

COLLABORATIVE SCIENCE FOR ESTUARIES

WEBINAR SERIES

Summary Points:

Dr. Lydia Olander directs the Ecosystem Services Program at the Nicholas Institute for Environmental Policy Solutions at Duke University. She leads the National Ecosystem Services Partnership, supporting efforts to integrate ecosystem services into decision making. She also studies environmental markets, such as water quality trading, and mitigation, including wetland, stream and endangered species, forestry and agricultural based climate mitigation.

Sara Mason joined the Ecosystem Services Program at the Nicholas Institute for Environmental Policy Solutions as a policy associate after graduating from Duke with a master's degree in environmental management. Her work focuses on the interdisciplinary nature of biodiversity conservation and how that can be leveraged to engage the public and policy makers in conservation efforts. Prior to joining the Nicholas Institute, Sara worked in ecological field research and endangered animal rehabilitation.



Lydia Olander

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Exploring Applications of Ecosystem Service Conceptual Models for Coastal Habitats



National Estuarine
Research Reserve System
Science Collaborative

Date: Wednesday, June 26, 2019

Time: 3.00 - 4.00 PM (EST)

Summary Points:

The webinar began with Lydia posing a background poll question to the audience to gauge familiarity with ecosystem services.



Exploring Applications of Ecosystem Services Conceptual Models for Coastal Habitats

LYDIA OLANDER AND SARA MASON

NERRS SCIENCE COLLABORATIVE

JUNE 26, 2019





NICHOLAS INSTITUTE

Linking academic knowledge and decision makers to solve environmental challenges

ECOSYSTEM SERVICES PROGRAM

Integrating Ecosystem Services into public and private decision making through improving methods, incentives and markets

NATIONAL ECOSYSTEM SERVICES PARTNERSHIP (NESP)

Engages both public and private individuals and organizations to enhance collaboration within the ecosystem services community and to strengthen coordination of policy, market implementation, and research at the national level

Summary Points:

Terminology:

- **Ecosystem Services:** The benefits that nature provides to people, going beyond what people usually think about in terms of ecological outcomes; e.g., thinking about effects on human well-being that come from nature.



What is NESP?

- Community of Practice
- Quarterly newsletter
- Webinars
- FRMES Online guidebook
- Best Practice Guidance & Workshops
- Engaged Expert Network

Summary Points:

[Federal Resource Management and Ecosystem Services \(FRMES\) Guidebook](#)

[Learn more about NESP](#)





Summary Points:

NESP Goals

- Create a national network for sharing ecosystem services information
- Establish pathways for *implementation* of ecosystem services concepts
- Integrate ecosystem services information into decision-making
- Create ecosystem services frameworks that are standardized, intuitive, and credible

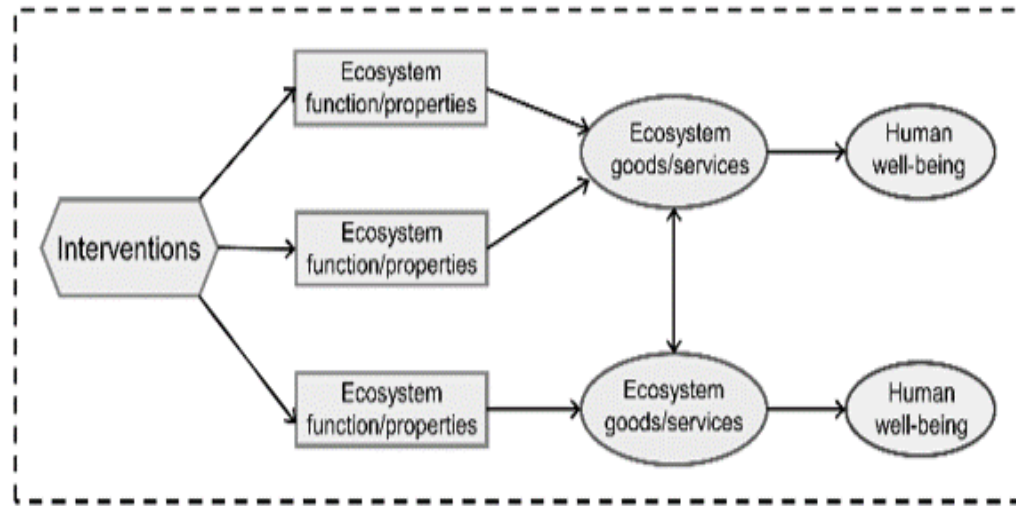
Ecosystem Services Conceptual Models (ESCMs)

Summary Points:

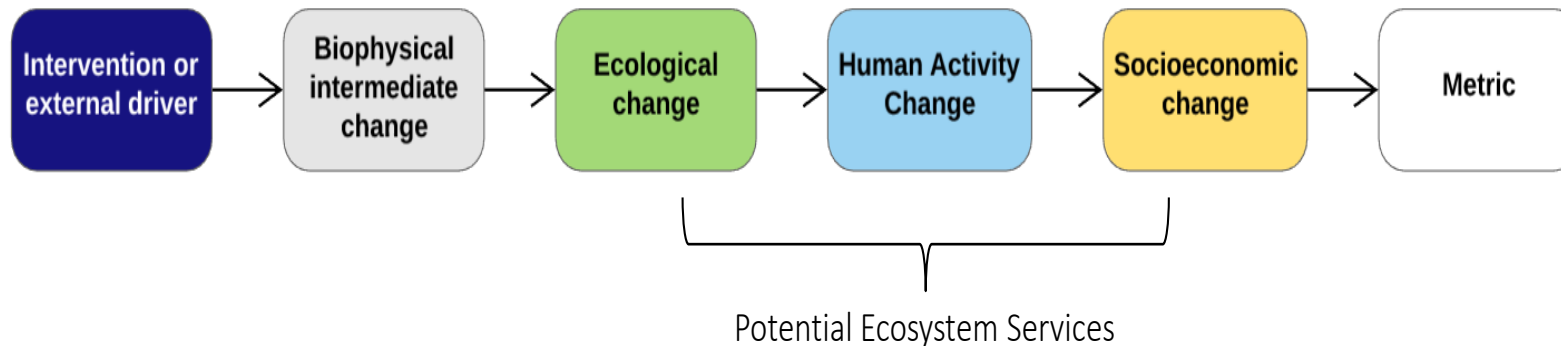
One of the approaches that Lydia and Sara tested through NESP is the use of ESCMs as a way to easily and consistently organize and share information regarding ecosystem services specific to a particular habitat, ecosystem, or management approach.



What do we mean by Ecosystem Service Conceptual Model?



Conceptual models connect an action or intervention to the resulting changes in the biophysical and social systems to outcomes that matter to people.



