.

## Summary Points:

This project represents the culmination of collaboration among Maggie and the education coordinators at GTM and Mission-Aransas, all of whom identified a need to update visitor centers. Having already identified funding as a potential constraint, the group explored options for feasible, but high-impact, updates. Maggie had a partnership with University of Delaware in which she acted as a client who had tasked a class with making games, and the group built upon this opportunity to address the need for updates to the visitor centers.



## Summary Points:

**Leap equipment:** Programmable back-end equipment required to make the games gesture-controlled; produced by [Leap Motion](#).

# Funding for the Project

## NERRS Science Collaborative: Science Transfer

- \$45,000 for a two year grant
- What the Money Bought:
  - 2 computer engineering interns for 2 summers
  - 2 art student interns for 2 summers
  - 2 large touch screen computers and stands
  - Leap equipment to make games gesture controlled



## Summary Points:

In the fall of 2016, Maggie visited an introductory software engineering course at University of Delaware to present specific information on the participating reserves and their Science Collaborative grants.

# Project Timeline

## Fall 2016

- Introduction presentation to course
- First round of Beta games tested



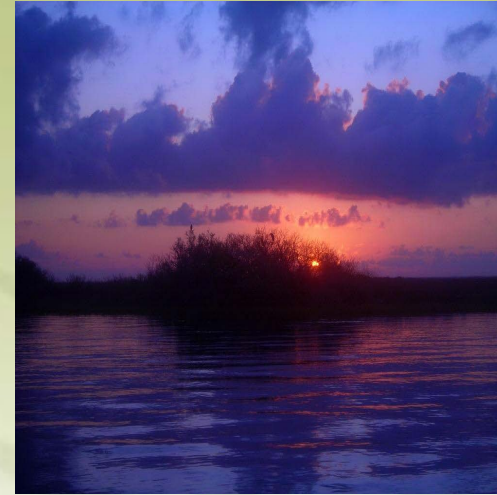
## Summary Points:

# Mission- Aransas NERR

**Name of grant:** Freshwater Inflows: Determining Flow Regimes in the Face of Land Use Change, Climate Change, and Other Unknowns.

### Problem Addressed:

- The mixing of fresh and salt water creates a gradient of salinity that is vital to the survival of estuary- dependent species such as fishes, shrimps, oysters, and crabs.
- Increasing amounts of freshwater are being drawn from rivers and streams to meet the growing needs of industry, agriculture, and municipalities in Texas.
- As human populations grow and demand for freshwater increases, the amount of freshwater that reaches estuaries is projected to further decrease.



Maggie gave the students background on two focus areas for the Mission-Aransas reserve:

1. Influx and dynamics of freshwater inflow into the estuary; and
2. How local crab dispersal differs throughout the estuary.

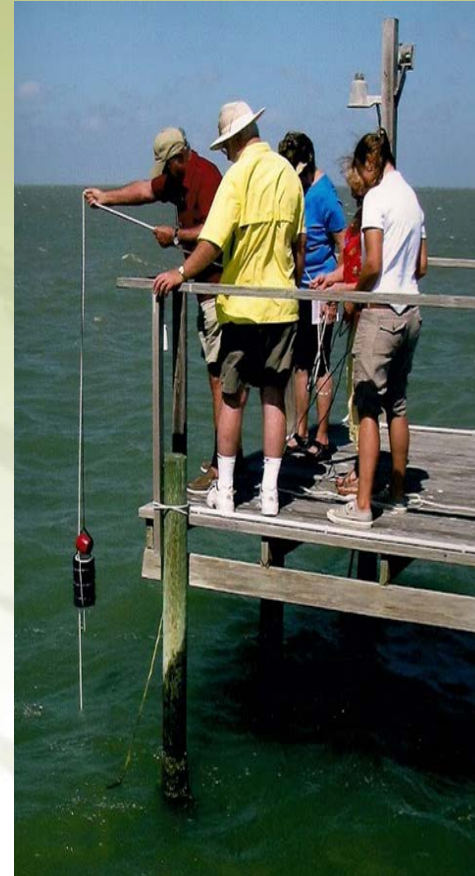
She then summarized some results from the projects, but did not specify whether any particular observations or results needed to be included in the finished games. Instead, she gave key predictions from the research, such as that future freshwater patterns would be affected more by precipitation patterns than land use, and noted those as pieces to include in the games.

