



OYSTER FISHERIES AND HABITAT MANAGEMENT PLAN

for the

Pensacola Bay System

May 2021

Table of Contents

each line is hyperlinked to the page in the Plan ('control + click' on a line)

List of Tables	i
List of Figures	i
Acronyms	ii
Acknowledgements.....	iii
Forward.....	iv
Introduction	1
Why the Pensacola Bay System	4
Statement of Purpose	5
Consensus Building Process	5
Role of The Nature Conservancy.....	5
Role of Facilitated Solutions, LLC	5
Stakeholder Assessment Interviews	6
Role of the Stakeholder Working Group.....	6
Alignment with Relevant Management Plans	8
Plan Structure	8
Themes.....	8
Objectives and Metrics	9
Strategies and Actions	9
Assigning Priority Leads	11
Themes A-D Descriptions.....	12
Theme A: Ecological – A Healthy and Productive Oyster Reef Ecosystem	12
Theme A: Objectives	12
Theme A: Metrics	13
Theme A: Strategies and Actions	14
Theme B: Wild Harvest and Aquaculture – The Management and Regulation of the Oyster Fishery and Aquaculture Industry	17
Theme B: Objectives	17
Theme B: Metrics	18
Theme B: Strategies and Actions	18
Theme C: Economy – A Thriving Economy Connected to the Pensacola Bay System	20
Theme C: Objectives	21
Theme C: Metrics	22

Theme C: Strategies and Actions	23
Theme D: Public Education and Communication - An Engaged and Informed Public and Decision-Makers	24
Theme D: Objectives	24
Theme D: Metrics	24
Theme D: Strategies and Actions	25
Strategies and Actions Referred to the PPBEP	26
Science Information and Gaps	29
Oyster Habitat Suitability Model	29
Draft Restoration Siting Plan.....	30
Gaps in Science	31
Projects Currently Planned or Underway	32
Moving Forward: Next Steps for Implementation	33
Recommendations for Implementation	33
Role of the PPBEP and the State of Florida.....	33
References	34
APPENDICES	35
Appendix A: Planning Team Members.....	36
Appendix B: Stakeholder Assessment Report.....	37
Appendix C: Stakeholder Working Group Members and Alternates.....	52
Appendix D: Web Links to Meetings Recordings and Presentations.....	53
Appendix E: Leads, Partners and Resources for Strategies and Actions.....	55
Appendix F: Charts of Leads and Partners of the Priority 1 and 2 Strategies and Actions	65

List of Tables

[Table 1. Criteria applied by the SWG for prioritizing the strategies](#)

[Table 2. Prioritization Ranking Scale for Strategies](#)

[Table 3. Theme A: Priority 1 Strategies and Actions](#)

[Table 4. Theme A: Priority 2 Strategies and Actions](#)

[Table 5. Theme B: Priority 1 Strategies and Actions](#)

[Table 6. Theme B: Priority 2 Strategies and Actions](#)

[Table 7. Theme C: Priority 1 Strategies and Actions](#)

[Table 8. Theme C: Priority 2 Strategies and Actions](#)

[Table 9. Theme D: Priority 1 Strategies and Actions](#)

[Table 10. PPBEP Priority 1 Strategies and Actions](#)

[Table 11. PPBEP Priority 2 Strategies and Actions](#)

[Table 12. Factors considered in development of the Oyster Habitat Suitability Model \(HSM\)](#)

List of Figures

[Figure 1. Map of the Pensacola Bay System](#)

[Figure 2. Historical extent of oysters in the PBS](#)

[Figure 3. Oysters Landed in Pensacola 1984-2018](#)

[Figure 4. Statistics of the SWG's involvement in developing the Plan](#)

[Figure 5. Oyster Habitat Suitability Model for Pensacola Bay](#)

[Figure 6. Spatial guidance on where different types of oyster reef restoration may best be suited](#)

Acronyms

BFA – Bream Fishermen’s Association

CCMP - Comprehensive Conservation and Management Plan

EBFM – Ecosystem Based Fisheries Management

FDACS – Florida Department of Agriculture and Consumer Services

FDEP – Florida Department of Environmental Protection

FOTC – Florida Oyster Trading Company

FWC – Florida Fish and Wildlife Conservation Commission

HSM – Habitat Suitability Model

IFAS - Institute of Food and Agricultural Sciences

NOAA – National Oceanic and Atmospheric Administration

NWFWMD – Northwest Florida Water Management District

PPBEP – Pensacola and Perdido Bays Estuary Program

PBS – Pensacola Bay System

RESTORE Act – Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States Act

SWG – Stakeholder Working Group

TNC – The Nature Conservancy

WFRPC – West Florida Regional Planning Council

Recommended Citation:

Birch, A., Brumbaugh, R., DeAngelis, B., Geselbracht, L., Graves, A., Blair, J., Jones, R., May 2021, Oyster Fisheries and Habitat Management Plan for the Pensacola Bay System, The Nature Conservancy, 78 p.

Acknowledgements

The Oyster Fisheries and Habitat Management Plan for the Pensacola Bay System is the first of its kind in Florida and is leading the way in how to restore and manage the oyster fishery and habitat. The Plan would not have been possible without the many people who have been working tirelessly to achieve a healthy bay system. Thank you to the individuals and organizations who were part of the planning process and without whom the Plan would not have happened.

First and foremost, the watermen and their families who have poured their hearts, minds, and bodies into the oyster fishery over the years, passing down their wisdom from generation to generation. A special thanks to Thomas Derbes II, Pasco Gibson, Travis Gill, LD Henderson, Donnie McMahon, Josh Neese, Pete Nichols, Tommy Pugh, Phil Rollo, and Calvin Sullivan. Their participation was possible because of the dedication and passion Christine Verlinde with the Santa Rosa County Extension Service brings to her work with the watermen and as a member of the Stakeholder Working Group.

Thank you to the 78 people throughout the community and agencies who agreed to be interviewed for the Stakeholder Assessment (Appendix B), which informed the membership of the Stakeholder Working Group. Many thanks to the Stakeholder Working Group members and their alternates, and the respective agencies, organizations, and companies they represented. They championed the process and stuck with it during the challenges of meeting remotely due to the Covid pandemic, maintaining their support, enthusiasm, and dedication over the 18-month process (see Appendix C for a list of the members and Figure 4 for a summary of meeting statistics).

To the invited guests who presented during the meetings to help inform the Plan, your time and expertise were valuable and much appreciated: Jon Brucker with the Florida Department of Environmental Protection, Farris Bukhari with The Nature Conservancy in Florida, Matt Deitch with the University of Florida, Bill Huth with the University of West Florida, Lydia Olander with Duke University, and Tom Soniat with the University of New Orleans.

Thank you to the Pensacola and Perdido Bays Estuary Program staff – Matt Posner and Whitney Scheffel as working group members, supported by Donald Killorn and Logan McDonald. From day one the Program staff stepped up to adopt the Plan as an integral part of the Program's Comprehensive Conservation and Management Plan, thus providing a secure home for the oyster plan that ensures its implementation with continued community involvement from diverse voices.

A big thank you to Jeff Blair and Robert Jones with Facilitated Solutions, LLC, who expertly facilitated the planning process. Their guidance, expertise, flexibility with change, and consummate facilitation and management skills ensured that the process remained consensus-based with equitable participation of working group members in an equitable manner and on schedule.

The Plan would not have been possible without the support from The Nature Conservancy in Florida and from the staff who provided support for the meetings, Darryl Boudreau, Farris Bukhari, Rachel Davis, and Fran Perchick.

Thank you from The Nature Conservancy's planning team to everyone involved who made the Oyster Fisheries and Habitat Management Plan a reality!

Anne Birch, Rob Brumbaugh, Bryan DeAngelis, Laura Geselbracht, and Andrea Graves

Forward

Nearly a decade ago a landmark study was published that revealed that shellfish habitat, namely oyster reefs, had declined by 85% worldwide. This defined oyster reefs as one of the most imperiled marine habitats (Beck, 2011). At the time of the report the Gulf of Mexico was the only remaining place in North America, and one of the few places worldwide, where the condition of remaining oysters was classified as ‘fair’ at 50% to 89% loss from known historic condition. All other places in the world with oyster habitat were classified as ‘poor’ (90% to 99% loss) or ‘functionally extinct’ (more than 99% loss). The report stated, *“Oyster fisheries in the Gulf of Mexico are probably the last remaining opportunity to achieve both large-scale oyster reef conservation and sustainable fisheries.”* To date, the Pensacola Bay System in Florida’s Panhandle region has seen a loss of at least 72% of oyster reef area since 1960 (FWC, 2019). However, recovery of the oyster fishery and habitat in the Pensacola Bay System is within reach.

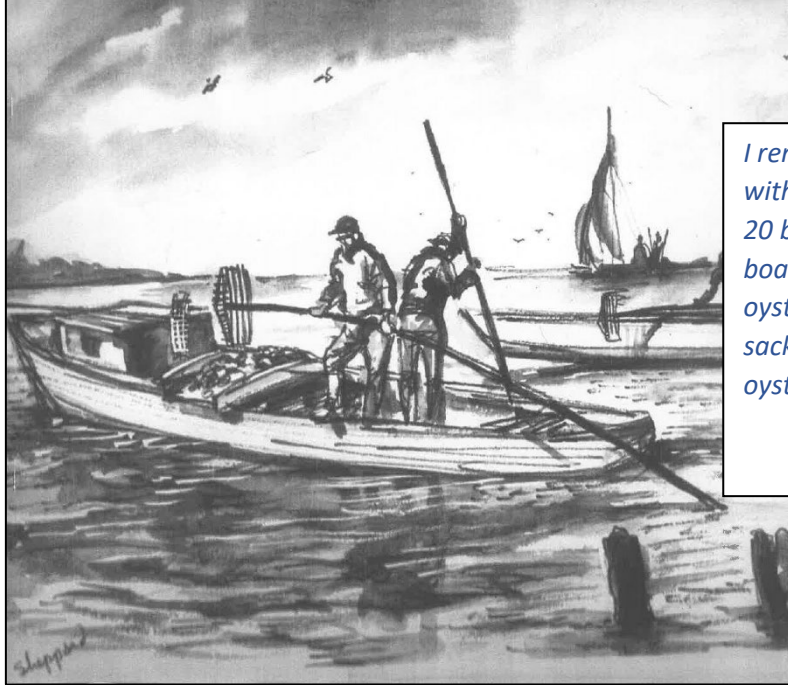
The celebrated way of life and culture created by the oyster fishery in Florida’s waterfront communities like Pensacola and other coastal states is steadily, and almost imperceptibly, fading away. Sadly, this includes the iconic Apalachicola Bay oyster fishery and the Pensacola Bay oyster fishery, where East Bay oysters were once a sought-after delicacy. The ability to sustain the time-honored way of making a living off the water as an oyster fisherman is in peril of disappearing if action is not taken by the community.

*East Bay oysters, people would drive 100 miles just to get a bag of them.
They’re known to be one of the best in the country.*

Tommy Pugh, Pensacola Waterman, December 2020

But the extensive loss of oyster reefs has not only impacted the fishery for oysters. The health of our bay systems depends on quality habitats like oyster reefs. Thus, the loss of oyster fisheries and the habitat that oysters provide creates a cascading series of ecological, economic, and social impacts to our estuaries and coastal communities. Economic consequences include closures of fish houses and processing plants, and the loss of associated jobs and livelihoods. More subtle effects may include impacts to the restaurant and waterfront tourism industries that were supported, in part, by a once flourishing oyster fishery. Ecological impacts include declining water quality, loss of other habitats supported by oysters (e.g., seagrass, salt marsh, mangroves), shoreline erosion, and loss of the diversity of fish, shrimp and crab species dependent on oyster reefs including many recreationally and commercially important fishery species. The deep roots and traditions of the oyster fishery that shaped the waterfront communities are vanishing. As new residents make Florida’s coastal areas their home, they are often not aware of the strong cultural history and importance the mighty oyster once had in shaping and supporting the community. Keeping the history alive and building back a thriving oyster fishery is critical to ensuring a prosperous working waterfront as well as ensuring the ecological health of the bay.

Oyster Harvesting in East Bay circa 1964., Artist: Sheppard



I remember being out there oystering with my grandfather and there being 20 boats. I was amazed how many boats were there, every day. If an oysterman could catch ten 50-pound sacks a day we could have some oystermen working the bay.

Pasco Gibson, December 2020

Facing a growing decline of the oyster habitat and the associated loss to the fishery, the State of Florida is championing a new approach to recovery. An approach that recognizes the need for oyster habitat to be restored, and the needs of the wild harvest oyster fishery and the burgeoning oyster aquaculture market, all while seeking to improve effective management of the resource. It is an approach that recognizes that while the oyster was once critical to communities across almost every Florida coast, restoration and recovery must happen at the bay scale and that habitat restoration can support recovery of the fishery. Achieving sustainable fisheries and a healthy environment requires a holistic approach that integrates a community's environmental, economic, and social well-being goals. Government agencies, fishing and aquaculture industries, and communities are best served when they engage together to develop solutions.