Summary Points:

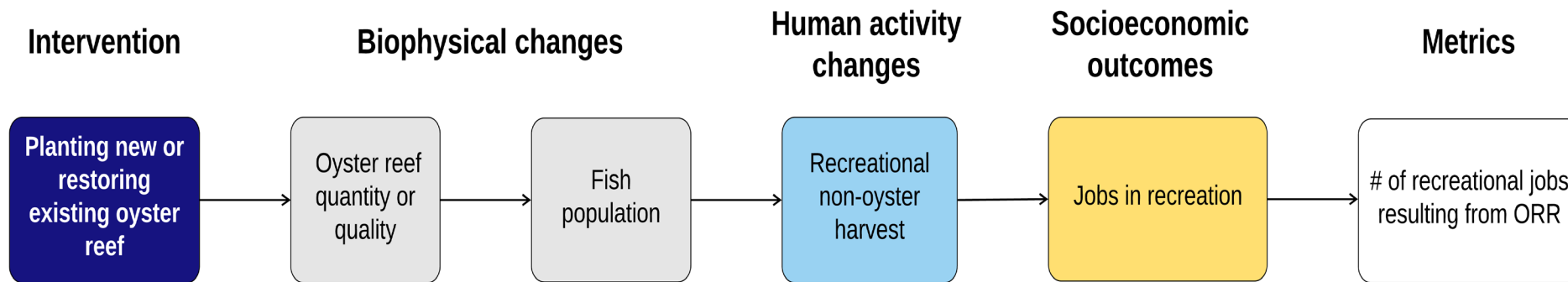
The top model shows how a conservation strategy or management action moves through a system, resulting in a physical environmental change which in turn has an effect on ecosystem services; these impacts on human well-being can be positive or negative changes. Interventions can also have direct impacts on people, such as job creation or educational programs.

The bottom pathway shows a detailed breakdown of a model's structure. Ultimately, the goal is to develop metrics that capture changes in human well-being.

Note: Ecosystem services are the connection between ecological and socio-economic changes.

Summary Points:

Example Model Content: Oyster Reef Restoration Chain



What can ESCMs do?

- Be **adapted** to different contexts
- Act as a foundation for socio-ecological **systems thinking**
- Act as a pathway for **consistency** in ecosystem service assessment
- Become an **evidence framework**
 - General **evidence library** and **strength of evidence map**
- Jumpstart **metric selection**
 - Establish a common set of associated **socio-ecological indicators** (BRIs) for standardized monitoring and comparison of ES outcomes across sites
- Identify **services and beneficiary groups**
- Create a foundation for **quantification and valuation**



Summary Points:

- **Adaptable:** Generic models can be adapted to different decision contexts with relative ease.
- **Systems thinking tools:** ESCMs bring stakeholders and experts together with transparent and logical models, helping people think beyond ecological outcomes and focus on what people care about. ESCMs also help incorporate non-target outcomes as well as target outcomes, including co-benefits.
- **Consistency:** Using consistent ESCMs can allow for comparisons across projects, management types, locations, and outcomes. Ecosystem services tend to be context-specific because they are unique to the specific communities, groups, or stakeholders who receive benefits from a particular ecosystem.
- **Evidence framework:** Developing a framework for evidence allows users to determine where gaps exist in monitoring or research.
- **Identify services and beneficiaries:** Extending these models to ecosystem services and social outcomes enables mapping of how different groups will be impacted by ecological changes.
- **Quantification and valuation:** The network model - extending to what people care about - is what economists need to perform accurate valuations. Network models are also useful for developing quantitative predictive models, such as Bayesian network models.

NESP, NOAA, and NERRS



Summary Points:

NESP has been testing ecosystem service ideas to put them into practice. A conversation with NOAA directed the team to the NERRS because:

- NERRS is an existing network that already thinks about standardization across reserves;
- The 2017-2022 strategic plan called for increased focus on ES; and
- There is growing interest and momentum in the reserve system for socio-economic monitoring.

How could this be implemented within the NERRS? Our Proposal:

Develop a new resource for NERRS based on the major habitats they manage.

A set of **evidence-based ecosystem service conceptual models** that have an associated set of **suggested social and economic metrics**, that can be adapted and specified to local contexts.

Summary Points:

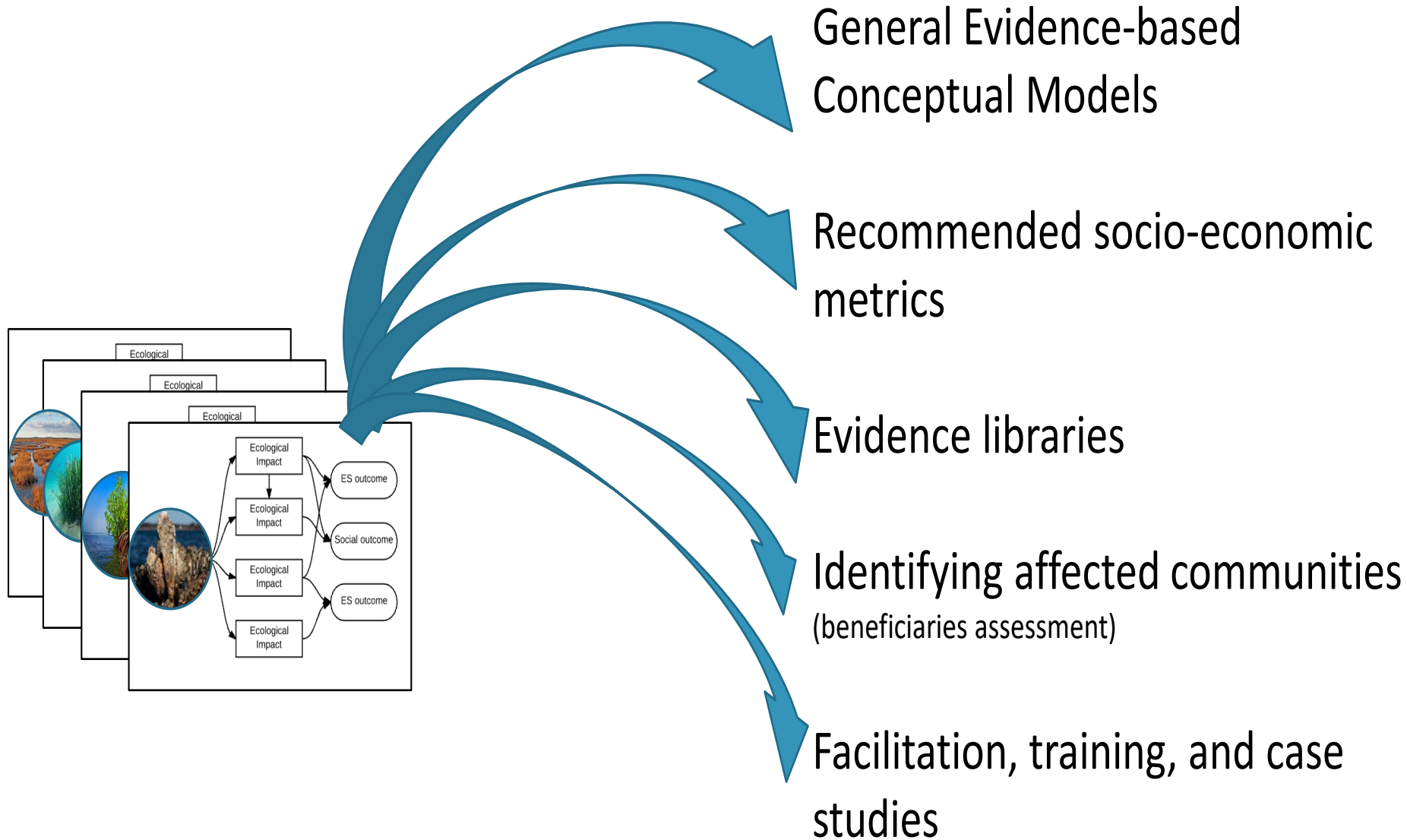
With a consistent framework from which to build, cross-comparisons will be easier and more efficient, which is valuable to the NERRS and their partners performing site restorations.