Significantly, most students were unfamiliar with estuaries at the start of the project.



## What the Projects Did to Inform Game Design:

- Used planning software to examine various scenarios of future land use, population growth, and precipitation levels and their potential impact on freshwater use and runoff regimes.
- Collected data on water exchange between adjacent bay systems to improve future predictions of salinity changes resulting from freshwater inflow into adjoining bays.
- Conducted experiments with blue crab larvae to explore the relationship between their movement into the estuary and salinity levels.
- Constructed a computer model to simulate population dynamics of blue crabs in response to different freshwater inflow and salinity regimes.



Volunteers collecting blue crab larvae in the estuary.

## Summary Points:

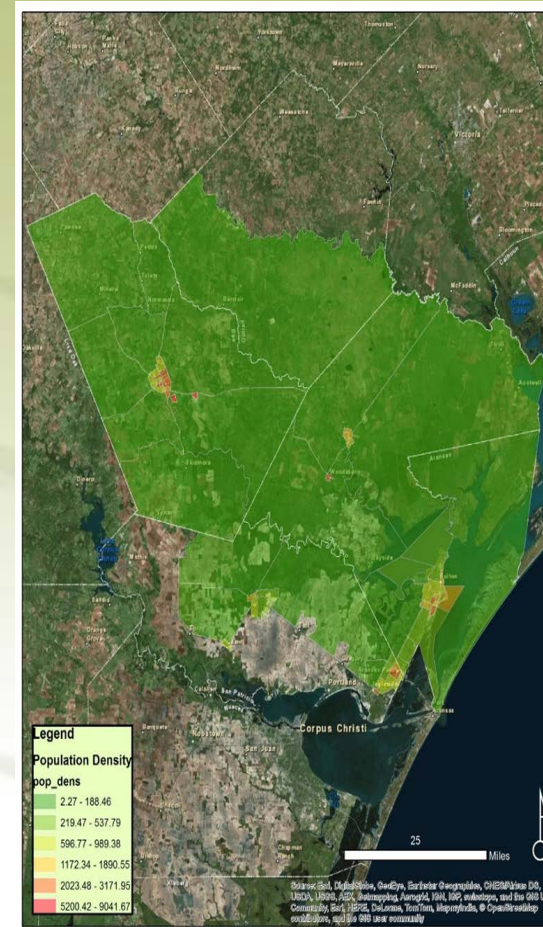
The reserves performed the actions listed here to collect the data that would inform game designs.



## What We Found:

### Future Growth and Land Use Computer Modeling

- Population increases will result in higher residential water use, fewer acres of cultivated cropland, and less water used for irrigation. The extent of these changes will depend on future precipitation levels and water conservation efforts.
- Future freshwater runoff patterns will be more affected by precipitation amounts and patterns than by land use changes.



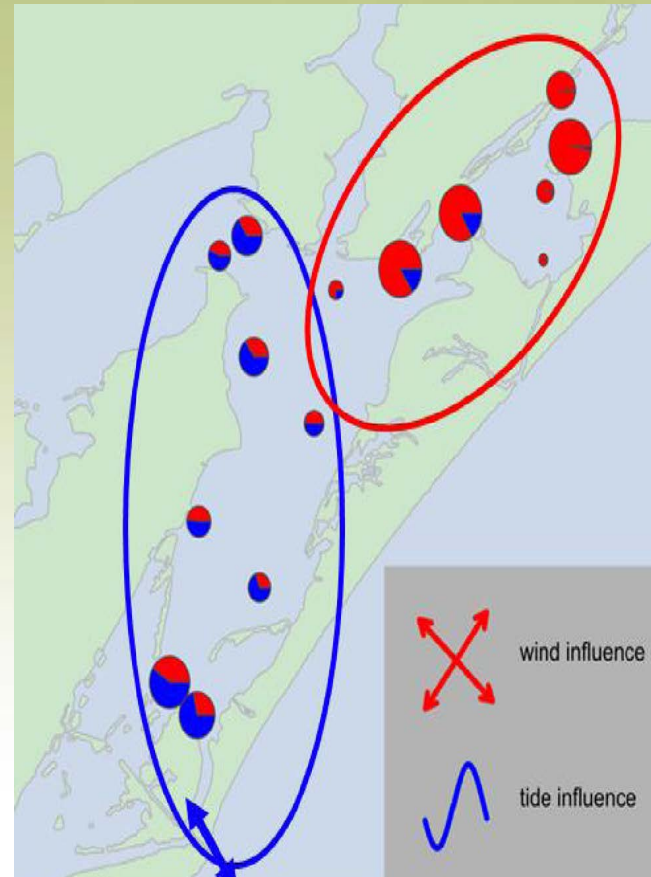
Human population density within the Reserve boundary.