The Nature Conservancy (TNC) is working with communities to tailor sustainable oyster recovery plans that meet the needs of the fishery in tandem with restoring and conserving the natural systems they need to thrive. In coordination with state and community stakeholders, TNC piloted the first bay-scale recovery plan – the Oyster Fisheries and Habitat Management Plan for the Pensacola Bay System (Plan). This document describes that process and serves as a model for recovery to help ensure that oysters thrive as a habitat and a fishery throughout the Pensacola Bay System (PBS) and Florida.

Introduction

Oysters are unique among Florida's fisheries and coastal habitats – they are a species, a fishery, and as one of the most important 'fish making' habitats they also create habitat (reefs) that provide a suite of valuable ecosystem services. Beyond supporting the oyster fishery and other reef dependent fisheries, oyster reefs protect shorelines and reduce erosion, improve water quality, remove nitrogen (denitrification), and provide habitat and food for a variety of birds, animals and recreationally and commercially important fish. Oyster restoration and management are a means to restore oyster resources as both a fishery, which is a local economic driver and an essential part of the cultural history of our coasts, and as habitat that provides a suite of ecosystem services.

The PBS, located in Escambia and Santa Rosa counties in Florida, is the fourth largest estuary in the state and once enjoyed a robust oyster population and associated oyster fishery. For the purposes of the Plan the PBS is defined as four bays – Pensacola and Escambia bays in Escambia County and East and Blackwater bays in Santa Rosa County (Figure 1).

Historically, extensive oyster beds occurred throughout the PBS, represented by the earliest map of oyster coverage created in 1883 (Figure 2). The spatial extent of oyster reefs in the PBS is less documented than in other estuaries. What is known is that the extent has been greatly diminished since the early 1900s with only an estimated 233 to 245 acres of reef remaining in 2015 (FWC, 2019). In 2021, TNC and the Pensacola and Perdido Bays Estuary Program (PPBEP) mapped reefs in the PBS that includes the estimated current extent and condition. Oysters, seagrass beds and salt marsh habitat, together with the uplands and rivers that feed the bays, help to maintain a healthy PBS. As the habitats decline so does the health and value of dependent species including the well-being of associated human communities (Lewis *et al.*, 2016).

The decline of oysters in the PBS is illustrated by the collapse of the oyster fishery (Figure 3). Known oyster die-offs were recorded as early as the 1950s due to disease, poor water quality, sedimentation, and a lack of suitable substrate for settlement (WFRPC 2005; Collard 1991b; Lewis 2016), in addition to poor management of the fishery and habitat. Additionally, human populations bordering the PBS in Escambia and Santa Rosa counties are increasing. The PBS has a drainage area of over 6,800 square miles (NFWFMD, 2017). Escambia and Santa Rosa counties have seen a 7% and 22% population growth rate, respectively from 2010 to 2019 (U.S. Census Bureau, 2019). Resulting land use changes from natural to populated areas are causing increased sedimentation and nutrients that runoff into the bay system and negatively impact the natural habitats (e.g., oyster reefs and seagrass beds) and the services those habitats provide. Sequential declines in oyster habitat from natural events and human perturbations eventually leads to a resource that no longer has the capacity to recover.

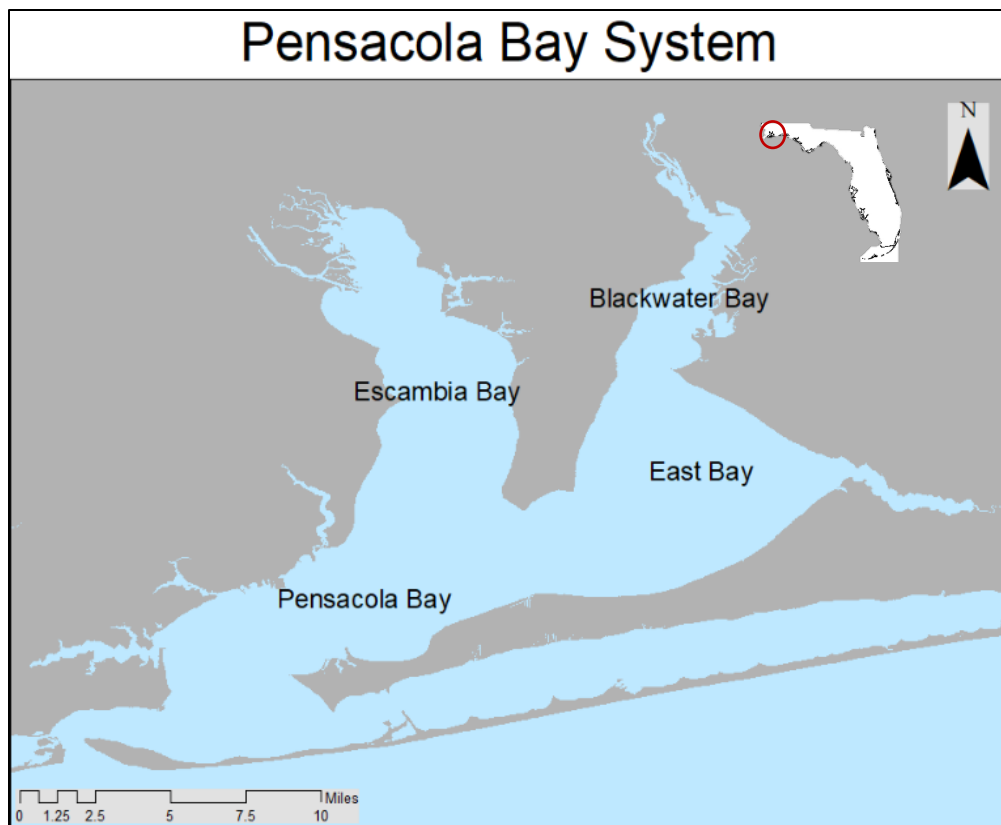


Figure 1: Map of the Pensacola Bay System

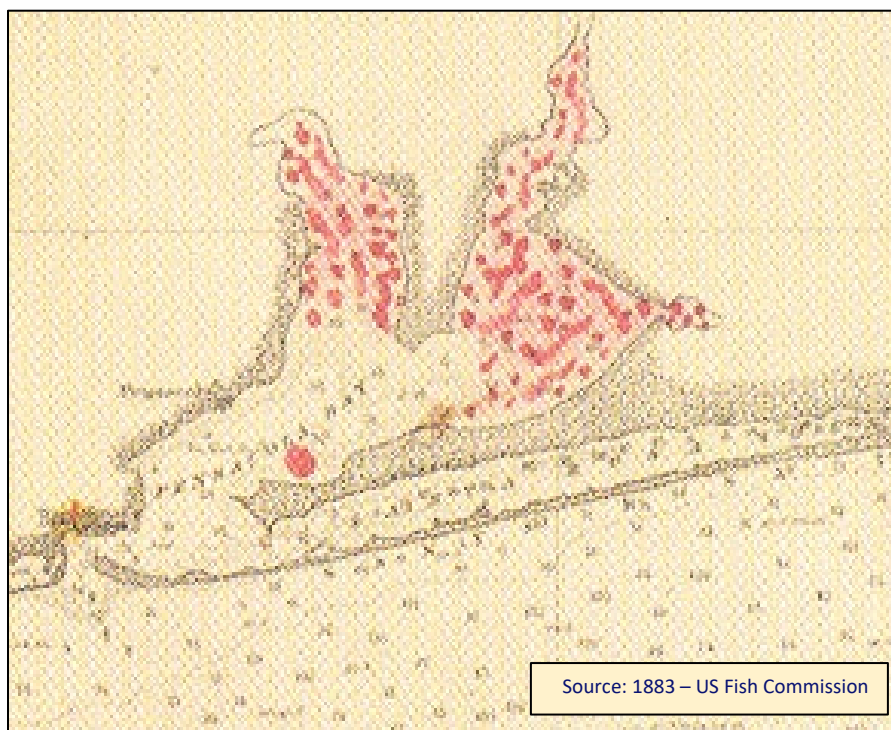


Figure 2. Historical extent of oysters in the PBS (1883)

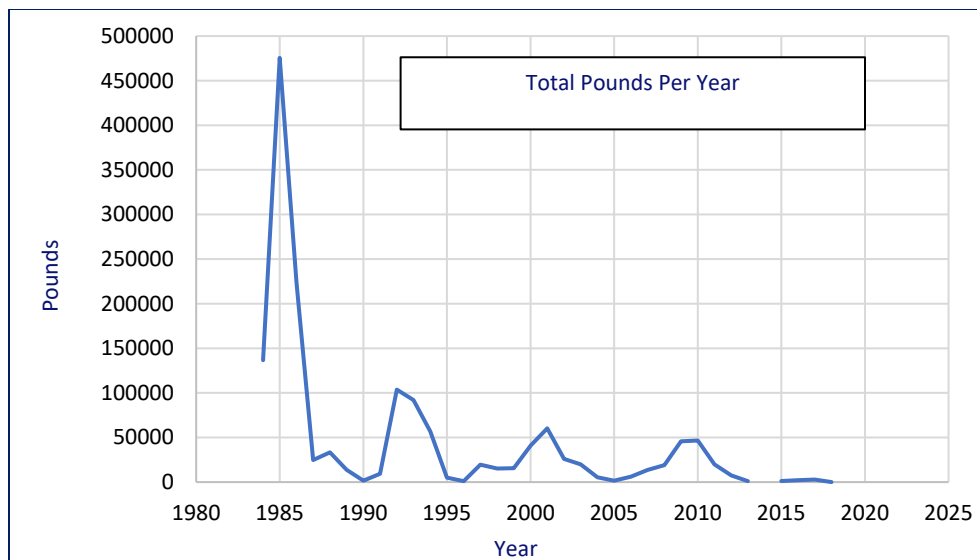


Figure 3. Oysters Landed in Pensacola 1984-2018 (FWC)

In the absence of a comprehensive oyster management and restoration plan, the State of Florida is championing the development of plans at the bay scale to provide a path forward for recovery of oysters. Management at the bay scale is a sound approach since each bay has a unique oyster population, environmental conditions (e.g., salinity, water quality, substrate), fishing industry, and community character. With support from the state and stakeholders in the PBS, in 2019 TNC launched a project to develop an oyster ecosystem-based fisheries management plan.

The Plan is based on four overarching and interdependent Themes: A. Ecological, B. Wild Harvest and Aquaculture, C. Economy, and D. Public Education and Communication.

NOAA defines Ecosystem-Based Fisheries Management (EBFM) as *“a holistic way of managing fisheries and marine resources by taking into account the entire ecosystem of the species being managed. The goal of ecosystem-based management is to maintain ecosystems in a healthy, productive, and resilient condition so they can provide the services humans want and need.”* (NOAA 2021). How EBFM is implemented is different depending on the fishery and can be tailored depending on the purpose (Trochta 2018). For the purposes of the Plan, EBFM is defined as ensuring the ecological conditions oysters require to thrive (e.g. improvements to water quality, sediment loads, etc.), focusing on requirements for oyster habitat and population restoration and recovery (proper siting of restored reefs, substrate requirements, broodstock requirements, etc.) while improving and making resource management decisions that consider the needs of the wild harvest oyster fishery and the burgeoning oyster aquaculture industry. In addition to managing for oyster fishery production and landings, management actions are aimed at achieving ecological outcomes (water filtered, nutrients removed, fish and invertebrates produced) and other social objectives (increased recreational angling opportunities) known as ecosystem services. The Plan recognizes the oyster fishery, aquaculture industry, and habitat as equal elements in development of the goals and strategies for restoration and management. Currently, there are no known oyster plans in the U.S. that focus at the bay scale while integrating oyster management using this holistic approach.

To be effective, the planning framework needed to apply a transparent, inclusive, and consensus-based decision-making process that encourages collaboration and support from all sectors and stakeholders across all objectives. TNC convened a Stakeholder Working Group (SWG) composed of diverse community interest groups including oyster harvesters and aquaculture farmers, state and local management agencies, scientists, economic and development interests, universities, and community organizations. The SWG's purpose was to pilot a new process for oyster management where all stakeholders have an equal voice and hand in developing and implementing a shared roadmap for recovery. The result is a model for community ownership and management based on the best available science.

This document details a way forward that was designed using a collaborative and consensus-based process to develop an oyster ecosystem-based fishery management plan for the PBS. Critical to the success of the Plan are the local watermen who have irreplaceable experience and generational knowledge of the bay system and fishery. They understand firsthand what is at stake because they have seen their livelihoods disintegrate over the years. Yet they have hope that the fishery and habitat can rebound if there is immediate and long-term support and commitment from the community to make it happen.

The Plan is designed to be actionable and adaptable and is only valuable if implemented. The PPBEP has committed to adopting the Plan as an integral piece of their Comprehensive Conservation and Management Plan (CCMP) and in achieving their mission *"To restore and protect the water quality and natural resources of the Pensacola & Perdido Bays and watersheds through partnerships, using a community-based, scientifically-sound approach to enhance resilience."* This ensures that restoration and management of oysters will be rooted in the operations of the PPBEP and the Plan can play an integral role in helping to guide the PPBEP's work to protect and restore the PBS. With a plan in place the community of the PBS is in a prime position to leverage funding sources such as Deepwater Horizon oil spill settlement funds and other public and private sources to advance the goal of restoring Pensacola's oyster fishery and habitat.