General Models



The types of resources:

Summary Points:



Year 1 Efforts: Salt Marsh Restoration



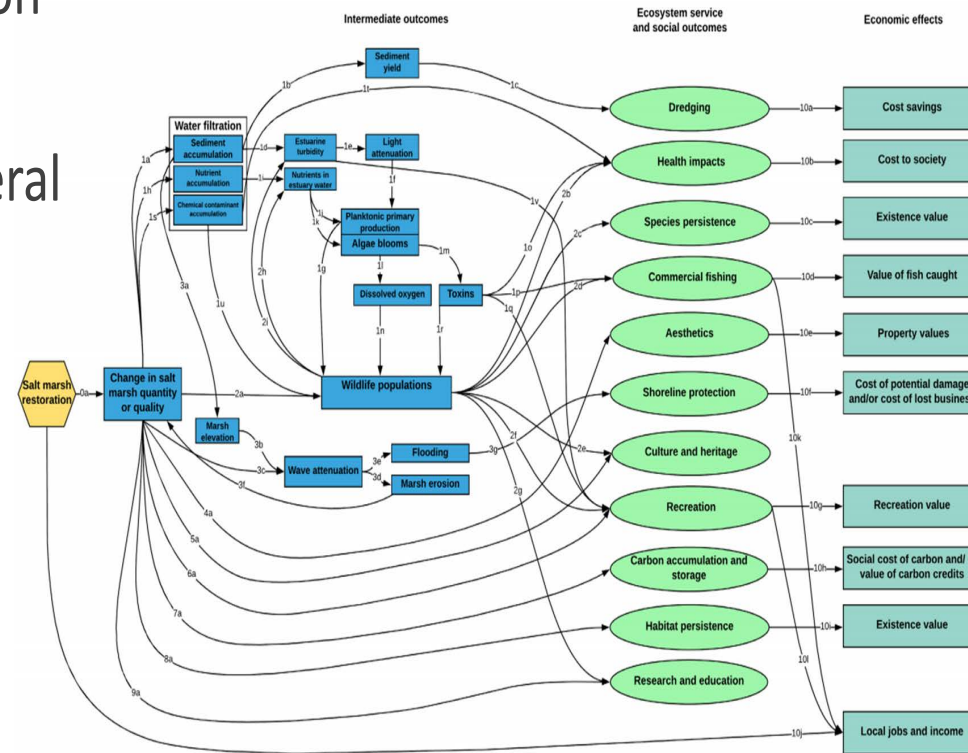
Built a general salt marsh ESCM

Specified the model to two NERR restoration examples to test how well that worked

Developed an evidence library for the general model (Identified research gaps)

Built a quantitative Bayesian network prediction model based on the ESCM

Question: Is this approach scalable and adaptable to specific contexts?



Summary Points:

In their first year, the team conducted a pilot project with NOAA to see if using ESCMs in the NERRS context was possible and useful. The team decided to build a model specific to salt marshes, a common habitat across NERR sites, and accomplished the following:

- Built a general salt marsh ESCM, as shown on the slide;
- Specified the model to multiple NERR contexts;
- Developed an evidence library and assessed evidence gaps; and
- Built a quantitative Bayesian network model to test how these conceptual frameworks could be adapted to quantitative models.

The team then reflected upon two questions: a) how could we start to scale this; and b) how could we test it with more habitats and more NERRS and start to generate momentum around it?

Gulf Research Program NAS project

Year 1 : Oyster Reef
Restoration

Year 2: Everything else



Gulf of Mexico Ecosystem Services Logic Models & Socio-economic Indicators (**GEMS**)

Approach:

Develop a set of **evidence-based common conceptual models** that follow through to social and economic outcomes, and a tractable set of **socio-economic metrics** that are relevant across projects, programs, and locations that can facilitate effective project planning, evaluation, and comparison.

This will allow funders and project planners/mangers to:

- Compare restoration approaches across a broader suite of shared goals
- Identify uncertainties and gaps in knowledge about social and economic outcomes
- Track performance toward social and economic goals

<https://nicholasinstitute.duke.edu/focal-areas/gems>

Summary Points:

For additional context, a related ongoing project using ESCMs.

There is no common assessment and reporting system for socio-economic outcomes of the major restoration efforts across the gulf, but there are goals related to community resilience and economic revitalization linked to the money being distributed; the GEMS approach, shown on the slide, is using ESCMs as a foundation to try and address this issue.

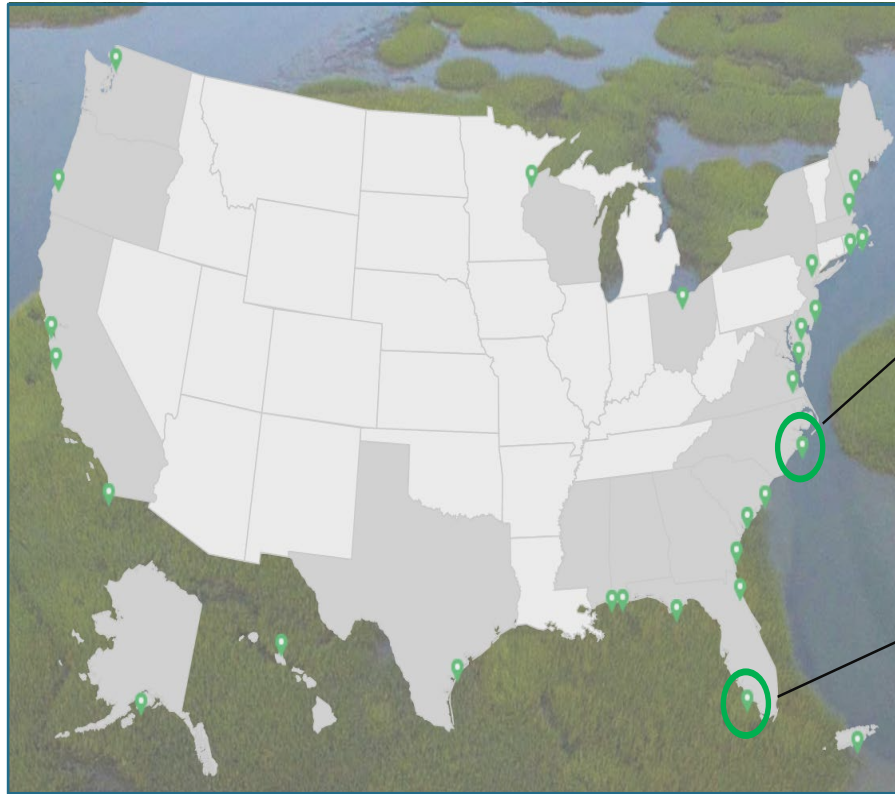
The first year of the GEMS project focused on oyster reef restoration, which provided a valuable comparison to Lydia and Sara's work with the NERRS and enabled synergy between both projects.