## What We Found:

### Water Circulation Monitoring

- Water exchange between the estuary and neighboring systems is strongly influenced by wind direction.
- Field measurements correspond well with the current pattern predicted by a circulation model used by the State for approximating salinity patterns in the estuary.



Pie charts indicating the influence of tides (blue) and wind (red) on current speed and direction at monitoring stations.





## What We Found:

### Blue Crab Larvae Experiments

- Blue crab larvae from Texas are able to detect smaller tidal changes in salinity than larvae from the Atlantic Coast, which could help them better find their way into the estuary based on salinity cues.

### Blue Crab Computer Modeling

- The computer model interface allows the settings to be adjusted so that countless different factors and scenarios can be explored to better understand the effect of future salinity patterns on blue crab population dynamics.



Larval blue crab from study.



## Summary Points:

# Guana Tolomato Matanzas NERR

**Name of Grant:** Re- Engineering living shorelines to halt erosion and restore coastal habitat functioning in high- energy environments.

## Proposed Solutions

- Partnered with University of Florida to copy what nature does best and install multiple living shorelines
- Reduce wave energy caused by boat wake from reaching the shore
- Slow down the shoreline from wearing away
- Restore oyster reefs using recycled oyster shell
- Repair natural processes that could have been lost

## What we're doing

- Develop profiles of wave/wake energy
- Develop and place gabions positioned behind wave breaks
- Final year will fine tune the gabions to optimize ability to stabilize salt marshes and restore reefs at different energy levels



Maggie then gave background information on the goals identified in the GTM reserve grant, identifying two major focus areas:

1. Examining the effects of non-natural infrastructure on shorelines; and
2. Exploring the ability of natural structures to reduce shoreline erosion.

The students received a brief overview of traditional methods used to repair and protect shorelines, including bulkheads and concrete seawalls, but were also introduced to some living shoreline techniques such as the use of offshore oyster gabions to reduce wave energy.



# Problem

## Bulkheads and Concrete Seawalls



Increase coastal erosion



Decrease the shoreline's ability to do what it does best



Decrease habitat for estuarine species

### Summary Points:

Reserves provided students with examples of how human activity may negatively impact coastal habitat and shoreline integrity. Students incorporated this information into their work to give an accurate portrayal of the simulated environment.

# Oyster Gabions

Summary Points:

Copy nature, restore  
functioning



## Summary Points:

The Delaware reserve grant focuses on taking system wide monitoring program (SWMP) data for water quality and weather, and synthesizing them in a way that is useful to others.

# Delaware NERR

**Name of Grant:** Expanding the Use and Value of System- Wide Monitoring Program Data by Prioritizing Questions, Targeting Products, and Building Capacity within the National Estuarine Research Reserve System

What we're doing:

Conduct a NERRS- wide, SWMP- related needs assessment  
Create a purposeful, collaborative approach to engage all sectors of the NERRS in the development of useful and accessible SWMP- based data products, that in turn reflect the diverse needs of the external audiences with whom the NERRS interacts.



## Proposed linkages....

- Water dynamics influence the biological diversity found in a location but also the physical characteristics of a habitat.
- By adapting and mitigating our estuaries to incorporate development we are creating a resilient estuary that can serve our communities.
- SWMP is the tool used to determine whether we're doing what we need to be doing.