Why the Pensacola Bay System

The Pensacola Bay System (Figure 2) was selected as a project site to model a holistic approach to oyster recovery for several reasons. The bay is a large important estuarine system in Florida surrounded by vibrant communities that benefit greatly from its presence. Oysters are a fishery as well as a key ecosystem component. Oysters were once nearly ubiquitous throughout the bay, providing services such as water clarification and nutrient removal, habitat for recreationally and commercially important sportfish and shellfish, and substrate stabilization. But the PBS has experienced a substantial decline in the oyster fishery and habitat over the last several decades. The loss of oyster habitat and production has impacted the community of fishermen reliant on this resource for a substantial part of their income (personal communication with oyster watermen). The absence of oysters, a key habitat component in the bay, contributes to the decline of others such as seagrass meadows and the associated diversity and

Stakeholder Working Member Affiliations

- Aquaculture
- City of Pensacola
- Community Organization
- Development
- Escambia County
- FDACS
- FDEP
- FWC
- IFAS-Escambia
- IFAS-SRC/Watermen Liaison
- NFWFMD
- Okaloosa County
- Oyster Watermen
- PPBEP
- Recreational Fishing
- Santa Rosa County
- University of West Florida
- Visit Pensacola

biomass of fish and invertebrate species. These components that make up an ecosystem work synergistically to sustain a healthy, productive bay system and nurture a healthy productive human community.

In addition, the services oysters provide are critical to the economy, such as tourism which is an important economic driver that depends on the health and vitality of the bay. The PBS community understands the need for investing in oysters for recovery of the fishery and habitat.

Statement of Purpose

The Plan provides the PBS community with a roadmap for long-term and sustainable restoration and management of oysters in the PBS. The Plan can also serve as a model for management of oyster resources throughout Florida's estuarine systems, the Gulf of Mexico, and beyond. Actions needed to achieve the Plan's goals will also benefit other bay habitats (e.g., seagrass and salt marsh) and the community's economic and social well-being. The health of the oyster fishery and habitat are at the core of the PPBEP's CCMP as metrics for measuring the health of the PBS. The intent is for the Plan to be developed, owned, and implemented by the community and the State, and the PPBEP has agreed to integrate the plan as an essential element of the CCMP.

Consensus Building Process

Applying a consensus building, collaborative process was the central tenet of the Plan's development. Consensus is a participatory process whereby, on matters of substance, the members strive for agreements which all the members can accept, support, live with or agree not to oppose. The SWG's recommendations were developed using this process. Working group members evaluated all components of the Plan using the best available science, data, and decision-support tools for management and restoration of the PBS and achieved 100% consensus on the final Plan.

Role of The Nature Conservancy

TNC worked with staff from the Florida Fish and Wildlife Conservation Commission (FWC) and the Florida Department of Agriculture and Consumer Services (FDACS) Division of Aquaculture on how to initiate oyster planning in the absence of a state plan and agreed that piloting development of oyster management and restoration plans at the bay scale made the most sense. In the fall of 2018, TNC staff met with key stakeholders in the PBS (watermen, state agency staff, local elected officials and staff, and other community members) to introduce the concept of a plan and determine whether the community wanted such a plan. The answer was a resounding yes from everyone interviewed. TNC provided the needed funding, from private donations, and administered the planning process. This included contracting a professional facilitator, Facilitated Solutions LLC, identifying SWG members, convening the SWG meetings, providing science and data to inform development of the Plan's outcomes, strategies, and actions, and providing drafts of the Plan throughout the process for the SWG member's review and revisions. Planning team members are listed in Appendix A.

Role of Facilitated Solutions, LLC

TNC contracted with Facilitated Solutions, LLC, based in Tallahassee, to conduct a series of stakeholder interviews and meetings in the community, and design and facilitate the 12 SWG meetings and two watermen workshops. Jeff Blair and Robert Jones, principals of Facilitated Solutions, LLC, are accomplished neutral facilitators with 30 years of experience with consensus-based solution processes. Their experience working with communities on oyster and other marine fisheries issues complemented the skills needed for the Plan. Team members are listed in Appendix A.

Stakeholder Assessment Interviews

Facilitated Solutions conducted 78 assessment interviews with individuals prior to the start of the planning process. The assessment process was designed to receive input regarding the interviewee's perspectives regarding the key issues, challenges, and strategies for addressing them and if they were in favor of an oyster ecosystem-based fisheries management plan for the PBS. The interviews also helped to identify members for the SWG. The key challenges identified included:

1. Oysters are important for a healthy bay system, but the population has collapsed and with it a decline in the ecosystem services they provide.
2. Growth and development impact the water quality and viability of oyster reefs.
3. Clean water is job #1 in supporting and sustaining robust fisheries, and the oyster reef systems.
4. Public and leadership education and outreach regarding the benefits and ecosystem services provided by healthy oyster reefs is important and needs to be inclusive of the entire community.
5. Collection of science-based data where gaps exist needs to be coordinated.

The results of the stakeholder assessments clearly identified strong support for development of an oyster EBFM plan and viewed the planning as timely and positive for the bay system. It also found that a watershed approach was needed to address the issues affecting oysters and that the solutions would require participation by the whole community. The Stakeholder Assessment Report is included as Appendix B.

Role of the Stakeholder Working Group

The SWG members were selected from the assessment interviews conducted prior to convening the SWG to represent the community's diverse constituency. They included oyster harvesters and oyster aquaculture farmers, state and local government agencies, businesses, universities, community members and the PPBEP. A list of the members and their alternates, volunteering their time either individually or through their respective affiliations they represented are in Appendix C. The SWG was convened by TNC to define multiple objectives to address the management and restoration actions needed to recover the wild oyster harvest, sustain oyster aquaculture, and restore lost ecosystem services provided by oyster habitat (e.g., clean water, more crabs and fish, nitrogen removal). Members evaluated oyster fishery practices and management options and restoration policies and developed the Plan's outcomes, strategies, and actions.

The SWG met during 12 daytime meetings held from October 2019 to March 2021. An additional two workshops were held in the evening to receive input from the watermen. The first three SWG meetings were held in-person (October and November 2019 and January 2020). Starting with the fourth meeting in April 2020 the meetings were held virtually to meet health safety precautions due to the Covid-19 pandemic. All agenda packages and meeting summaries for the 12 regular SWG meetings and two watermen workshops can be viewed at the PPBEP web site <https://www.ppbep.org/the-plan/oyster-plan>. The web links to the meeting recordings (Table 1) and to the PowerPoints presented during the meetings by SWG members, TNC staff, and invited guests (Table 2) are in Appendix D. The SWG agreed to the following Goal Statement and Guiding Principles for the planning process:

Goal Statement:

The goal of the PBS SWG is to develop a package of consensus recommendations informed by the best available science, data, and stakeholder experiences for the management and restoration of the PBS.

Guiding Principles:

The Working Group will...

1. Strive to work together collaboratively and seek to understand and respect differing perspectives.
2. Strive to achieve consensus on the evaluation and development of recommendations submitted to the TNC Project Team and appropriate management and regulatory agencies.
3. Operate under policies and procedures that are clear, concise, and consistently and equitably applied.
4. Serve as accessible liaisons between the stakeholder groups they have been appointed to represent and the PBS Working Group.
5. Strive to both inform and seek input on issues the Working Group is addressing from those they represent.

The SWG maintained their enthusiasm and support and continued to volunteer their time despite the challenges presented by the Covid-19 pandemic. Figure 4 summarizes some participation statistics.

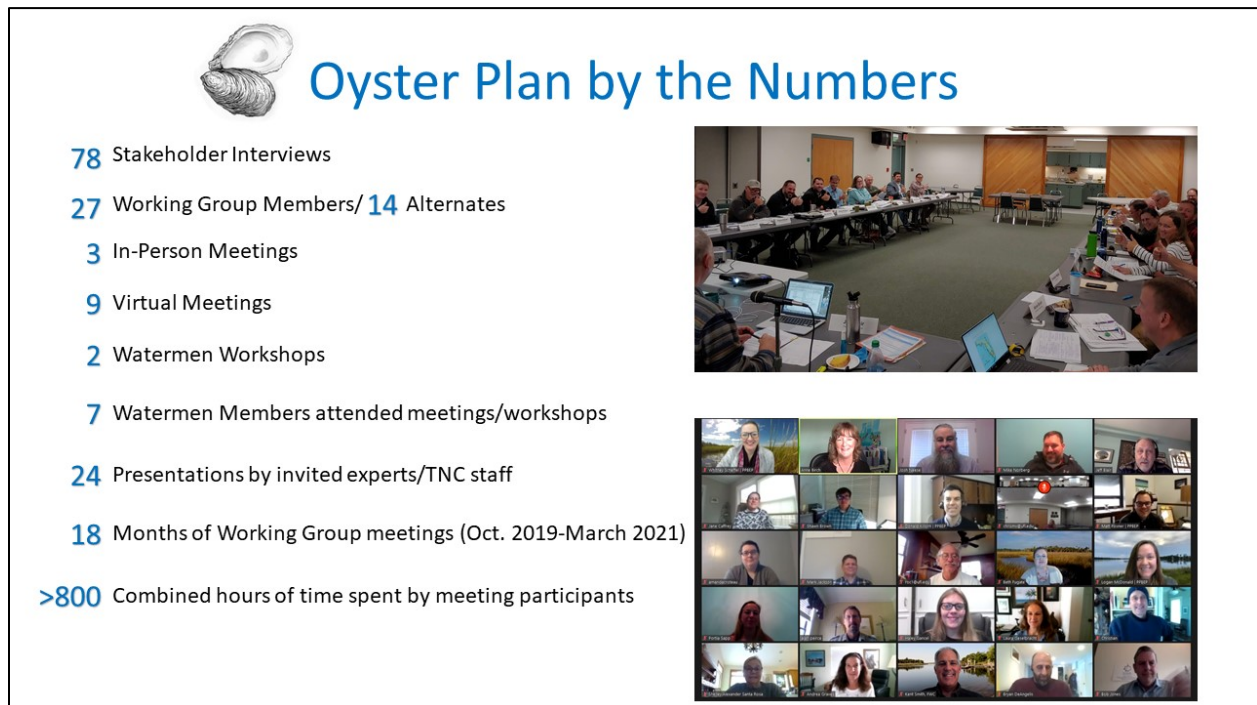


Figure 4. Statistics of the SWG's involvement in developing the Plan

Alignment with Relevant Management Plans

A review of 12 oyster management plans was conducted by TNC to evaluate if any provided a structure for an EBFM plan that could be duplicated for the PBS. The evaluation included a range of objectives that exist in public-facing plans, identified commonalities across plans, and identified elements that would be suitable for use in an ecosystem-based oyster management plan for the PBS. The plans were state-wide or regional (Gulf of Mexico) in scope. The review revealed three primary types of plans, based on their stated objectives and metrics of success:

- Fishery-Centric Plans are those with a primary (or exclusive) focus on oyster fishery metrics, typically expressed in annual landings. Such plans sometimes acknowledge potential ecological co-benefits or ecosystem outcomes from fishery-driven management actions, but these are not expressed as explicit management goals.
- Habitat-Centric Plans are those that focus primarily or exclusively on ecological outcomes and metrics are typically expressed as acres of reef substrate. Oyster fishery co-benefits are sometimes acknowledged as potential outcomes from habitat-management actions, but these are not expressed as explicit management goals.
- Oyster-Centric Plans are those that are sharply focused on species recovery or management of oyster populations for sustainability at an organismal (oyster species) level. These plans acknowledge the importance of habitat as it pertains to sustaining the oyster species and the connection to past or present oyster fisheries but do not have explicit fisheries outcomes or metrics associated with them.

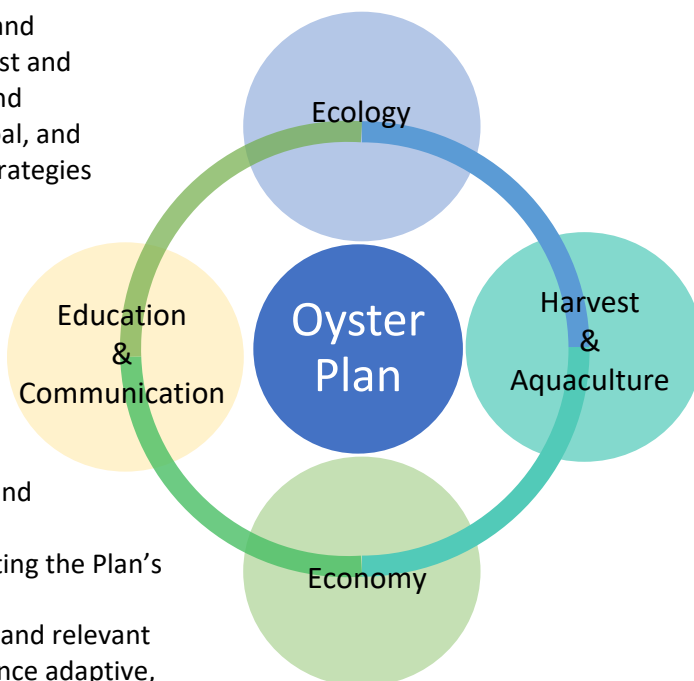
Plan Structure

Themes

The Plan was developed based on four overarching and interdependent themes: A. Ecological, B. Wild Harvest and Aquaculture, C. Economy, and D. Public Education and Communication. Each Theme has a stated Vision, Goal, and Outcome, and corresponding Objectives, Metrics, Strategies and Actions. Each Theme is described in detail in subsequent sections of the Plan. Each Theme is described in its own section. The sections include the Theme's Vision, Goal, Outcomes, Objectives, Metrics, and Strategies and Actions.