<https://nicholasinstitute.duke.edu/focal-areas/gems>

Current Science Collaborative Catalyst Project

Further testing of the usefulness of ESCMs at 2 NERR sites using different habitat types:

- North Carolina NERR: Oyster Reefs
- Rookery Bay NERR: Mangroves



Summary Points:

This project is continuing to test the idea that ESCMs can be a foundation for integration of ecosystem services into decisions. The project focuses on two NERRS sites to develop additional habitat-based general models and examine associated applications.

Project Approach



- Workshops
 - To develop models
 - To brainstorm socio-economic metrics
- Refine models through expert interviews
 - Ecosystem experts
 - “Social” experts
- Assess feasibility and applicability of metrics generated at workshops
- Generate education and outreach materials related to our products

Summary Points:

The project started with workshops to develop habitat-based ESCMs and brainstorm socio-economic metrics that measure outcomes, followed by refining the models through expert interviews to capture nuances and ensure proper understanding of the biophysical, ecological and social outcomes that people valued.

Experts fell into two categories: Ecosystem or social. Ecosystem experts describes practitioners and researchers studying the habitats on which the team focused, whereas social experts describes people at the interconnection among nature, the environment, and socio-economic outcomes, such as ecotourism guides, local fishing guides, and the local seafood industry.

Project Outputs

- 1) ESCM workshop process and facilitation guide
- 2) New general habitat models
- 3) Socio-economic metrics
- 4) Education and outreach materials
- 5) Evidence libraries



Summary Points:

Note: Evidence libraries have not been created for this project, but Sara and Lydia are, at the time of this webinar, assessing demand. As of June 2019, the team is prepared to create evidence libraries for mangrove forests and oyster reefs.

1. ESCM Workshop Process and Facilitation Guide

Summary Points:

The project team's first output is the ESCM Workshop Process and Facilitation Guide, which documents the workshop process and enables other organizations to develop specified models within the context of a target site.

The two participating reserves indicated that the process of hosting and taking part in a workshop to develop these models and think about possible socio-economic metrics was a valuable experience for both NERR staff and partners in attendance. Both reserves found that the model building process promoted more intentional thinking about ecosystem services at their reserves and increased their ability to think about the socio-ecological system more holistically. This was important for identifying gaps in knowledge, starting to normalize ecosystem services thinking across different stakeholders, as well as contemplating how NERR management decisions affect different stakeholder groups.



2. General Habitat Models

Model Building Process:

- Come to workshops with a rough draft
- Use workshop to edit and improve the draft model
- Show the model to habitat experts for further feedback
- Interview 'social' experts to make sure all nuance has been captured



- General oyster reef restoration model for NC



- General mangrove model for FL
- Specified mangrove model for the Fruit Farm Creek Restoration site

Summary Points:

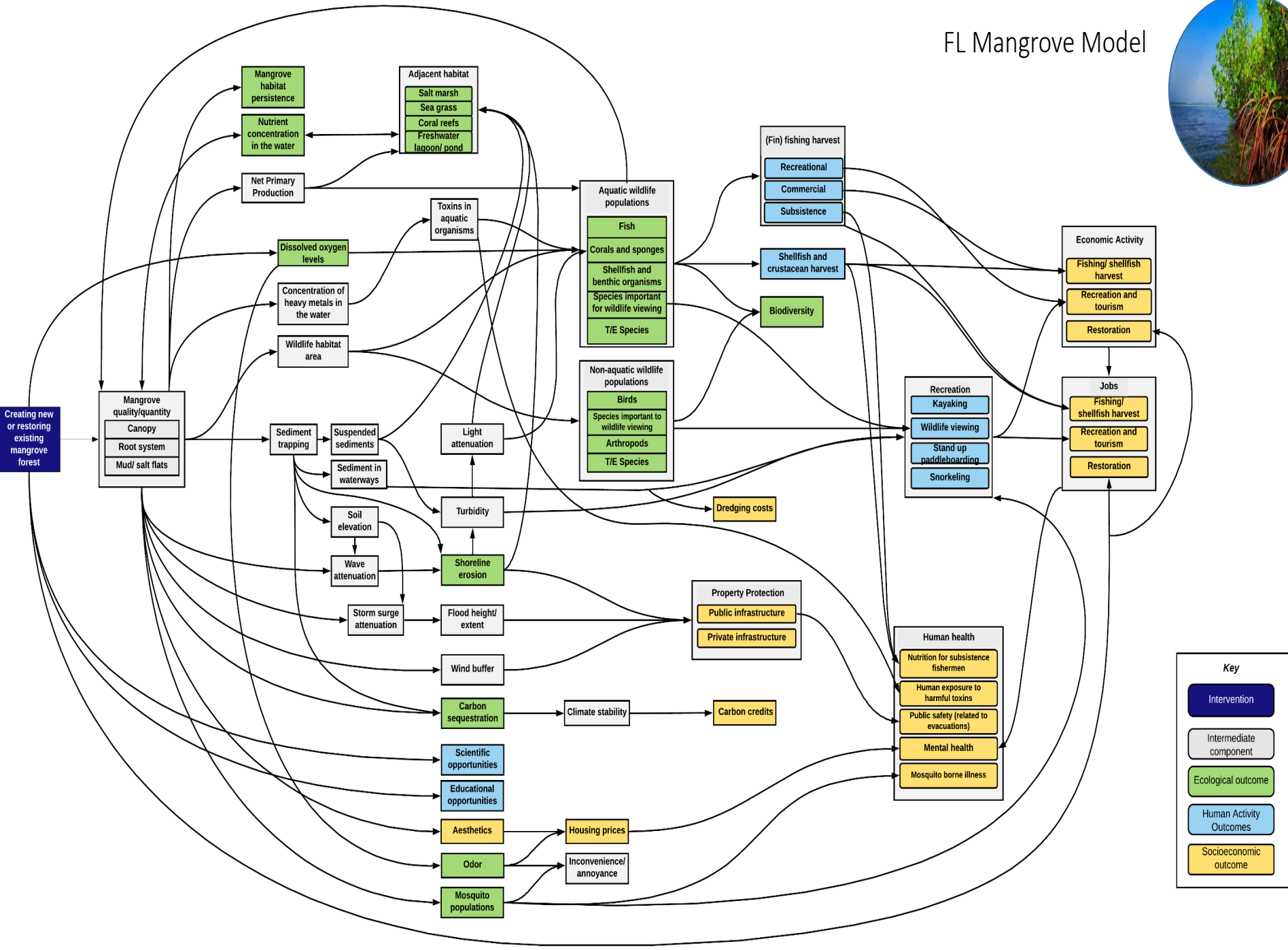
The second set of outputs from the project is a collection of ESCMs for the habitats the team explored. The model building process yielded three different conceptual models, as shown on the slide.

FL Mangrove Model



Summary Points:

The Florida mangrove model contains many of the same elements as the North Carolina oyster reef model.