## Summary Points:

**Proposed linkages:** Key concepts and lessons - common to the participating reserves - upon which Maggie's team asked the students to reflect while designing the interactive games.



## Summary Points:

The students received minimal restrictions from Maggie's team, but they were required to learn about the estuaries and animals they incorporated into the games.

The students' curriculum and midterm examinations contained estuary-related material to ensure that they dedicated sufficient time to learning core concepts, and they were also required to complete a Teacher's on the Estuary (TOTE) module and provide proof of completion to their instructor.

# The Reserve partner expectations

- Must incorporate SWMP (System - Wide Monitoring Program)
  - Maybe as a reference point
- Utilize an animal as the variable
  - The animal is the "customer" to please
- Students will need to dedicate time to understand their animal and the influences on that animal.
- Animals List: Animals specific to the participating reserves (e.g. Horseshoe crab, Eastern oyster, Blue crab)
- Video - YouTube
- Storyboard - Google Drawing
- Complete TOTE Module: Where River Meets the Sea - <http://tinyurl.com/totemodules-ver8>



# Beta Games Fall 2016

- Estuary Adventure
- Crabby Quest
- SWMP ROMP



## Summary Points:

### Estuary Adventure

Users move a blue crab through a maze to show how blue crabs move up an estuary based on salinity. Another piece of the game was an homage to horseshoe crab spawning surveys. And the third component illustrated how oyster gabions and bulkheads affected wave damage to shorelines.

### Crabby Quest

Users move a crab to show how crabs move up estuary based on freshwater-salinity gradient, but in a less structured side-scroller setting. Another component let the users collect oysters to build gabions and remove trash from the shoreline.

### SWMP ROMP

Users incorporated resilience elements to defend against a storm event.





# Project Timeline

## Fall 2016

- Introduction presentation to course
- First round of Beta games tested

## Spring 2017

- Refined games from fall course
- Second round of Beta games tested

## Summary Points:

Maggie's team used these beta games, and the feedback collected from other Education Coordinators, to inform the direction of their final products.



## Summary Points:

Teachers on the Estuary: Where River Meets the Sea

# The Reserve partner expectations

- Complete the Teacher's on the Estuary online module called "Where River Meets the Sea". Make sure to save your exam certificate at the end for evidence of completing the module.  
<https://goo.gl/ytJmDY>
- Students will need to dedicate time to...
  - Research Estuary Adventure Game
  - Go through the following slides and understand what the client is asking for. If you are unclear of anything it is your responsibility to email as soon as possible.
- Create a video of your game - YouTube
- Storyboard - Google Drawing



# Client Guidelines

- Must be 3 mini games
- Each game should be able to be played within 2 minutes
- Improve upon Estuary Adventure's mini games 1 and 3
- Themes for each mini game are as follows:
  - Mini Game One - We Are Places
  - Mini Game Two - We Are People
  - Mini Game Three - We Are Connected

## Summary Points:

Maggie's team also used the first-round beta test feedback to help develop new guidelines for the students -- shown to the left -- and also provided focal themes for the students to emphasize, which were based on the Reserve system slogan.



# Mini Game One

- We like the concept of the blue crab navigating the maze based on salinity levels. We'd like this to tell a short story and have the "salinity," the "blue crab," and the "reasoning of the maze" to be variables that can be adjusted based on the location the game is being played at. We would ideally like you to use our SWMP (swamp) visualization to guide your "parameter gauge".
- This larval blue crab hatched in the ocean (where there is more salt in the water). It must make its way into the estuary (where there is still salt in the water, but not as much because the estuary usually has freshwater input from rivers) so that it can grow big and strong.
  - Added obstructions...
    - There might be a drought which reduced freshwater inflow and might provide confusion to the Blue Crab's navigation.
    - Might be freshwater removed for a new city being built, which reduces freshwater input into the estuary which might confuse the blue crab's navigation.
- [Click here for additional stories](#)

## Summary Points:

Students received refined instructions and feedback, emphasizing that the following elements should be based on scientific observation:

- The playable animals' interaction with the game environment;
- The narrative for the in-game instructions; and
- Obstructions encountered by the playable animal.