The overarching approaches of the Themes are to:

1. Utilize the Habitat Suitability Model as a means for identifying areas for oyster reef restoration and siting of aquaculture facilities.
2. Evaluate non-traditional methods for implementing the Plan's management and restoration actions.
3. Utilize models and other decision support tools, and relevant information on climate change impacts to influence adaptive, sustainable reef management.



4. Identify local partners to coordinate and collaborate with the lead entities on the implementation of strategies (e.g., watermen, citizen scientists, advocacy groups, NGOs, universities, counties, and other local governments, PPBEP).
5. Include commercial fishermen in discussions and to help work on: management, restoration design, and implementation (locations, size, total coverage, cultching, etc.), establishment of permanent closed areas, shell recycling, shelling, oyster relaying, mentoring, and workforce entry development, etc.

Objectives and Metrics

Objectives describe in concrete terms how to accomplish the goal to achieve the vision within a specific timeframe and with available resources. Metrics are quantitative, regular measures commonly used for assessing, comparing, and tracking performance that generates reliable data on the effectiveness, efficiency, and sustainability of programs and plans.

Objectives were developed for each of the four Themes. Each objective has a goal statement briefly describing the successful result of the objective. NOTE: The Plan's objectives do not yet have assigned timeframes and should be added to each objective by the oyster advisory committee to be established by the PPBEP.

Metrics were developed to measure the performance success of the objectives under each Theme. Metrics will be used to measure the results of proposed management and restoration options. When properly defined, metrics help identify areas that are working well to meet the stated goals and objectives, as well as identifying areas for improvement. They tell us whether a process is good enough to meet the goals and objectives, or whether that designed process needs to be adapted and/or improved to accomplish the stated goals.

Typically, a group or combination of metrics is used to measure the effectiveness of a process, rather than relying on a single metric. The group of metrics identified for each Theme's objectives should be reviewed on a regular basis to maintain a performance assessment of the associated strategies and actions.

The suite of metrics that can and should be considered as the strategies and actions of the Plan are implemented are identified for the corresponding objective(s). The metrics are not meant to prescribe *exactly* what quantitative metrics must be used, but rather, provide options that should be considered to appropriately assess the performance of the strategies and actions in accomplishing the stated goals and objectives.

Once metrics are adopted, they should also be used with associated performance goals (e.g., how much should a measure be expected to change quantitatively) as well as be used with appropriate temporal considerations (e.g., how often should measures be taken and metrics assessed).

Strategies and Actions

Strategies are defined as a method, plan of action, or policy that can be tested to determine whether it solves a problem and helps to achieve objectives and goals in the context of bringing about a desired future for the PBS. Actions are defined as a specific activity, or suite of activities, needed to achieve a strategy.

The SWG identified 26 strategies and 57 actions across the four Themes. The strategies were ranked based on the criteria (Table 1) and ranking system (Table 2) as described below. The strategies and

actions are listed within each Theme section (Tables 3-9). Eight additional strategies and associated actions were referred to the PPBEP for evaluation and prioritized using the same criteria (Tables 10 and 11).

List of Priority 1 and 2 Strategies and Actions Tables by Theme

Theme A

- Priority 1: Table 3
- Priority 2: Table 4

Theme B

- Priority 1: Table 5
- Priority 2: Table 6

Theme C

- Priority 1: Table 7
- Priority 2: Table 8

Theme D

- Priority 1: Table 9
- Priority 2: No priority 2 strategies

Table 1. Criteria applied by the SWG for prioritizing the strategies

Effective Strategies are 1. Urgent to Implement, 2. Have Support, and are S.M.A.R.T. (Specific, Measurable, Attainable, Relevant, and Time-Framed)		
Criteria		Explanation
1.	Urgent	Is it essential to address the issue to achieve the goals and objectives? Will things move in the wrong direction if the issue is not addressed?
2.	Support	There is commitment and support from key stakeholders and regulators for implementation of the <i>Strategy</i> .
S	Specific	It is detailed enough so that anyone reviewing the <i>Strategy</i> will know what is intended to be accomplished.
M	Measurable	The result can be identified in terms of quantity, quality, acceptable standards, etc. You know you have a measurable <i>Strategy</i> when it states in objective terms the result or product.
A	Attainable	The <i>Strategy</i> is likely to be implemented, and there are resources available, or likely to become available for implementing the <i>Strategy</i> .
R	Relevant	The <i>Strategy</i> is relevant, and if implemented it is likely to be successful in achieving the relevant goals and objectives of the Project.
T	Time-Framed	There are milestones with a specific date attached for completion.

Applying the above criteria, the SWG members prioritized each strategy using a scale of 1-10, with 10 being the highest priority and 1 the lowest priority (Table 2). The sum of the rankings for each strategy were averaged to get an overall prioritization score for that strategy (e.g., 10 members rank a strategy with the sum totaling 70 = an averaged rank of 7= Priority 2 strategy). Priorities were defined as follows:

- **Priority 1 Strategies - Important To Do Now:** average ranking of 8-10
- **Priority 2 Strategies = Important But Less Time Sensitive:** average ranking of 5-7
- **Priority 3 Strategies = As Time and Resources Allow:** average ranking of 1-4

Table 2. Prioritization Ranking Scale for Strategies

Scale Range 10 – 1 (10 highest rating to 1 lowest rating)			
10	Highest Level of Priority—Urgent/Critical	5	Medium Level of Priority
9	Very High Level of Priority	4	Medium Low Level of Priority
8	High Level of Priority	3	Low Level of Priority
7	Medium High Level of Priority	2	Very Low Level of Priority
6	Moderately High Level of Priority	1	Lowest Possible Priority—Don't Pursue

Strategy Prioritization Ranking Results	
Priority 1 Strategies	20 strategies ranked in this category
Priority 2 Strategies	6 strategies ranked in this category
Priority 3 Strategies	0 strategies ranked in this category

Unless otherwise noted, all the strategies within a priority category (1 or 2) are of equal importance and should be implemented based on a logical sequencing and as resources are available. It's also important to keep in mind that there are interdependencies of the strategies across the Themes.

The strategies and actions are identified in tables in each Theme section of the Plan. The strategies are numbered sequentially from Priority 1 to Priority 2. The actions are not numbered sequentially but rather are unique to their associated strategy.

Assigning Priority Leads

The SWG discussed potential leads and partners for implementing the priority strategies and actions. Appendix E details the Priority 1 and 2 Strategies and Actions with the Lead and Partner(s) and Resources identified by the SWG for each theme. The tables are only partially filled in and will be completed by the PPBEP with oyster advisory committee members and other partners during implementation of the Plan. Appendix F provides a simple way for the Leads and Partners to identify each Strategy and Action they have a role in implementing.

Themes A-D Descriptions

Theme A: Ecological – A Healthy and Productive Oyster Reef Ecosystem

Theme A focuses on the importance of oyster habitat to the overall health of the PBS. This theme describes the restoration and management actions needed for long-term sustainability of the habitat and the ecosystem services it provides while complementing the management of the wild harvest fishery and aquaculture industry strategies described in Theme B. Oyster reefs as a non-fished habitat provide a variety of ecosystem services that benefit both nature and people. Beyond supporting the oyster fishery and other reef dependent fisheries, oyster reefs protect shorelines and reduce erosion, improve water quality, remove nitrogen (denitrification), and provide habitat and food for a variety of birds, animals and recreationally and commercially important fish. Oyster reefs are some of the most important ‘fish making’ habitats in the world yet they are also recognized as one of the most imperiled marine habitats globally and throughout the U.S., including Florida (Beck et al 2011). Restoring and managing oyster habitat in an estuary is an integral piece of maintaining the integrity of the bay system, as outlined in the following Vision, Goal and Outcome for Theme A.

Vision: The oyster reef ecosystem is managed in a manner that supports ecosystem services by protecting and enhancing the habitat and resource in a sustainable and productive manner.

Goal: The Pensacola Bay System sustains a healthy and productive oyster reef ecosystem.

Outcome: By 2030, the oyster reef ecosystem within the Pensacola Bay is managed in a sustainable manner providing measurable ecosystem services.

The Objectives and Metrics to achieve the Vision, Goal and Outcomes are described under four topic areas: 1. Oyster Populations, 2. Ecosystem Services, 3. Substrate, and 4. Future Conditions. A goal is identified for each Objective.

Theme A: Objectives

Oyster Populations

1. Measurements of oyster reef and population conditions (including larval availability, spat settlement, Spawning Stock Assessment, shell budgets) are defined and quantifiable, with target and threshold levels identified.
Goal: Reef area is expanding, and population variables are improving.
2. Oyster recruitment and survivorship occurs in the estuary on an annual basis at a level that sustains oyster harvest and ecosystem services from harvested and non-harvested oyster reefs.
Goal: Oyster recruitment and survivorship increases throughout the PBS.
3. Spawning stock biomass and parental standing stock has increased across the ecological gradients (e.g., salinity, dissolved oxygen) appropriate for oyster growth and survival.
Goal: Oyster standing stock and biomass are increasing across appropriate ecological gradients in the PBS.
4. Shell-budget needs are attained on both harvested and non-harvested fished and non-fished oyster reefs to meet the management objectives of fishing, water filtration and fish production while oyster reef restoration is underway.
Goal: Net shell budgets are positive and increasing on all reef types.

Ecosystem Services

5. Key ecosystem services (fishing and fish production) and ecological health indicators (water filtration/water quality) are defined and measurable, with identified target and threshold levels.
Goal: Ecosystem service and health indicator metrics are increasing/improving.

Substrate

6. Policies and programs are established and implemented that provide the means to return a significant portion of the harvested oyster shell back to the PBS for substrate needed for larval recruitment to enhance population productivity on harvested and non-harvested oyster reefs.
Goal: Oyster shell returned to the system is increasing.
7. Abundant oyster settlement substrate exists across the estuarine ecological gradients, where appropriate for oyster growth and survival.
Goal: Oyster shell returned to the system is increasing across ecological gradients as appropriate.

Future Conditions

8. Climate-ready considerations are incorporated into restoration and management plans for the PBS to consider changes in management and future environmental conditions.
Goal: Water regime (quantity, timing, hydrodynamics) and water quality inputs into the PBS as well as changes in PBS water and habitat quality are improving in terms of their impact on oyster resources.
9. Impacts and activities from future climate scenarios affecting the health and restoration of the PBS ecosystem are considered and addressed to minimize negative effects to the PBS ecosystem.
Goal: PBS O-EBFM Plan is adaptable to climate change and other management considerations.

Theme A: Metrics

The following are suggested metrics for each of the Theme's four topic area objectives.

Oyster Populations

- Stock assessment and shell budget data on all reefs (harvested and non-harvested):
- Location, extent/height and amount of oysters and reef structures (m² and m³; harvestable and non-harvestable).
- Density of live oysters, recent boxes and dead shell (number per m²) on defined reef areas.
- Total oyster biomass (by reef and/or by reefs with similar management objectives).
- Amount (e.g. weight and volume) of cultch and type (see <https://oystersentinel.cs.uno.edu/shell-budget> type characterization) for shell budget. (Only cultch above the anoxic sediment layer).
- Area and relief (spatial configuration and interstitial space) of settlement substrate in the estuary.
- Spatial extent and quantity of larvae in the water column and spat settled throughout the PBS (on standardized substrate) by season and year.
- Funding allocated for restoration.

Ecosystem Services

- Established ecosystem service targets are quantified.
- Quality and spatial extent of fine sediments present in the bay and their propensity for resuspension and redistribution of pollutants potentially harmful to oysters and people.

Substrate

- Amount (m³) of shell returned to the system as result of policies and programs implemented.
- Oyster shell returned to the system by ecological gradients appropriate for oyster growth and survival.

Future Conditions

- Quantity, timing, and quality of water flowing into the PBS.
- Spatially explicit characterization of PBS water quality over time.
- Volume and quality of sediments entering the Bay.

Theme A: Strategies and Actions

Priority 1 and 2 strategies and actions are listed in Tables 3 and 4, respectively, on the next 2 pages.

Table 3. Theme A: Priority 1 Strategies and Actions

The SWG noted that Strategies A1, A2 and A3 should be completed first to inform the remaining strategies.