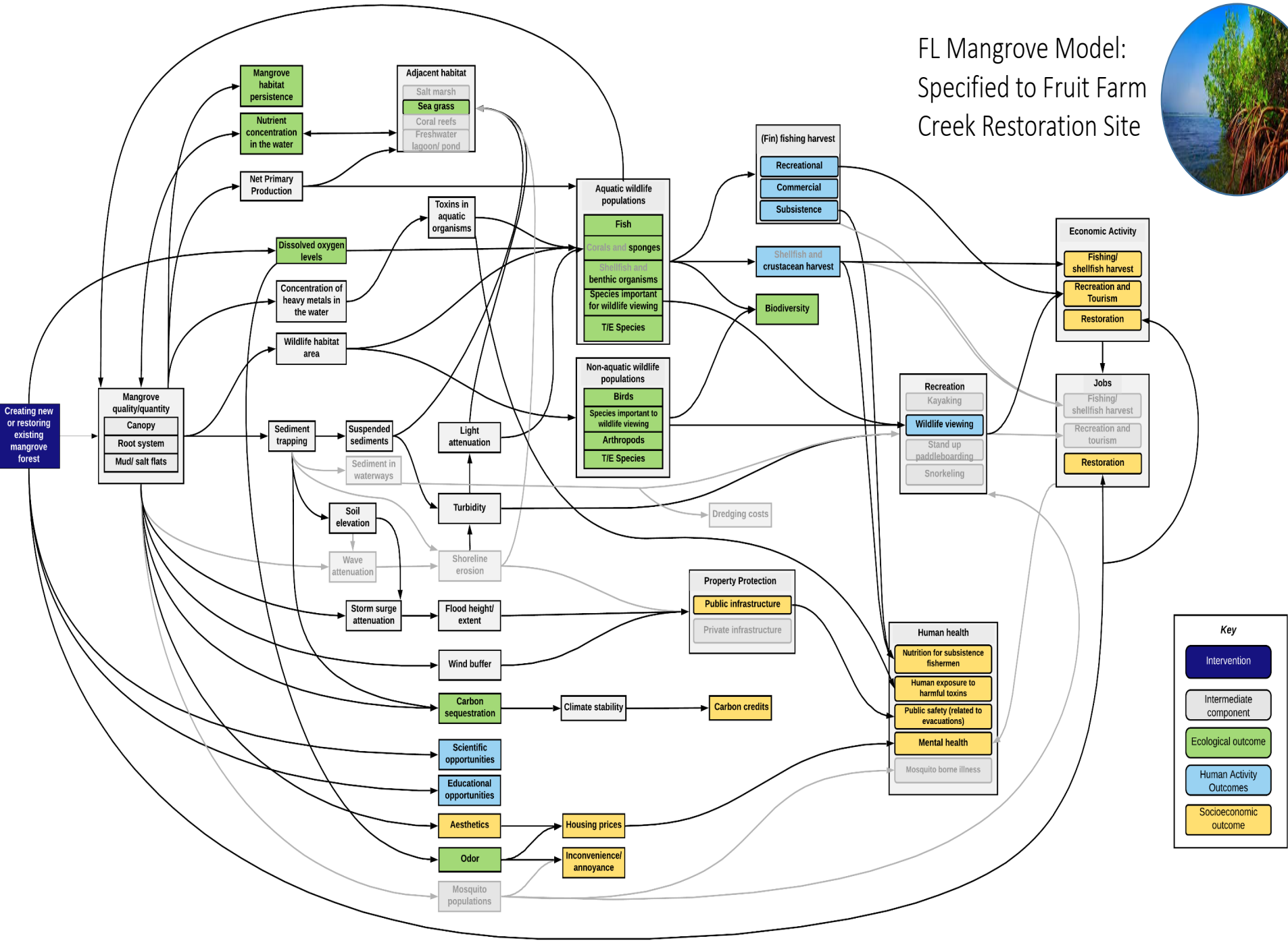
FL Mangrove Model:
Specified to Fruit Farm
Creek Restoration Site



Summary Points:

This example shows a revised version of the Florida mangrove model, specified to a site called Fruit Farm Creek - which is made up of 225 acres of dead and dying mangroves, and requires a connection to the surrounding hydrology for restoration. Parts of the model are shown in grey to indicate that they are not relevant at this site.

The team also developed a worksheet that delved into further details about some of the elements in this model, such as who would be affected by aesthetics and odor caused by the die-off, what species might be most affected, and potential recreational site users.



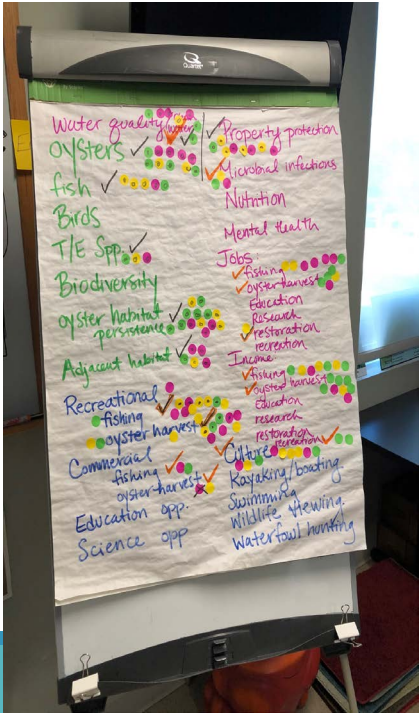
3. Socio-economic metrics

Metric Generation Process:

- Prioritize ecosystem services outcomes from the models
- Generate metric ideas in small groups at workshops
- Come to agreement with the full workshop group on selected metrics for each ecosystem services outcome
- Complete a metrics assessment, to determine the feasibility and applicability of metrics generated at workshops

Summary Points:

The third output of the project was a set of socio-economic metrics, generated via worksheets in small groups at the workshops and later refined via a metrics assessment conducted by the team.



Outcome: Recreational Fishing

1. Circle the group's top 3 metrics, and put a star next to the group's "dream" metric

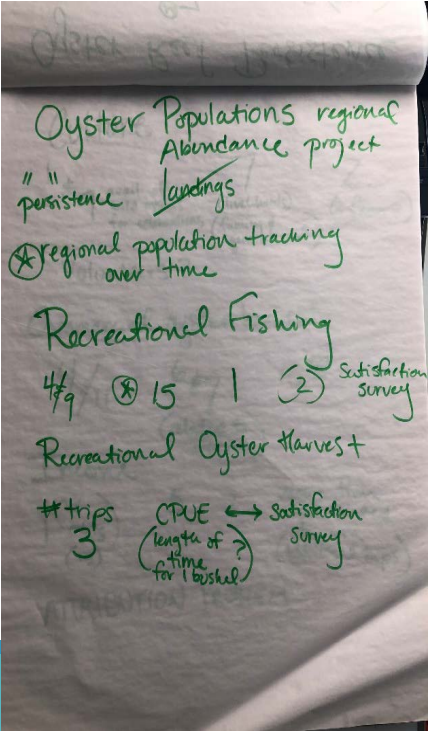
Possible Metrics	Ecological, BBI, or Monetary (E/B/M)
1 No. of recreational fisherman using a reef / unit time	B
2 Abundance of a particular fish species at reefs	B/E
3 Fish catch per unit effort at reefs (# fish/ trip; # fish per hour)	B
4 No. of recreational fishing trips to a reef	B
5 Quality of fishing experience at reefs (survey)	B
6 Quality of fishing experience at reefs (fish size)	B
7 No. of recreational fishing licenses sold	B
8 Travel cost to fish at reefs	M
9 No. of charter trips to reefs	B
10 Access to the reef for fishing (no. of marinas, boat ramps, piers etc)	B
11 Changes to regulations/ catch size, limits	B
12 Fish catch per unit effort in the project region (#fish/trip; #fish/ hour)	B
13 Recreational fishery permits sold for fishing grounds with known population connection to the reefs	B
14 Number of tourists traveling to the region to fish recreationally for fish supported at reefs	B
15 Tourism dollars generated by tourists travelling to the region to fish recreationally for fish supported at the site	M
16	
17	
18	