Notably, Maggie's team and the students replicated this process for multiple animals so that the games could be customized to reflect reserve-specific content.



# Mini Game Two

- We like the concept for Mini Game Two to be the 3rd game of Fall 2016's Estuary Adventure (crab building sea walls and oyster gabions). We'd like there to be improvements on the types of boats producing different types of wakes. There wasn't much evidence demonstrating the difference between sea walls and gabions. We'd like to add the component of replanting habitats with smooth cordgrass as an additional support.
  - Things to keep in mind...
    - If you plant the smooth cordgrass further in the water (than where you put the sea wall) the grass will not be able to expand.
    - If you plant it too deep, it will die.
    - If you plant it too dry, it will die.
    - There are rules to not making one long line of barriers because aquatic animals could get trapped and die if they aren't able to escape (ie., manatees, sea turtles, horseshoe crabs).
- The Story line... The shoreline is eroding due to increased human use around the estuary. More specifically, more boat traffic along these shores.



# Mini Game Three

- We'd like this game be an estuary version of <https://www.storycubes.com/>.
- Essentially, you'd ask the participant to frame their story about...
  - What's the issue?
  - What do they think are things they can do to help?
- They would push or do a motion that would shake the die. The die would layout in no particular order. The participant would be asked to drag the die into a particular order and as they were doing so would tell a story. Their imagination is what guides the story. Hopefully, they've played the previous games so that might guide their stories a little, but ultimately this game could potentially stand on its own (as could the others).



# Project Timeline

## Fall 2016

- Introduction presentation to course
- First round of Beta games tested

## Spring 2017

- Refined games from fall course
- Second round of Beta games tested

## Summer 2017

- Two computer engineering student interns hired to turn Beta games into Alpha games
- One art student intern hired to create graphics

- ## Fall 2017 –
- Games installed at three centers for
- 

## Summary Points:

The initial revised timeline called for installation in fall 2017, with testing the following spring; this did not go as planned, as the interns were not able to create a usable product, so the team was forced to change directions.



# Poll Question 4: Do you have ideas for science stories that could become games?

- Yes
- Maybe
- No; at least not yet

## Summary Points:

Results:

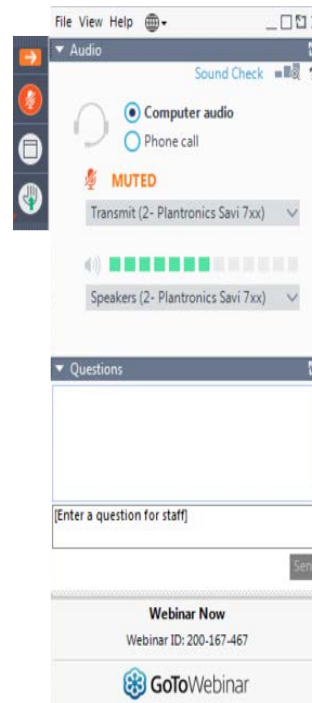
- Yes (0%)
- Maybe (45%)
- No, at least not yet (55%)





# Break: Question and Answer

- Use the “Raise Hand” feature on the GoToWebinar console
- Submit your questions through the “Questions” box