STRATEGIES (7)	ACTIONS (16)
A1 - Use data collection, monitoring, annual status of oyster assessment data, and comprehensive shell budget models to inform management of oyster populations.	A1.1 - Develop and implement a monitoring plan that references methodologies used. A1.2 - Develop shell budget model scenarios. A1.3 - Implement a spat collection program throughout the bay to inform restoration of the habitat and fishery
A2 - Enhance the monitoring and accuracy of harvested and non-harvested reefs and aquaculture stock data collection and reporting methods for inclusion in recovery targets (restoration and management).	A2.1 - Design and implement a program(s) to supplement state monitoring activities
A3 - Establish restoration and management targets for functional harvested and non-harvested oyster reefs using 1-3 ecological health indicators (e.g., amount of water filtered by oysters, amount of juvenile fish enhancement by reefs; seagrass habitat and other adjacent ecosystems established or restored).	A3.1 - Create and manage a prioritized list with spatially explicit maps of restoration projects for the bay system based on the Habitat Suitability Model and restoration and management targets A3.2 - Establish ecosystem service targets to manage the Bay System (e.g., water filtration, rec. fishing, and denitrification)
A4 - Implement policies and programs for the return of sufficient oyster shell back to the PBS to support sustainable oyster populations and demographic targets and thresholds.	A4.1 - Examine existing laws and create novel policies and programs to support return of shell back to the system (e.g., TX law requires return of material to the water). A4.2 - Examine if policies should also apply to the State's fossil shell sources. A4.3 - Demonstrate the benefits of shell recycling programs to return shell back into the System. A4.4 Identify the current location, quantity, and fate of shell material as a by-product of shucking.
A5 - Manage and remediate sources of sedimentation to the estuary and sediment sinks in the estuary impacting the oyster reef ecosystem.	A5.1 - Identify sources of sediment into estuary. A5.2 Identify how sediment sinks in the bay system affects oysters
A6 - Restore and create reef structures suitable for sustained oyster settlement that enhance ecosystem services in designated restoration areas.	A6.1 - Design and implement projects to achieve multiple ecosystem service targets (e.g., recreational fishing, shoreline protection). A6.2 - Implement restoration projects simultaneously rather than sequentially.
A7 - Evaluate the effects of land use changes in the watershed on the health of oysters (e.g., floodplain forests, marshes, open spaces).	A7.1 - Track land use changes over time (retrospectively and prospectively) to determine if future changes could adversely affect oyster viability in the system. A7.2 - Proactively address potential adverse impacts.

Table 4. Theme A: Priority 2 Strategies and Actions

STRATEGIES (2)	ACTIONS (1)
A8 - Develop and seek a long-term funding source for the development of a dashboard with key metrics and indicators for monitoring ecosystem health that is used across programs and projects.	No Actions identified yet
A9 - Evaluate the development of a policy that would require setting sustainable harvest goals and placing limitations on or a complete closure to harvesting based on the results of data (e.g., stock assessment) collected and evaluated under a comprehensive monitoring program designed to sustainably manage the resource.	A9.1 - Co-management advisory committee assess and make a recommendation to the State.

Theme B: Wild Harvest and Aquaculture – The Management and Regulation of the Oyster Fishery and Aquaculture Industry

Theme B focuses the recovery and management of the wild harvest fishery and management of the aquaculture industry such that long-term sustainability is achieved and complement each other and the restoration of oyster habitat described in Theme A. Sustainably managing the oyster fishery and aquaculture industry are integral pieces to maintaining the economies and cultural presence of these fisheries and the integrity of the bay system, as outlined in the following Vision, Goal and Outcome for Theme B.

Vision: The management, regulation, restoration and enhancement of the oyster fishery and aquaculture industry is conducted by working collaboratively with stakeholders to create a plan that ensures that protection of the fishery and habitat is monitored and implemented in a manner that is supported by science, data, and field and industry experience and observation, and provides fair and equitable access to the oyster resource.

Goal: A productive, and sustainably managed and regulated oyster reef fishery and aquaculture industry in the Pensacola Bay System.

Outcome: By 2030, oyster reefs in the Pensacola Bay System support a sustainably managed and productive fishery and aquaculture industry supported by stakeholders, using the best available science and monitoring to manage and regulate fishery and aquaculture activities in a fair and equitable manner.

Theme B: Objectives

1. Establish sustainable biological and production thresholds and targets for wild harvest.
Goal: Oyster stocks and harvest levels are improving to meet the established targets for oyster fishery enhancements.
2. For wild harvest and aquaculture, ensure management is adaptable and re-assessed on a periodic basis to account for changes in climate and other future environmental conditions.
Goal: Oyster managers are knowledgeable about how changes in climate and other future environmental conditions are changing and could impact oyster resources
3. Growth and expansion of the oyster aquaculture industry in the GPSBS uses best management practices that have broad support of the industry and community, and enables economic opportunities, while maximizing beneficial services of aquaculture, and preventing negative effects to the PBS and its users.
Goal: Industry and community support for growth and expansion of the oyster aquaculture industry in the PBS is high

Theme B: Metrics

Suggested metrics are listed for each of the Theme's three objectives.

Objective 1

- Stock assessment, shell budget, and harvest data to inform management – refer to Performance Measure #1 in Goal A above, with the addition of the following metrics:
- Total harvest in bags or pounds.
- Harvest by fishery type (commercial & recreational).
- Time of harvest during the open fishing season.
- Harvest per licensed harvester.
- Effort expended harvesting/Catch per trip.
- Amount of illegal harvest.
- Number of full-time harvesters that the fishery can support.
- Percent of live oysters harvested.
- Number of acres restored to meet fisheries restoration objectives.

Objective 2

- Changes in climate and other future environmental conditions are studied and analyzed (e.g., modeled, etc.) to anticipate how these conditions might impact oyster resources.

Objective 3

- Annual aquaculture production by bay region.
- Aquaculture's contribution to ecological services based on biomass measurements.
- Industry and community support for growth and pace of expansion of the oyster aquaculture industry.

Theme B: Strategies and Actions

Priority 1 and 2 strategies and actions are listed in Tables 5 and 6, respectively.

Table 5. Theme B: Priority 1 Strategies and Actions

The SWG noted that Strategies BA1, B2 and B3 should be completed first to inform the remaining strategies.

STRATEGIES (8)	ACTIONS (15)
B1 - Annually assess the status of oysters in the PBS and provide regular updates	No Actions identified yet
B2 - Develop a shell budget model	No Actions identified yet
B3 - Develop oyster population and demographic targets and biological thresholds (at the smallest scale that makes sense to inform harvest targets).	B3.1 - Apply routine monitoring data and shell budget models. B3.2 - Define the scale used for the specific boundaries.
B4 - Manage the commercial oyster industry and recreational oyster fishing to provide for sustainable spat production and spawning and the recovery of oyster populations.	B4.1 - Evaluate management scenarios (e.g., closures, rotational harvest, non-harvested spawning reefs, Territorial Use Rights of Fishing, limited entry, regulations, transferable license program). B4.2 - Evaluate existing allowable and minimally destructive alternative gear type options and harvest methods, including the use of experimental gear for wild oyster harvesting.
B5 - Enhance the monitoring and accuracy of commercial and recreational oyster harvest and aquaculture stock data collection and reporting methods for inclusion in fisheries management targets.	B5.1 - Develop and implement a monitoring plan that references methodologies used. B5.2 - Develop shell budget model scenarios. B5.3 - Collect annual estimate of aquaculture harvest (implement via FDACS). B5.4 - Evaluate whether recreational data should be monitored, how it would be implemented, and in relation to a cost/benefit analysis for collecting the data.
B6 - Restore and create reef structures suitable for sustained oyster settlement and production for harvesting.	B6.1 - Work with watermen to evaluate cultching techniques for growing oysters (e.g., historical non-traditional, trees). B6.2 - Design and implement projects to achieve oyster fishery production targets. B6.3 - Design projects that include both fished and non-fished reefs.
B7 - Support and prepare for the expected growth of aquaculture in the PBS.	B7.1 - Develop an aquaculture growth plan that outlines and defines optimal expansion of the aquaculture industry. B7.2 - Develop Spatial Area Management Plan that maps ideal areas for current and future growth using abiotic (DO, salinity, temperature, etc.) and social variables (proximity to docks, exclusion zones, etc.). B7.3 - Establish Aquaculture Use Zones (AUZ).
B8 - Characterize and quantify current biological (e.g., red tide) and chemical hotspots (e.g., pesticides, heavy metals) and inputs into the PBS and their effect on oysters.	B8.1 - Commission studies to collect and analyze data.

Table 6. Theme B: Priority 2 Strategies and Actions

STRATEGIES (3)	ACTIONS (7)
<p>B9 - Promote opportunities for agencies, law enforcement and watermen to work together on enforcement of oyster resource regulations</p>	<p>B9.1 - Evaluate strategies for increasing the capacity of enforcement agencies. B9.2 - Track law enforcement capacity over time. B9.3 - Evaluate, and if needed, improve the process for watermen to communicate with law enforcement. B9.4 - Develop a process for managers and watermen to work with state attorneys and judges on enhancing enforcement and evaluating appropriate penalties.</p>
<p>B10 - Investigate oyster shell and oyster relay programs to move both cultch and live oysters to more favorable habitat.</p>	<p>B10.1 - Use the HSM, information on larval source areas and environmental conditions to inform the potential programs. B10.2 - Research similar relay programs in other areas as potential models and cautionary tales.</p>
<p>B11 - Create public/seafood industry stakeholder programs to cooperatively manage harvested reefs.</p>	<p>B11.1 - Evaluate relaying oysters and/or distributing seed programs.</p>

Theme C: Economy – A Thriving Economy Connected to the Pensacola Bay System

Theme C focuses on the importance of oysters to the economy and culture of the PBS. By aligning their practices to benefit the economic and ecological health of the PBS, businesses can serve as influencers and partners in the recovery and management of oysters and help generate community investment and pride in the culture and heritage that oysters bring to the PBS.

Vision: The Pensacola Bay System oyster fishery, aquaculture, and oyster reef ecosystem serve as key components of the region's cultural heritage and economic viability and serve to sustain an economically viable and thriving fishery, recreation and tourism industry.

Goal: A healthy Bay System contributes measurably to a thriving economy for the Pensacola Bay region.

Outcome: By 2030, recovery of the Pensacola Bay ecosystem spurred by restoration of oyster reef ecosystems and a sustainable oyster fishery and development of aquaculture has led to a thriving economy that provides opportunities for sustainable and responsible industry, development, business, recreation and tourism.

Theme C: Objectives

1. Oyster habitat, oyster harvesting, and oyster aquaculture are recognized and valued as key components of the local economy and cultural heritage by the PBS community and the state.
Goal: Recognition and value of oyster habitat, oyster harvesting, and oyster aquaculture as key components of the local economy and cultural heritage is high or increasing in the PBS community and state.
2. Economic indicators of the commercial oyster fishery, aquaculture industry and associated industries in the PBS demonstrate increasing viability and growth over 10 years.
Goal: The commercial oyster fishery, aquaculture industry and associated industries in the PBS are viable and growing.
3. Investments in water quality management are being made with the goal of protecting and supporting the oyster habitat and oyster aquaculture industry (including land use impacts).
Goal: Water quality parameters of importance to oysters in the PBS are sufficient for supporting vibrant fished and farmed oyster industries.
4. The oyster fishery and oyster aquaculture industries provide economic and career growth opportunities.
Goal: Participation in the oyster fishery and oyster aquaculture industries are growing and creating sustainable careers.
5. Industries, and businesses within the PBS are supportive of and compatible with a healthy, well-managed, and resilient PBS ecosystem.
Goal: Level of support by industries and businesses within the PBS for a healthy, well-managed, and resilient PBS ecosystem is expanding.
6. Government policies, plans and regulations affecting oysters are increasingly compatible with a healthy and well-managed ecosystem while maintaining a thriving economy and supporting cultural heritage.
Goal: (Incorporated into objective)

Theme C: Metrics

Suggested metrics are listed as a group for the Theme's 6 objectives.

- Public attitudes about oyster habitat, oyster harvesting, and oyster aquaculture as key components of the local economy and cultural heritage in the PBS community and state.
- Number of fishermen participating in the fishery/Number of aquaculture leases/Number of workers participating in the aquaculture industry,
- Landed value per pound.
- Number of oyster harvester and aquaculture-related jobs created (deckhands, fish house employees, etc.).
- Number of jobs created for habitat and fishery restoration.
- Cost of management measures (e.g., restoration efforts).
- Percent of local wild harvest and local aquaculture oysters in the market.
- Commercial and recreational total annual catch (bags/day)/total annual aquaculture production.
- Amount of local, state, federal (and RESTORE) funds allocated for management and restoration actions in the PBS.
- Estimated production of reef-enhanced finfish and crab species.
- Spatially explicit characterization of water quality parameters (e.g., Turbidity/Water clarity-reduction in suspended matter and chlorophyll, and extent of seagrass cover.
- Percent removal of nitrogen and value of nitrogen reduction (in dollars).
- Social benefits (value of ecosystem services). (i.e., quality of life increase of sportfishing in the system, swimmable days).
- Level of investment in improving PBS water quality for oyster resources.
- Level of support by industries and businesses within the PBS for a healthy, well-managed, and resilient PBS ecosystem.
- Number of restaurants selling locally produced oysters.
- Number of locally owned businesses that have contributed to restoration and recovery efforts.
- Workforce development initiatives designed to ensure the industry remains economically viable and sustainable.
- Number of "future oyster farmers" programs implemented including the number of participants.
- Number of mentor program "graduates" that enter the oyster restoration and/or fishery workforce in the PBS or other estuary in Florida.
- Number of education and mentoring programs created to build a new oyster workforce for restoration and monitoring, wild harvest, and aquaculture industries (number of engagements/participants).
- Number of government policies, plans and regulations passed that are compatible with a healthy and well-managed ecosystem while maintaining a thriving economy and supporting cultural heritage.
- Number of land development code policy changes implemented to enhance and protect the PBS.