2. Which criteria do the top 3 metrics meet?

Metric 1:

Metric 2:

Metric 3:



Metric Assessment Criteria

Criteria	Score 1	Score 2	Score 3
Metric has been measured elsewhere	There is no clear or published method for measuring this metric	Measurement of this metric has not taken place at NERRS but there are publications that include clear guidelines on how to measure the metric in relevant contexts	Measurement of this metric has taken place in similar contexts and a replicable method within NERRS sites exists
Ease and cost of data collection	Very difficult and/or costly	Somewhat difficult and/or costly	Relatively easy and/or cheap
Metric captures the ecosystem services outcome of interest	Important aspects of outcome are not captured	Metric captures some important aspects of the outcome	Metric captures the outcome fully or directly
Changes in the metric can be attributed to a restoration project	Attribution is difficult/impossible	Attribution might be possible	Change in metric is likely directly attributable to restoration
Changes in the metric could be detected within a typical project lifecycle	No, unlikely to see this change within 5 years	Might see minor changes within 5 years	Yes, likely to see this change within 5 years
Data on this metric would resonate with important stakeholders	No, data on this metric will not resonate well with people outside the academic community	Somewhat, select stakeholders will be able to connect with this metric	Yes, the metric connects easily to things that people care about

Summary Points:

Lists generated at the workshops represent what individuals at each workshop thought would be feasible and applicable to measure; however, the team wanted to further assess these metrics by applying criteria that would enable them to rank and compare the metrics. The criteria shown on the slide represent a high-level assessment, examining different aspects of the metrics. The team is assessing the outputs of this metric ranking and comparing the outputs to some of the metric assessments conducted for the Gulf project.

GEMS Metrics matrix

	Tier 1 – important to measure and feasible; required	Tier 2 – Nice to have, but harder to measure; not required
Project scale	<u>TIER 1 – Project Scale</u> Ex. Jobs in aquaculture– number of jobs supported by an aquaculture project	<u>TIER 2 – Project Scale</u> Ex. Recreational fishing– number of fishing guides visiting restored oyster reef
County scale	<u>TIER 1 – County Scale</u> Ex. Jobs– number of jobs supported by commercial fishing- modeled from county landings revenue	<u>TIER 2 – County Scale</u> Ex. Education (cultural value)- number of people with additional knowledge of oyster reefs – County wide survey

Socioeconomic outcomes

Jobs

Economic Activity

Human Health

Cultural Values

Resilience

Public Infrastructure Protection

Summary Points:

The team categorized their final list of metrics into the matrix shown on the slide.

There are two different scales of metrics:

- **Project scale** metrics are monitored and reported by individual projects; and
- **County scale** metrics are broader than any one project and would need to be compiled by a third party.

The team also identified two ‘tiers’ of metrics according to the difficulty of obtaining measurements:

- **Tier 1** metrics require little additional work and are very feasible, thus the team recommends that projects be required to report them whenever relevant; and
- **Tier 2** metrics would be nice to have, but require more additional work to measure, and are thus not required.

4. Education and Outreach Materials

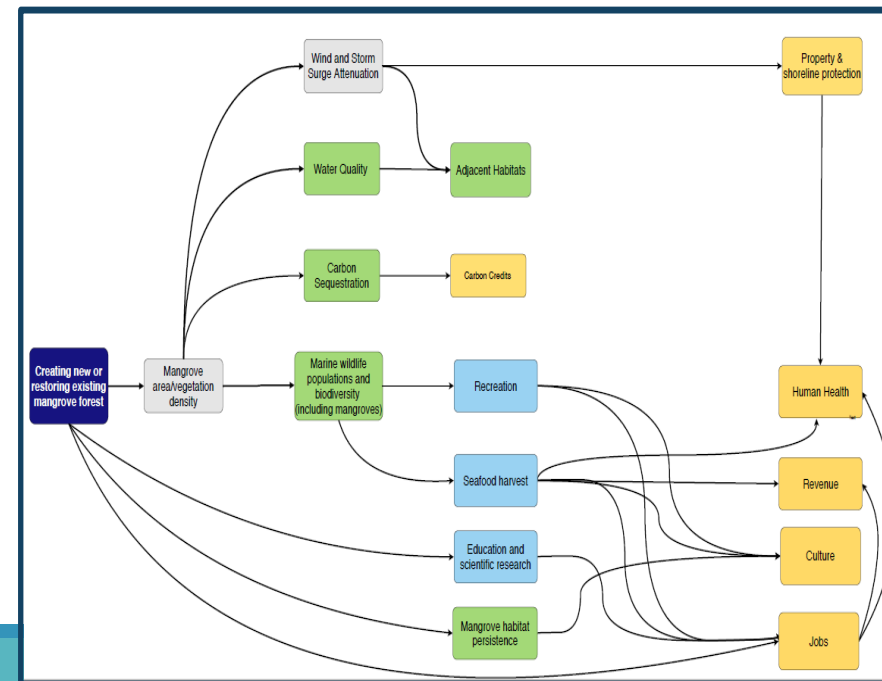
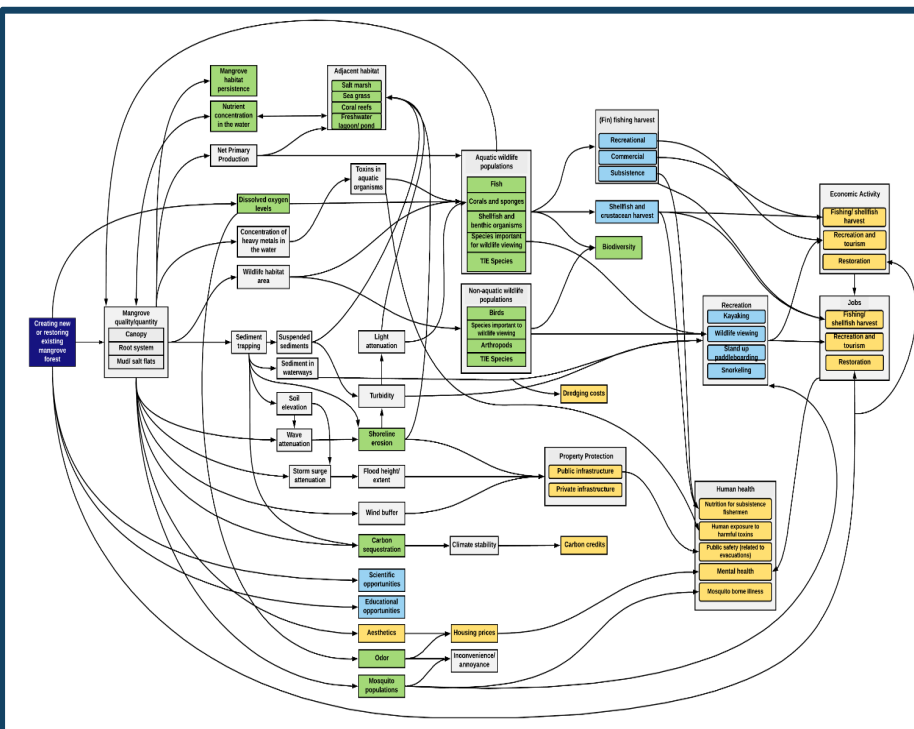
Products:

- Simplified models for communications purposes
- Infographics
- Ecosystem services educational content/ activities for middle school audiences
- An adaptable powerpoint presentation that describes ecosystem services to different stakeholder groups

Summary Points:

The fourth output of this project is a collection of education and outreach materials, as listed on the slide.