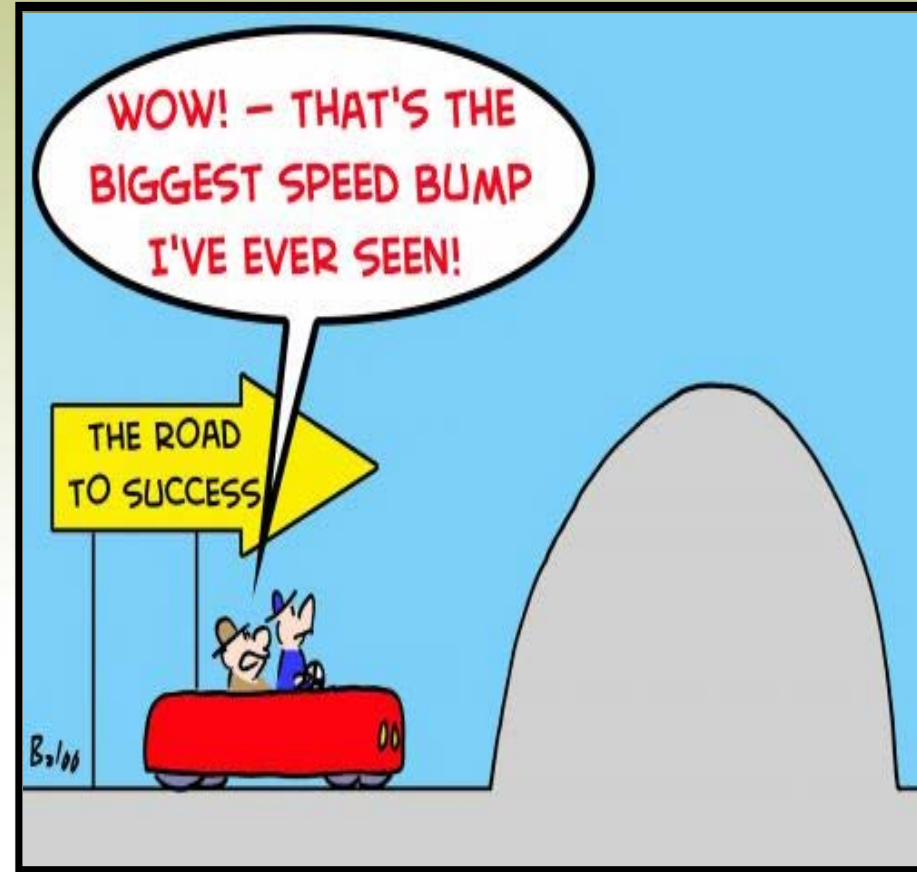
## Questions:

**Have you had any students K-6th grade play these games yet?**

Co-workers' children have played it. We were unable to install the games as originally intended, but the children that did play it enjoyed it. Most testing to date has been done with adults and educators to ensure that information is correct and being conveyed effectively. GTM has these installed in their visitor centers and have had visiting students play their games.

# Speedbumps

- Student interns hired summer 2017 unable to complete the games
- Games that were provided could not be easily transferred to partner Reserves to try and test
- Interactive screens not purchased or delivered until November 2017
- Had to break contract with University of Delaware



## Summary Points:

The summer interns never finished the games or responded to communications after the first meeting.

When the team did eventually receive games in October 2017, there were technical issues with downloading the games to computers and running them as executable files.

Maggie's team was eventually forced to break the contract in December 2017 in order to complete the games.



# Items Purchased



## Touch Screens

- Ideum Presenter Touch Screens 43 inch
- Smartlift Mobile Stand

## Presenter Software

- Intuilab/Intuiface Player
- Google Slides



# Project Timeline

## Fall 2016

- Introduction presentation to course
- First round of Beta games tested

## Spring 2017

- Refined games from fall course
- Second round of Beta games tested

## Summer 2017

- Two computer engineering student interns hired to turn Beta games into Alpha games
- One art student intern hired to create graphics

Fall 2017 – Updated timeline and contracts

## Spring 2018

- Worked with students at University of North Florida to get games running on screens
- Installed current game versions at visitor centers

## Summary Points:

The Delaware and GTM reserve installed interactive displays in Spring 2018, and teams have been collecting feedback.

As of March 2019, Mission-Aransas has not collected feedback as interactive displays were not installed due to damage dealt to the visitor center by Hurricane Harvey.



## Summary Points:

Final versions of the games installed at visitor centers.  
Click [here](#) to watch the overview video on the Science Collaborative YouTube channel.



[30 Second Teaser Video](#)



# Project Timeline

## Fall 2016

- Introduction presentation to course
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## Spring 2017

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## Summer 2017

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**Fall 2017** – Updated timeline and contracts

## Spring 2018

- Worked with students at University of North Florida to get games running on screens
- Installed current game versions at visitor centers

## Summer 2018

- Did nationwide search for college interns to complete the games
- Hired three interns



## Summary Points:

Maggie's team revised the guidance given to student interns to consist of four distinct outputs. The contract agreed upon by the students explicitly stated that they would not be paid until the four defined outputs were completed to the team's specifications.