Theme C: Strategies and Actions

Priority 1 and 2 strategies and actions are listed in Tables 7 and 8, respectively.

Table 7. Theme C: Priority 1 Strategies and Actions

STRATEGIES (2)	ACTIONS (3)
C1 - Demonstrate the economic and social benefits derived from the ecosystem services provided by oyster fisheries and restored/natural reef habitat	C1.1 - Compile information on the economic and social benefits accruing from restored reefs (fished and non-fished). C1.2 - Seek out partnerships with researchers that have been doing this work.
C2 - Align local and state government policies and practices that support oyster restoration, fisheries and aquaculture	C2.1 - Evaluate existing policies and practices and recommend adjustments.

Table 8. Theme C: Priority 2 Strategies and Actions

STRATEGIES (1)	ACTIONS (3)
C3 - Monitor key economic indicators for changes over time based on restoration efforts in the PBS.	C3.1 - Characterize the connection between enhanced recreational fishing and tourism opportunities and oyster reef habitat quality and quantity. C3.1 - Identify which economic indicators will be most valuable to monitor. C3.1 - Include indicators that characterize and track the following: key ecosystem services of oyster habitat (e.g., water quality and sport fisheries enhancement), oyster fishery and oyster aquaculture industries

Theme D: Public Education and Communication - An Engaged and Informed Public and Decision-Makers

Theme D focuses on enhancing and creating education and outreach opportunities to inform the constituents of the PBS about the importance of oysters, as a fisheries and habitat, to the health of the bay and the community.

Vision: Stakeholders of the Pensacola Bay System are committed to working together collaboratively to serve as a hub for best practices and research, and provide education and communication on the importance of maintaining the health and productivity of the oyster reef ecosystem, fishery, and aquaculture, and the role they play in ensuring a thriving community.

Goal: The oyster reef ecosystem of the Pensacola Bay System is supported and protected by an engaged and informed public, and decision-makers

Outcome: By 2030, the Pensacola Bay System stakeholders are informed of the importance of sustaining the health of the Bay System, and work actively to invest in and implement the Plan.

Theme D: Objectives

1. Establish a coordinated outreach and education plan to increase public and stakeholder awareness and support for a healthy and well-managed oyster and PBS ecosystem.
Goal: The implemented outreach and education plans increase public and stakeholder awareness and support for a healthy and well-managed oyster resources and PBS ecosystem.
2. The Pensacola and Perdido Bays Estuary Program incorporates and promotes the recommendations of the PBS oyster plan.
Goal: The PPBEP increasingly incorporates and promotes recommendations of the PBS oyster plan.

Theme D: Metrics

Suggested metrics are listed as a group for this Theme's 2 objectives.

- Number of times Plan is referenced in county and city growth management plans.
- Number of people with improved understanding of the ecosystem services provided by oysters important to health and restoration of the PBS (to be identified through a survey).
- Number of businesses, schools, industries, non-profits, and local governments participating in outreach efforts (include number of people participating in each event as well).
- Number of volunteers participating in oyster reef restoration efforts.
- Number of citizen science programs initiated and number of participants/participant hours.
- Number of outreach events held (and number of attendees) on the benefits of shell recycling programs.
- Number of public engagement and education programs held (and number of participants) that focus on oysters as drivers of restoration and management of the PBS.
- Number of community initiatives for growing oysters for their ecosystem services implemented as well as their number of participants.
- Quantify the ecosystem and social benefits of provided by oyster reefs and oyster fisheries.
- Percent of funds secured in relation to funds needed to implement the Plan.
- Extent to which the Estuary Program implements recommendations in the Plan.
- Extent to which implemented outreach and education plans increase public and stakeholder awareness and support for a healthy and well-managed oyster resources and PBS ecosystem.

Theme D: Strategies and Actions

Priority 1 strategies and actions are listed in Table 9. There are no priority 2 strategies for Theme D.

Table 9. Theme D: Priority 1 Strategies and Actions

The SWG identified all strategies in Theme D as Priority 1, therefore, there are no priority 2 or 3 strategies.

Note: The SWG noted that Strategies D1 and D2 should be completed first to inform strategy D3.

STRATEGIES (3)	ACTIONS (12)
D1 - Build a broad constituency to support outreach efforts that generate and increase public awareness and support for a healthy and well-managed oyster habitat and fisheries and the ecosystem services they provide.	<p>D1.1 - Engage businesses, industries, non-profits, and local governments to gain their support and include them in outreach and education efforts</p> <p>D1.2 - Address both positive and negative consequences of depleted/lost oyster reef habitat respectively.</p> <p>D1.3 - Seek public buy-in for supporting restoration efforts by highlighting the benefits to and enlisting the support of recreational fishing, ecotourism, and water sports interests.</p> <p>D1.4 - Establish an oral history project to document the history, present day circumstances, and future visions for oysters by the community in the Pensacola Bay System.</p>
D2 - Promote sustainable wild harvest and cultured oysters and the value of ecosystem services provided by restored oyster populations in the PBS.	<p>D2.1 - Develop and implement a marketing and communication plan, which celebrates oysters as an important feature of the area's cultural heritage.</p> <p>D2.1 - Promote and market certification programs and engage with certification agencies and organizations to certify Pensacola Bay oysters.</p>
D3 - Expand existing or create new mentoring and education programs focused on restoration and monitoring of oyster habitat and fisheries and training for aquaculture farming that involves all sectors of the community.	<p>D3.1 - Develop and support new and existing volunteer citizen-science programs for monitoring, data collection, and restoration efforts for oyster restoration projects at all levels (e.g., youth, adult, K-12, and colleges and universities).</p> <p>D3.2 - Demonstrate the benefits of shell recycling programs to return shell back into the System.</p> <p>D3.3 - Develop and support education programs that focus on oysters as drivers of restoration and management of the PBS.</p> <p>D3.4 - Develop education and mentoring programs to create a new oyster workforce for restoration and monitoring, wild harvest, and aquaculture industries.</p> <p>D3.5 - Design and implement local community initiatives for growing oysters for their ecosystem services (i.e., Mobile Bay oyster gardening), ensuring that science-based best practices are utilized</p> <p>D3.6 - Develop a "future farmers" program that helps locals in the area learn about aquaculture and the potential for making a living by growing oysters in the PBS. (e.g., Partner with existing programs such as Sea Grant MS/AL programs).</p>

Strategies and Actions Referred to the PPBEP

The SWG referred several strategies to the PPBEP. Although the entire Plan will be implemented by the PPBEP as part of the CCMP these are overarching strategies that address the governance of the Plan and watershed-based actions needed to improve the health of the bay and its oyster fisheries and habitat. The SWG prioritized the strategies into priority 1 and 2 categories.

Table 10. PPBEP Priority 1 Strategies and Actions

STRATEGIES (4)	ACTIONS (14)
PPBEP1 - Evaluate and ensure that the Plan works synergistically with and leverages the benefits of the other strategies, plans, and initiatives that are ongoing or planned for the PBS.	PPBEP.1 - Engage businesses, industries, non-profits, and local governments to gain their support and include them in outreach and education efforts.
PPBEP2 - Convene an advisory committee under the auspices of the Estuary Program to evaluate the effectiveness of the Plan. Composition: PPBEP, state management agencies (FWC, FDACS, FDEP, NFWFMD), watermen, and other key stakeholders.	<p>PPBEP 2.1 - Establish the Advisory Committee's organizational structure and define the committee's scope of work.</p> <p>PPBEP 2.2 - Meet (insert how often here) to assess and report progress on meeting the Plan's objectives, outcomes, strategies, and actions in achieving the desired goals and modify the plan as needed to address gaps and issues that may arise.</p> <p>PPBEP 2.3 - Actively engage with state programs to encourage their adoption of the Plan's and PPBEP's long-term monitoring guidelines and metrics for assessing water quality, oyster abundance, and demographics and to regularly review and update these guidelines and metrics to maintain a healthy and sustainable oyster harvest and ecosystem.</p> <p>PPBEP 2.4 - Encourage agencies to prioritize the Plan's recommendations for investing more funding in the management and restoration of oyster resources.</p> <p>PPBEP 2.5 - Recommend changes and/or additions to the state's shellfish management policies to specifically address the needs of oyster recovery in the Pensacola Bay System.</p>

Table 10. PPBEP Priority 1 Strategies and Actions (con't)

STRATEGIES (4)	ACTIONS (14)
<p>PPBEP 3 - Create a comprehensive funding approach for Plan implementation including a comprehensive analysis for future grant funding for strategies, including support for sustainable monitoring deriving from the Plan.</p>	<p>PPBEP 3.1 - Evaluate funding sources for implementation of management and restoration strategies included in the PBS Ecosystem-Based Oyster Fisheries Management Plan (e.g., region-wide Gulf trustee implementation group for NRDA funding.)</p> <p>PPBEP 3.2 - Evaluate grant opportunities from recommendations included in the PBS Ecosystem-Based Oyster Fisheries Management Plan</p> <p>PPBEP 3.3 - Allocate sufficient funding for habitat restoration based on the oyster HSM and restoration and management targets (e.g., Develop funding source for cultch used in oyster reef restoration.)</p> <p>PPBEP 3.4 - Allocate sufficient funding for restoration of harvested reefs and aquaculture farms based on the oyster Habitat Suitability Model (HSM).</p> <p>PPBEP 3.5 - Evaluate funding sources to generate awareness, education, and support for a healthy oyster and PBS ecosystem.</p> <p>PPBEP 3.6 - Develop and seek long-term funding for a comprehensive monitoring program that is used across programs and projects with a dashboard on metrics and indicators to leverage resources, standardize the metrics and indicators measured, and to share data.</p> <p>PPBEP 3.7 - Work across estuary programs to fund and leverage large scale monitoring for the Panhandle Region – Perdido to Suwanee.</p> <p>PPBEP 3.8 - Develop and seek a funding source to provide cultch for habitat restoration.</p>
<p>PPBEP 4 - Develop a set of water quality strategies as common ground that can address pollution and sediment impacts on the oyster resource.</p>	<p>No Actions identified yet</p>

Table 11. PPBEP Priority 2 Strategies and Actions

STRATEGIES (4)	ACTIONS (0)
PPBEP 5 - Restore seagrass and other SAV, and wetland and riparian habitat concurrently to work synergistically with oyster habitat restoration to enhance restoration of the PBS.	No Actions identified yet
PPBEP 6 - Conduct research needed to continue to address and find solutions for oyster disease, predation and oyster spat.	No Actions identified yet
PPBEP 7 - Consider the long-term environmental impacts on the oyster resource including but not limited to ocean acidification and climate change/sea level rise, and population growth.	No Actions identified yet
PPBEP 8 - Consider nutrient credit trading impacts on oyster fishery/resource.	No Actions identified yet

Science Information and Gaps

Oyster Habitat Suitability Model

TNC developed an Oyster Habitat Suitability Model (HSM) to inform the SWG about locations in the PBS likely to be viable for restoration of the fishery and habitat and suitable for oyster aquaculture. While several biogeophysical factors were considered during construction of the model, seven factors were ultimately selected for inclusion due to relevance, quality, and spatial coverage. Table 6 illustrates the factors considered for inclusion in the HSM and those ultimately selected. The resulting HSM, which combines the equally weighted seven factors, identifies the most promising areas for oyster reef restoration for oyster fishing and ecosystem services regeneration, and for oyster aquaculture. SWG members reviewed and recommended modifications to the HSM which were incorporated into a revised HSM version illustrated here (Figure 5). The HSM is not intended to be static but rather easily updated as new information such as reef mapping and condition assessment and improved larval distribution becomes available.