Many of the reserves already do ecosystem service-related outreach, even if they do not use the term 'ecosystem services.' The team is trying to determine if they can make useful education and outreach material using the models as a starting point. While the general public likely has no use for a full, complex model, the simplified models and the model structure would be beneficial in developing unique outreach material. As of June 2019, this is still under development.



5. Evidence Libraries

Summary Points:

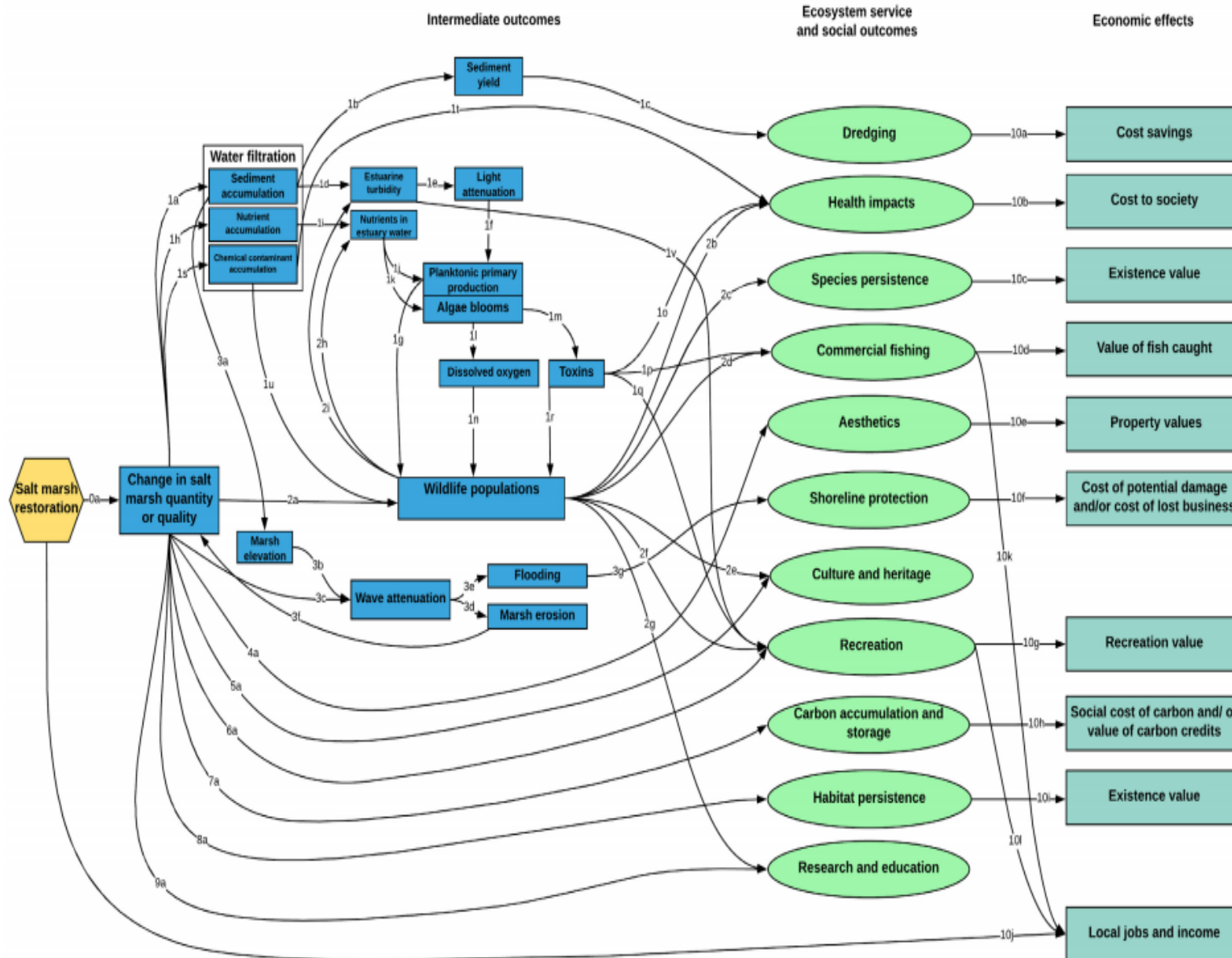
The team did not produce evidence libraries for this project, but it has created them previously for different projects.

In general, an evidence library consists of entries compiled into a document which accompanies a model. The library serves as a reference for examining what is known about a particular linkage and how strong that evidence is. This can become a gaps assessment, and also a reference resource from which users can obtain summaries about what is known in their system.

Importantly, these libraries do not require expertise on all areas represented by the different arrows in the library, and these summaries can be a starting point for understanding how various components relate to one another.

For EVERY Arrow:

- Description of the relationship
- Summary of the evidence
- Confidence in the assumption given available evidence
- List of other factors that may result in variation (location, timing, external drivers, and so on)
- List of sources