# Summer Interns 2018

## The interns four outputs to complete:

- 1) Review the current projects, compile a list of modifications to be made with descriptions of why those modifications should be made. Provide a vision of what the updated product would look like.
- 2) Provide a rough draft of the modified interactions.
- 3) Provide completed interactions.
- 4) The games will have some modifiable content (e.g. quiz questions and answers, photos). Provide a brief screen capture video showing how to edit the content. Additionally, provide a brief screen capture video showing how to install the game on a computer and run it.



# Project Timeline

## August 2018

- Final games completed and installed at all three Reserve Centers.

## September – December 2018

- Testing computer games and getting additional feedback from users.

## Future Plans

- Updating and fixing any additional issues in the games as funding allows
- Dissemination to the other 26 Reserves nationwide



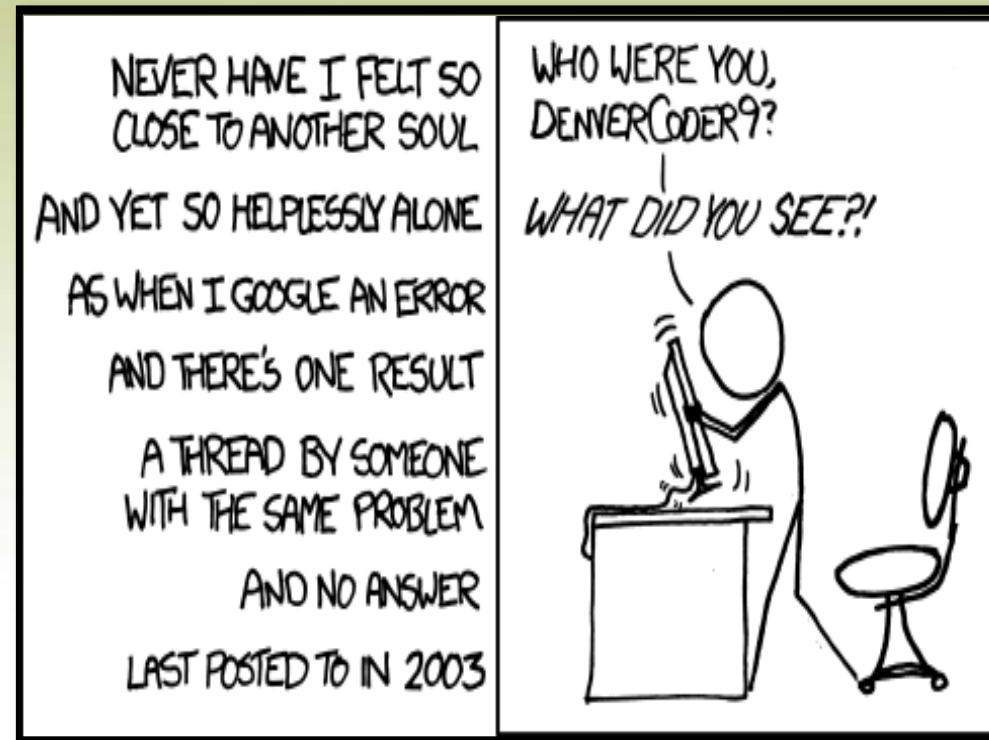


## Summary Points:

Students gained real-world experience receiving constructive criticism, working toward client needs, public speaking, and developing software.

# Lessons Learned

- Must be explicitly clear in expectations to students
- Better to pay students based on results, rather than hours worked
- May have been a too tight of a deadline
- How to troubleshoot java programs!



# Funding Source

This work is/was sponsored by the National Estuarine Research Reserve System Science Collaborative, which supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is funded by the National Oceanic and Atmospheric Administration and managed by the University of Michigan Water Center (NAI4NOS4190145).

# Additional Partners



# Poll Question 5: What would be the biggest hurdles for your organization to use these kinds of games?

- The technology is intimidating
- The displays are likely too expensive
- I'm not sure our audience would engage with games
- We'd want to customize the games and not sure we could find the right assistance
- We are already using interactive displays and games!

## Summary Points:

Maggie responds to polling results and gives recommendations.