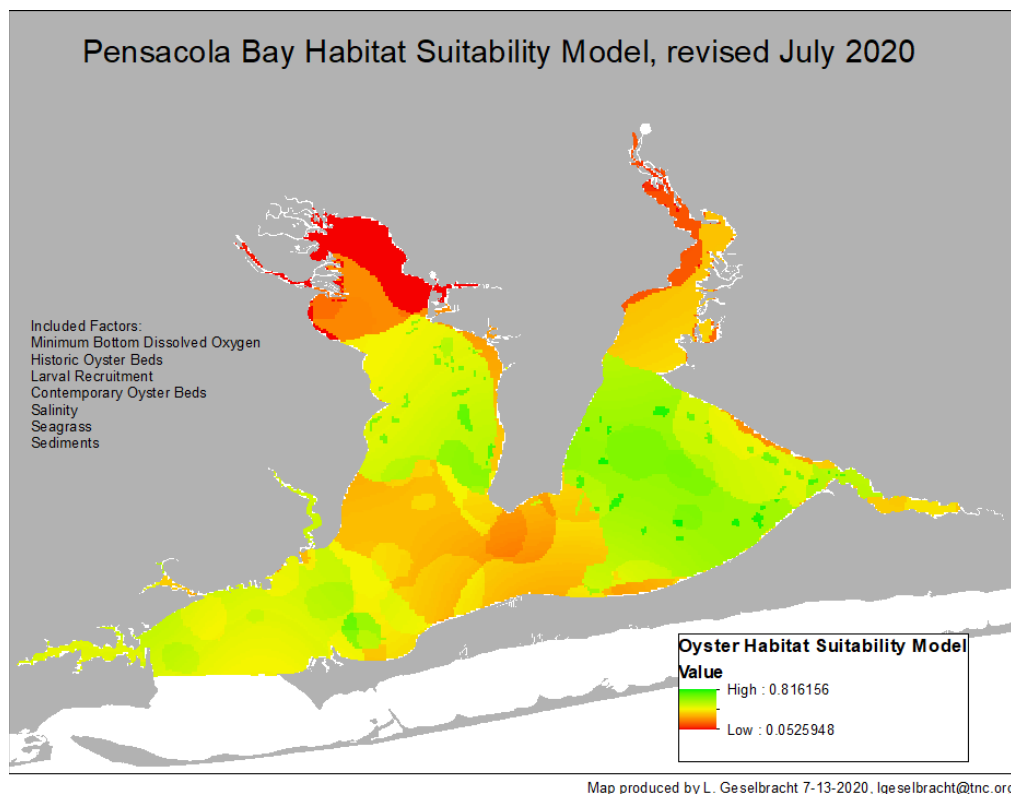


Figure 5. Oyster Habitat Suitability Model for Pensacola Bay.

Table 12. Factors considered in development of the Oyster Habitat Suitability Model (HSM)

Evaluated but not Included	Included and their Scoring for the HSM
<ul style="list-style-type: none"> • Water Flow • Disease • Predators • Managed Areas • Shoreline Type • Sea Level Rise • Aquaculture Lease Buffers • Temperature • Closed Military Areas • Chlorophyll A Concentration 	<ul style="list-style-type: none"> • Contemporary* Oyster Beds (present = 1, absent = 0) • Historical Oyster Beds (present = 1, absent = 0) • Minimum Bottom Dissolved Oxygen (<2 mg/l = 0, 2 to 4 mg/l = 0.5, >4 mg/l = 1) • Seagrass (present = 0, absent = 1) • Sediments (Mud = 0, Muddy Sand = 0.25, Sand = 0.5) • Salinity (< 5 ppt = 0.5, ≥ 5 ppt = 1.0) • Recruitment (variable from 0 to 1 depending on concentration)

*Contemporary here means present within the last couple of decades but may currently be absent.

Draft Restoration Siting Plan

The HSM was overlaid onto the existing regulatory map of opened/closed oyster harvest areas to develop a Draft Restoration Siting Plan (Figure 6). The Draft Restoration Siting Plan provides an indication of where to place harvestable reefs, aquaculture facilities and non-harvested reefs aimed at improving ecosystem services and identifies how much area may be available for each type of use. The Approximately 7,600 hectares of promising areas to restore harvestable reefs (green areas outside of prohibited waters) are identified in the Draft Restoration Siting Plan (Figure 6). However, based on the historical presence of reefs in the yellow and orange areas (11,285 ha), siting of harvestable reefs may also be appropriate in these areas if site-specific assessments indicate this.

The Draft Restoration Siting Plan provides more generalized guidance and the resolution may not preclude restoration success in areas identified as less favorable. Similarly, in the prohibited harvest areas (hatched areas), 1,693 ha are identified as promising for siting reefs focused on providing ecosystem services (green under hatch). Some areas that are considered harvest prohibited waters and are identified as yellow and orange areas (9,685 ha) may also be appropriate if site specific evaluations indicate. Siting decisions will need to consider a number of other factors prior to final siting decisions such as availability of oyster larvae in the vicinity of the potential reef sites, likelihood of producing the greatest water quality benefits, propensity to avoid sedimentation, and accessibility to recreational fishers and oyster harvesters. The completion of mapping and condition assessment in East and Blackwater bays is expected in Summer 2021. The information will enable restoration practitioners to fine-tune actions and locations for restoring oyster habitat both for fishing and conservation. Restoration siting plans can be refined as additional information on these, and other factors become available.

Pensacola Bay DRAFT Spatial Management Plan

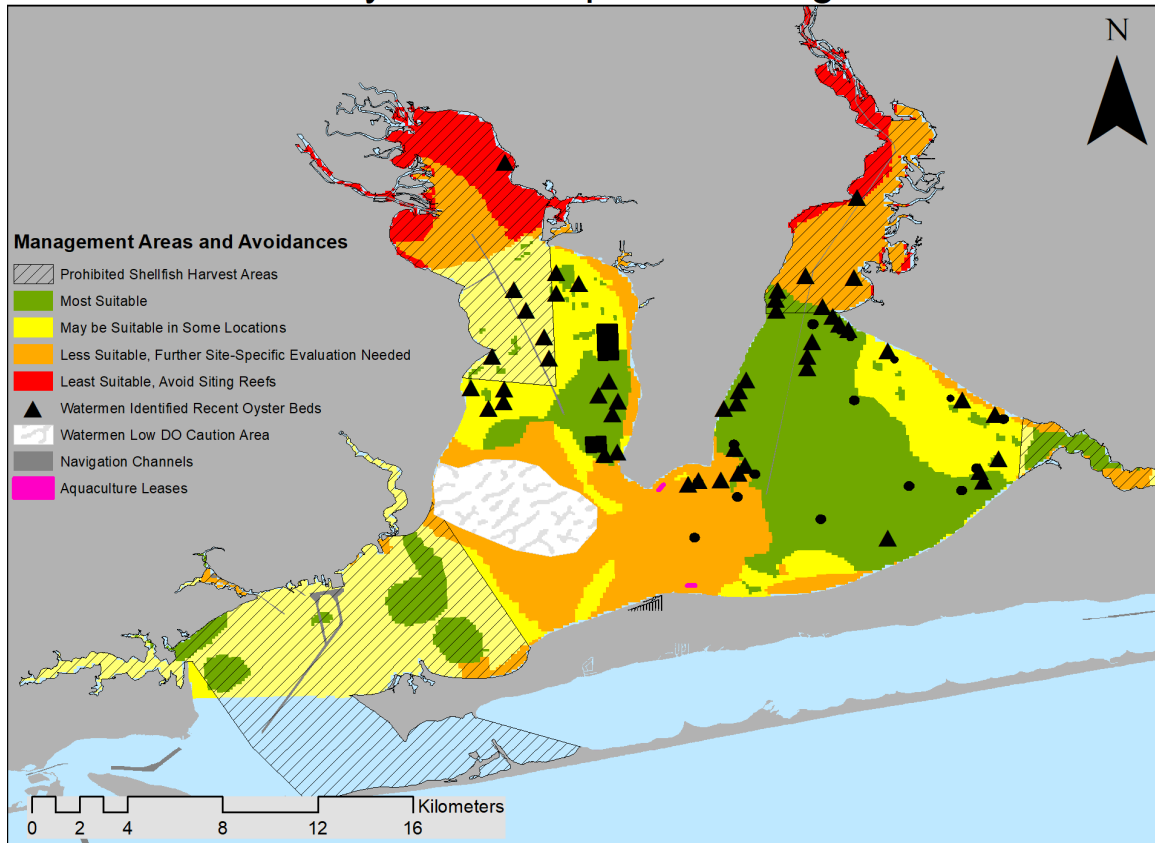


Figure 6. Spatial guidance on where different types of oyster reef restoration may best be suited. Note: Existing management designations are overlaid on the Habitat Suitability Model.

Gaps in Science

Key data gaps necessary to inform restoration remain. These gaps include knowledge of historical and current locations of oyster habitat, larval oyster density and distribution throughout the PBS, restoration design criteria, prevalence of disease, and site-specific water quality factors such as sedimentation and salinity. Filling these gaps can help advance restoration in the PBS.

- Crucial for informing restoration is an understanding of where reefs used to occur, where they are located in the present day and their condition (number of live oysters per area, size classes, and disease prevalence), and where conditions are right for oysters but where no oysters are present. TNC and Escambia County are conducting oyster habitat mapping (2021) to help close this gap in knowledge.
- Restoration of oyster reefs in the PBS primarily requires the addition of hard substrate for the settlement of oyster larvae that will ultimately turn into adult oysters. This is one of the most cost-efficient methods for restoring oyster reef in estuarine systems but requires that oyster larvae of sufficient quantities are present. Oyster larvae in the PBS need to be spatially characterized and quantified prior to finalizing oyster reef restoration projects to ensure cultch is placed in areas likely to receive larval supply.
- Salinity is a key factor in oyster survival and widespread current conditions of salinity gradients throughout the PBS are not completely known. Furthermore, the salinity regime will change over time with sea level rise and other climate change impacts so it will be useful to better understand how these changes could affect oysters.

- Sedimentation has likely contributed to the decline of oyster reefs throughout the PBS and elsewhere. Sediment sources include uplands draining into rivers, and eventually entering the PBS, coastal run-off, and the resuspension of sediments during strong storm events. There are also several locations within the bay system, such as Bayou Chico, that are known to contain contaminated sediments. What remains unknown is where contaminated sediments may overlap with oyster harvest areas and what risk this overlap may present to human health. There is a need to conduct bioassays on prospective areas to be cultched to understand the potential human consumption impacts; to better understand if and how channel dredging affects resuspension of sediments; and whether either of these contribute to human health concerns related to eating shellfish in the PBS.
- There is a lack of data on the prevalence of diseases in PBS oyster populations, resistance to these diseases, and the extent to which contaminated sediments may make oysters in the PBS more susceptible to disease.

Projects Currently Planned or Underway

Several projects that address one or more of the Plan's strategies and actions are underway or being developed by SWG members. The projects, compiled by the PPBEP, are identified in Appendix G Table 1. The location and short descriptions of each project can be found on an ArcGIS web-based map produced by the PPBEP by visiting:

<https://www.arcgis.com/home/webmap/viewer.html?webmap=ab003e20236f439e8aa3fdd42663144d&extent=-87.6458,30.201,-86.6316,30.7095>

Project examples include the following:

1. TNC is working with the PPBEP, the Environmental Protection Agency, and oyster academic professionals to develop water filtration ecosystem service data that inform locations for future restoration. (SWG members: Matt Posner and Whitney Scheffel with the PPBEP)
2. University of Florida and University of West Florida are collaborating with the PPBEP to quantify impacts, stressors and outcomes for the long-term conservation and management of the estuary system. This project is funded by the FL RESTORE Act Centers of Excellence Program. (SWG member: Dr. Jane Caffrey)
3. PPBEP and TNC are conducting mapping and condition analysis of oyster reef habitat in Escambia and Santa Rosa counties, respectively, with anticipated completion by June 2021. The information will be used in concert with the data on reef locations and condition of the reefs restored for wild harvest with Deepwater Horizon oil spill funding to inform future restoration. (SWG members: PPBEP and Santa Rosa County staff)
4. TNC is implementing a large-scale oyster habitat restoration project in East and Blackwater bays in Santa Rosa County funded by the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund. (SWG members involved: Beth Fugate, Christine Verlinde, Katie Konchar, Kent Smith, Portia Sapp)
5. Florida Oyster Trading Company, LLC, Escambia and Santa Rosa County IFAS Extension offices, SmartOysters Pty. Ltd, and FDACS are developing a public/private concept to provide "resources necessary to innovatively develop the oyster aquaculture industry while collaboratively assisting with the reestablishment of the commercial wild harvest." (SWG members: Christine Verlinde, Josh Neese, Portia Sapp, Rick O'Connor)

Moving Forward: Next Steps for Implementation

Recommendations for Implementation

The Plan is designed to be an adaptable living document that is regularly assessed and modified as needed as work is completed and conditions change (environmental, economic, social or political). SWG members and community stakeholders will continue to meet as an advisory sub-committee (described below) to implement the Plan.

The stakeholders in the PBS are leaders in shaping a new path for management and restoration of oysters. The Plan is an experiment of how an oyster fishery and habitat can be both managed and restored using a community-based collaborative approach. The intent is for oyster fishermen, regulatory agencies, and other interested stakeholders to be at the table with equal voices in the decision-making process. Results and lessons learned as the Plan is implemented need to be shared with partners within the PBS and beyond so that oyster fishery, habitat restoration, and regulatory stakeholders continue to improve management using a collaborative adaptive ecosystem-based approach.