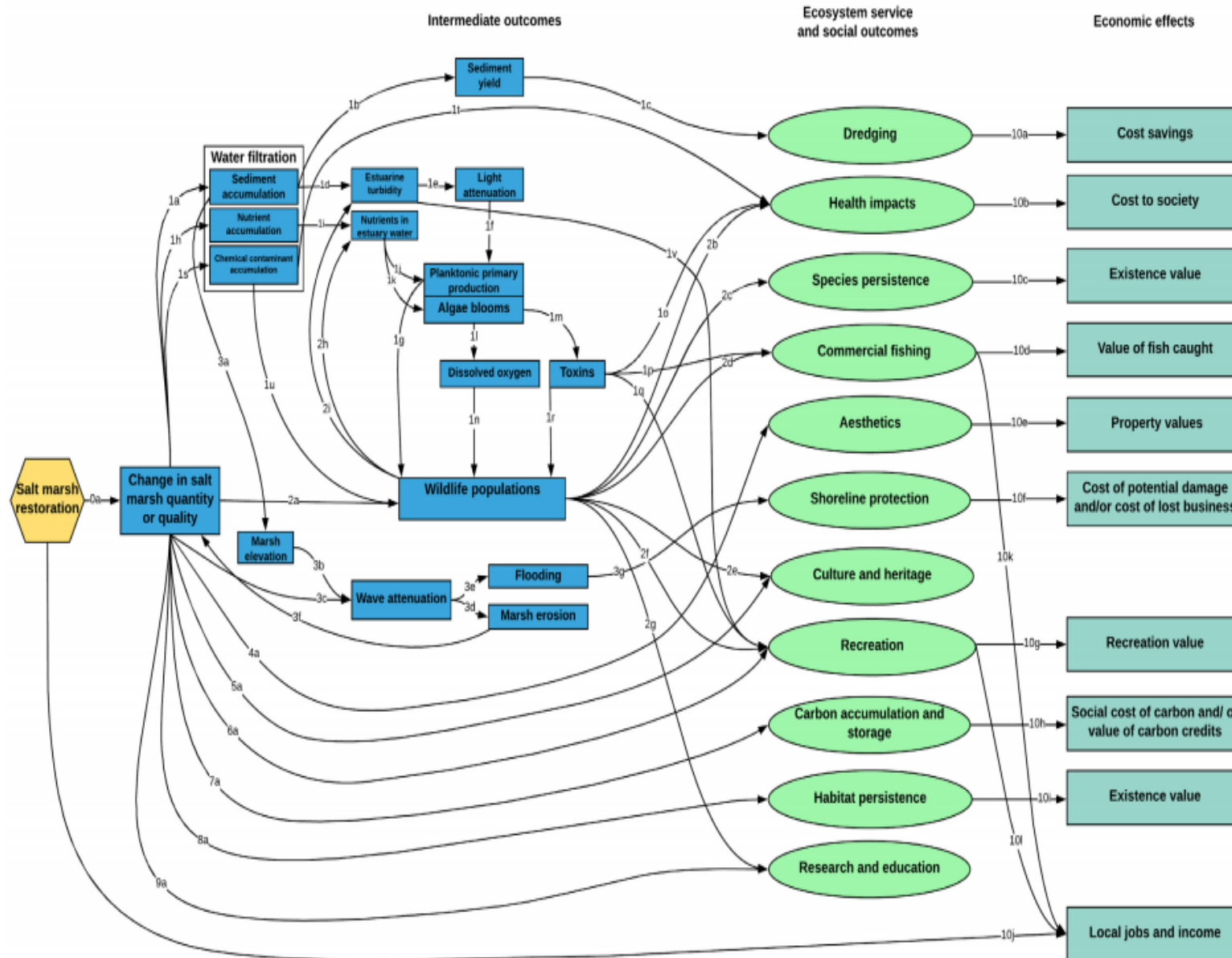


5. Evidence Libraries (continued)

Summary Points:

Sometimes there is site-specific information useful to a particular region or site that would not be included and would have to be considered separately; this is especially true when assessing the right-hand side of the diagram, which focuses on connections between ecosystem services and socio-economic outcomes that are often localized and dependent on the context of the community.

Synthesizing the general evidence provided in an evidence library and site-specific information yields a 'strength of evidence map,' which gives a color-coded visual representation of where evidence is strong or lacking for a particular system.

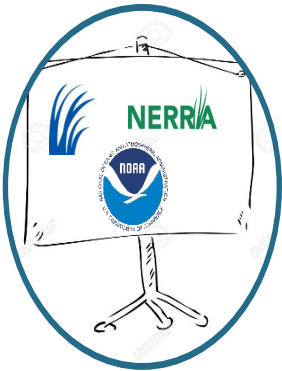


For EVERY Arrow:

- Description of the relationship
- Summary of the evidence
- Confidence in the assumption given available evidence
- List of other factors that may result in variation (location, timing, external drivers, and so on)
- List of sources

Potential Next Steps

Next Step	Details	Under Development?
Engagement at NERRS/ NERRA 2019 meeting	Presenting findings and engaging other NERRs to try out the process	✓
Adding a module to the current NOAA ES training	Conversations underway and searching for funding	✓
Create ESCMs for remaining habitats	Plan to create models for barrier islands, beaches/ dunes, and seagrass for GEMS (not coral reefs)	✓
Develop set of recommended socio-economic metrics	Almost completed for oyster reefs Will be developed for other habitats and some gray infrastructure options	✓
Evidence libraries for remaining habitats	Currently have: salt marsh, oyster reef. No existing projects plan to create libraries for remaining habitats	✓
ESCM for cultural services	Initial exploration with He'eia NERR underway	



Summary Points:

Questions?

Lydia Olander: lydia.olander@duke.edu

Sara Mason: sara.mason@duke.edu

Project Page: <http://nerrsciencecollaborative.org/project/Olander18>



Questions:

Could the arrow between environmental change and social change be bi-directional? See slide 6 for diagram reference.

Yes, there is feedback in all pieces of this model.

What software did you use to create the model flow diagrams?

The team used [Lucidchart](#), which provides trial and enterprise accounts, and enables sharing with people who do not have Lucidchart accounts. [Draw.io](#) is also a good free option, as recommended by the presenters.

Can you mention how present ecosystem services work is informed by “Changes in the global value of ecosystem services,” Costanza, et.al., 1997, which pegs value of ecosystem services greater than world GDP; updated 2011 with ES value set at double world GDP?

This work is about how to integrate consideration of ecosystem services into management decisions happening on the ground. Ideally, if we do that, we’ll be facilitating and enhancing ecosystem services rather than degrading them. Other work looking at accounting for natural capital at a global scale would ideally be able to capture and account for those kinds of changes over time. I think there are two connected dimensions here: one is measuring and accounting for changes in services; and then what we’re trying to do, which is figure out how to integrate these considerations into decision making.

Questions?

Lydia Olander: lydia.olander@duke.edu

Sara Mason: sara.mason@duke.edu

Project Page: <http://nerrsciencecollaborative.org/project/Olander18>



Questions:

Can we explore ways for non-NERRS to benefit from your work?

We would love to have other people and programs involved in using this work. We understand that the training we're going to be working on with NOAA is available to other institutions and organizations. All of these materials will be available online through us, but also through NOAA's Digital Coast. If people have particular questions or issues, we're happy to follow up directly as well. Contacts: [Lydia Olander](#); [Sara Mason](#).

In building the salt marsh generalized model, did you consider coastal marshes broadly speaking, e.g., marine and freshwater coastal marshes? How well do you think the generalized model might apply to freshwater (Great Lakes) coastal marshes?

We were looking at salt marshes for that model, but we have thought a bit about how that might apply to freshwater marshes. The model structure probably would not change too much, but you would have to work with people who are familiar with the system to make sure that everything you needed would be incorporated. What really would change would be the strength of evidence map and the evidence library behind the model - since those were assembled for coastal marine systems, they would need to be adapted for freshwater contexts.

Questions?

Lydia Olander: lydia.olander@duke.edu

Sara Mason: sara.mason@duke.edu

Project Page: <http://nerrsciencecollaborative.org/project/Olander18>



Questions:

Is this group developing any large scale ecosystem models focusing on biological effects, i.e. food chain support, rather than socio-economic?

There is some underlying work associated with key species identified in these models that may look to some of the food chain models, but we don't delve into the really detailed ecological underpinnings of the food chain in great detail. Other conceptual models focus on the ecological side of the system that do that, but we're really focused on the human side and which changes are most critical to affecting people.

Where can we get copies of this presentation?

If you get in touch with Sara she can share the slides

Where is a Bayesian model used?

We did not use a Bayesian model in this Science Collaborative project, but did test its use in the context of ESCMs for our year 1 work-- you can find that summarized in [this document](#). A journal article with further details is currently under review.

Has your study of mangroves been informed by studies by Climate Observatory at PUCE.edu.ec in Ecuador?

No, but we will look into that research!