### **The displays are likely too expensive (18%)**

Recommendations: Try playing them on a laptop if the interactive displays are too expensive to be purchased alone or as part of a grant. All of the games were designed to be played on a laptop, and are optimized to run smoothly.

### **I'm not sure our audience would engage with games (27%)**

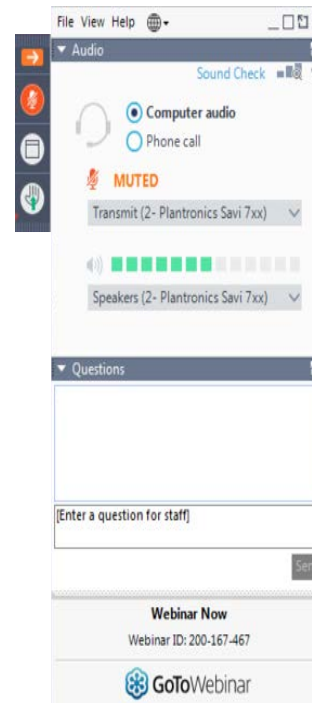
Recommendations: Try taking games to public events on a laptop to give people a chance to play them. Most of the time, visitors are only playing on the interactive display at the visitor centers.

### **Not sure we could find assistance customizing the games (55%)**

Recommendations: Try working with local universities, community colleges, and internships to find help customizing games and projects.

# Question and Answer

- Use the “Raise Hand” feature on the GoToWebinar console
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## Questions:

### **What’s next for this?**

I’m still partnering with the University of Delaware, so I’m still looking to keep that relationship open even if I don’t have opportunities to provide internships to students. We also hope to share this far and wide. Please contact the Science Collaborative at [neres-info@umich.edu](mailto:neres-info@umich.edu) if you would like to use these games in your lessons or reserves.

### **Do you have any tips for anyone who might be balancing a grant project with other responsibilities? Finding the right projects?**

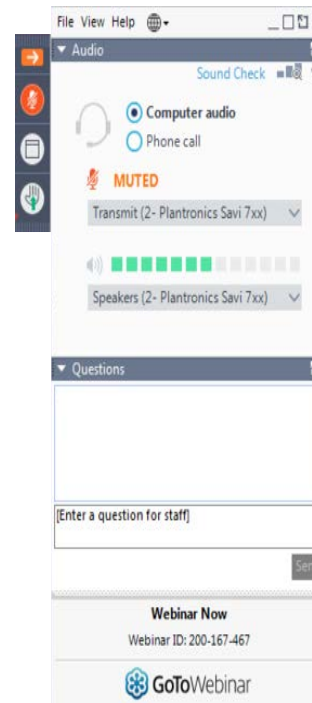
I had already started developing a working relationship with a professor and had this project in mind, so I had already tested if the project would work prior to applying for a grant. To me, it was very helpful to have a project in motion; I recommend that you take a project you are already passionate about and find a way to advance that with your work. When writing the initial proposal, it also makes sense to define clear roles -- for each team member -- that pertain to specific aspects of the project.

### **What would you say was your biggest takeaway from this experience?**

The main one is probably that you have to be explicitly clear with expectations for the students at the start of the project, including concrete deadlines.

# Question and Answer

- Use the “Raise Hand” feature on the GoToWebinar console
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## Questions:

**What other topics do you see being turned into a game?**

Last semester we did “careers in the reserve,” so students had to make individual games that highlighted education, stewardship and management, and research. The games turned out really nicely; for example, the education one had players create a brochure by putting things in order of information.

Other projects in development focus on:

- Bird migration, feeding habits, and reproduction; and
- Marine debris and the issues surrounding it.

**Are you thinking of evaluating the games in terms of learning main concepts?**

That was an original goal, but we’re aware that doing a proper evaluation requires a lot of work. On the back-end of the storycubes game, it saves the entry choices and order chosen, so we can see that information. We had wanted to be able to record the students reading or writing their stories as a sort of informal evaluation for how they connect pieces, but we ran into liability issues with recording voices.

Another thought was to give a short evaluation after users play the game, but that would also require personnel to assist with that process.