Role of the PPBEP and the State of Florida

The PPBEP, FWC, and FDACS will continue to explore and transform their respective roles in implementing oyster restoration and management according to the Plan's guidance. They are committed to continuing to advance and guide this type of oyster planning effort beyond the Pensacola Bay System.

The FWC and FDACS have agreed to serve as members of the Plan's Oyster Advisory Committee along with TNC and members of the SWG to aid with the Plan's implementation. The committee will serve as a standing sub-committee under the PPBEP's Technical Advisory Committee, as approved by the PPBEP's Policy Board on March 31, 2021, to help guide implementation of the Plan.

The PPBEP has agreed to two important steps:

1. Adoption of the Plan as a key element that guides the direction of the Comprehensive Conservation and Management Plan (CCMP); and
2. Convening the Plan's Oyster Advisory Committee, which was identified by the SWG as a Priority 1 strategy for the PPBEP.

These are important commitments that ensure the Plan is put into action and that the CCMP's actions throughout the watershed are guided with the intent of restoring, managing and conserving a healthy bay system that can support a healthy oyster industry and habitat.

References

Beck, M.W., Brumbaugh, R.D., Airoidi, L., Carranza, A., Coen, L.D., Crawford, C., Defeo, O., Edgar, G.J., Hancock, B., Kay, M.C., Lenihan, H.S., Luckenbach, M.W., Toropova, C.L., Zhang, G.F., and Guo, X.M. 2011. Oyster reefs at risk and recommendations for conservation, restoration, and management. *BioScience* 61(2):107-116.

Collard SB. 1991b. Management options for the Pensacola Bay System: the potential value of seagrass transplanting and oyster bed refurbishment programs. Water Resources Special Report 91-4,

Lewis, Michael, J. Taylor Kirschenfeld, and Traci Goodheart. 2016 Environmental Quality of the Pensacola Bay System: Retrospective Review for Future Resource Management and Rehabilitation. U.S. Environmental Protection Agency, Gulf Breeze, FL, EPA/600/R-16/169.

NOAA 2021 <https://www.fisheries.noaa.gov/insight/understanding-ecosystem-based-fisheries-management>

Northwest Florida Forward. 2017. A Regional Strategy for Economic Transformation. Florida's Great Northwest and Tip Strategies report, 113 pp., <http://www.northwestfloridaforward.com/page/strategy>

Trochta JT, Pons M, Rudd MB, Krigbaum M, Tanz A, Hilborn R (2018) Ecosystem-based fisheries management: Perception on definitions, implementations, and aspirations. *PLoS ONE* 13 (1): e0190467. <https://doi.org/10.1371/journal.pone.0190467>

West Florida Regional Planning Council, Bay Area Research Council, National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency. 2005. The Pensacola Bay Watershed Management Plan, an Integrated Action Plan. Cooperative publication of U.S. Environmental Protection Agency, Bay Area Research Council, National Oceanic and Atmospheric Administration, the West Florida Regional Planning Council, Pensacola, FL. 324 p.

U.S. Census Bureau 2019, <https://www.census.gov/>

APPENDICES

Appendix A: Planning Team Members

The Nature Conservancy

Anne Birch, Marine Program Manager, Florida
Robert Brumbaugh, Caribbean Division Director
Bryan DeAngelis, Marine Habitat Scientist, Global Marine Initiative
Laura Geselbracht, Senior Marine Scientist, Florida
Andrea Graves, Marine Project Coordinator, Florida



Facilitated Solutions, Inc.

Jeff Blair, Principal/Owner
Robert Jones, Facilitator





**Oyster Ecosystem-Based Fishery Management Plan (O-EBFM)
for the Greater Pensacola Bay System**

STAKEHOLDER WORKING GROUP QUESTIONNAIRE REPORT

TABLE OF CONTENTS

I. MOST IMPORTANT OUTCOME FOR THE OYSTER ECOSYSTEM-BASED FISHERY MANAGEMENT PLAN (O-EBFM)	2
II. LOOKING BACK- GREATER PENSACOLA BAY SYSTEM	3
III. LOOKING AROUND	5
A. Tailwinds: Factors Enhancing the Health and Success of the Greater Pensacola Bay System.	5
B. Headwinds: Factors Impeding the Health and Success of the Greater Pensacola Bay System.	7
C. Trends: Affecting the Greater Pensacola Bay System	8
IV. KEY STRATEGIC ISSUES AND CHALLENGES	10
A. The Role of Oysters in a Healthy Greater Pensacola Bay System- How Critical	10
B. The Water-Land Interface for Sustainable Growth and Development- How Critical?	12
C. Water Quality Issues and Challenges – How Critical?	13
D. Public and Leadership Education and Outreach Challenges – How Critical?	14
E. Research and Data Gaps- How Critical?	15

V. LOOKING FORWARD	16
A. Describe a Very Undesirable Future for the Greater Pensacola System in 2030.	16
B. Envision a Successful Future for the Greater Pensacola System in 2030.	16
C. Draft Vision of Success Themes (drawn from the responses).	18
D. Stakeholder Working Group Members Responding	19

STAKEHOLDER WORKING GROUP QUESTIONNAIRE REPORT

The Stakeholder Working Group is being convened to develop consensus on an Oyster Ecosystem-Based Fisheries Management Plan (O-EBFM) for the Greater Pensacola Bay System (GPBS). In advance of the Organizational Meeting on October 9, members were asked to respond to a Questionnaire. Their responses are incorporated into this Questionnaire Report and to the Working Group meeting agenda.

I. MOST IMPORTANT OUTCOME FOR THE OYSTER ECOSYSTEM-BASED FISHERY MANAGEMENT PLAN (O-EBFM) PROCESS

From your perspective, what would be the single most successful outcome for the Oyster Ecosystem-Based Fishery Management Plan (O-EBFM) Working Group process to achieve?

MOST IMPORTANT OUTCOMES FOR THE OYSTER ECOSYSTEM-BASED FISHERY MANAGEMENT PLAN <i>Listed In order of frequency</i>	
1.) An implementable science-based plan for reestablishing an oyster fishery in the Pensacola Bay System	<ul style="list-style-type: none"> • An implementable plan with achievable goals. • Develop a plan that supports a healthy oyster population. • A plan that can be implemented vs. one that sits on the shelf. • To create an oyster fishery again in Pensacola Bay system. • A science-based plan/agreement on oyster restoration in local waterways. • Local and regional stakeholders support a GIS supported oyster restoration plan incorporating all oyster fisheries, protected areas, and provision of target ecological services. • Creating an actionable framework and plan to move forward. • Local and regional stakeholders support a GIS supported oyster restoration plan incorporating all oyster fisheries, protected areas and provision of target ecological services.
2.) Identify ecosystem priorities and solutions	<ul style="list-style-type: none"> • Identify priorities and solutions that will improve resilience and ecosystem services of GPBS oyster ecosystems. • Identify and prioritize solutions to the issues faced. • Identify and prioritize issues influencing oyster sustainability in watershed and solutions with most bang for buck.
3) Reestablish an oyster fishery	<ul style="list-style-type: none"> • A commercial oyster fishery industry compatible with recreational activities. • To create an oyster fishery again in Pensacola Bay. As far as I understand the wild oyster fishery is currently dead.
4.) A growth plan for the region that protects the health of Pensacola Bay	<ul style="list-style-type: none"> • A comprehensive growth management plan for the region that is actually implemented by local governments.
5.) Improve water quality in the Pensacola Bay System	<ul style="list-style-type: none"> • Removal of all the Wastewater Effluent from Santa Rosa Sound and Blackwater River.
6) Consensus	<ul style="list-style-type: none"> • Local and regional stakeholders support a GIS supported oyster restoration plan incorporating all oyster fisheries, protected areas and provision of target ecological services.

II. LOOKING BACK- Greater Pensacola Bay System

Looking back, list below the key milestones, people, eras that have made a difference (for better or for worse) for the Greater Pensacola Bay System:

LOOKING BACK: SHARED HISTORY- GREATER PENSACOLA	
KEY MILESTONES/INITIATIVES	PEOPLE/LEADERS
<ul style="list-style-type: none"> • Founding of the Bream Fisherman Association in 1950's. (2) • Clean Water Act 1972. • EPA/Olinger 1975 recovery report. • 1996, the County Water Quality Division, the County Marine Resources Division. • Chemical discharges into eleven-mile creek severely impacted the health of Perdido Bay. • Industrial discharges into Escambia River severely impacted the health of upper Escambia Bay. • Pre-NPDES development (including ag. and silviculture) throughout watershed yielding sedimentation and channelization of nearly all 1st and 2nd order streams (exponential loss of ecological services for all bay inputs)! • 1999 Grand jury investigation, Report of the Special Grand Jury on Air and Water Quality 1999 Pensacola Bay System. • Escambia County Wetlands Ordinance 2002. • Lack of Rx Fire throughout watershed yielding ecological succession to high standing biomass forest with effects on hydroperiod and other ecological perimeters. • Overharvesting of shellfish (oysters and scallops) greatly decreased their abundance in the bay. • Establishing the County Department of Neighborhoods and Environmental Services. • Excessive development resulted in increased run-off and decline of habitats such as seagrasses and oyster beds. • 2014 growing population in city of Pensacola and especially infill development downtown, which avoids some of the water quality damaging sprawl development happening on undeveloped lands. • Industrialization of Bayou Chico. • Continued operation of an industrial port. • Failure to maintain Navarre Pass. • Acquisition of Escribano Point and associated restoration. • Establishment of Yellow River Aquatic Preserve. • Restoration activities on Garcon Peninsula. • Relocation of ECUA to mid-county / IP joint effluent project. • Escambia County inclusion of wetland buffers in LDC. • Beach Haven septic remediation project. • Holley-by-the-Sea stormwater retrofit (in process). • Establishing the Bay Area Resource Program. • The Environmental Grand Jury Findings Report. • All septic to sewer conversion project. • Project Greenshores. • Wastewater treatment plant modernization and relocation. • Project Green Shores. • Addressing sedimentation, water quality and stormwater issues. • Hopefully the shelling projects a few years ago were beneficial to the reef systems. • Relocation of ECUA WWTP from downtown Pensacola (post Ivan). • Sewer vs. septic in Navy Point and Beach Haven (ongoing). 	<ul style="list-style-type: none"> • NPDES mitigation on Eglin (Sandy Pizzalato) • Mike Lewis EPA; • Barbara Albrecht, • Ernie Rivers, • JD Brown BFA; • Keith Wilkins, • Chips Kirschenfeld, • Robert Turpin Escambia County; • Darryl Boudreau, TNC; • Sava Varazo FDEP • Grover Robinson County Commissioner • Mayor • Like with many other fisheries, it's a long list of people, events, and regulations that led to our current situation with oysters in the GPBS

<ul style="list-style-type: none"> • Stormwater capture around Bayou Texar. • Establishment by Yarboro and Carlson of Seagrass Integrated mapping and monitoring program. • These habitat reductions triggered a decline of certain estuarine species – some of the economically important. • The conversion from septic to sewer, and the installation of baffle boxes, reduced the levels of bacteria (and the number of health advisories issued) in the local bayous. • Those same conversions and mitigations reduced the amount of nutrients in these waters and the number of large fish kills reported. The creation of the Estuary Program. 	
<p style="text-align: center;">KEY ERAS</p>	
<ul style="list-style-type: none"> • 1800-1950 over harvest of oysters without replacing substrate. • 1880-1950 shift from natural forested uplands to silviculture with unpaved logging roads. • 1880-PRESENT Accelerating sea level rise and climate alterations due to human caused climate change causing changes in freshwater flows, salinity regimes, coastal erosion and inundation. • 1900-2018 landscape alterations, (coastal development) due to human population increase- includes watershed alterations for commercial purposes. • 1930s--decision to recruit industry to settle here 1950--post war economic boom combined with zoning and cheap gasoline fueled a new spread-out and land-gobbling (and waterway destroying) form of low-density development--sprawl; the worst land use for water quality. • 1950s-70s -unchecked direct discharges (IP; Navarre WWTP, ECUA); lack of investment in stormwater infrastructure; road building in wetlands (Santa Rosa County); culverts vice spanning of new bridges in Santa Rosa. • Bad polluting of the Bays in the 1970's and 1980's. • Allowing point source discharges from Industries, Monsanto, American Cyanamid, Air Products, Gulf Power Coal Plant and International Paper In addition to, allowing the use of septic tanks, currently numbered in the tens of thousands all along the coastal areas. • 1970-2018 Shift on military lands from consumptive natural resource uses to conservation and restoration of natural communities. • 1980-2010 Florida Forever and NFWWMD large-scale conservation and land purchases and habitat restoration efforts. • 1990-PRESENT Focal shift toward improving water quality through shifting communities to advanced wastewater treatment systems. • 1990-PRESENT Active implementation of live shoreline projects along public and private shorelines (coastal hazard reductions for effects of climate change. • 1999 - 2004 Citizen and some political engagement supporting local government environmental regulation and effective state regulation. • UWF- PERCH project – 2002-2007. • 2010-2019 response to the BP oil spill. I know it seems counterintuitive, but the political support and citizen engagement had waned to the point the County was going to significantly cut their environmental department as had happened across the state with local governments as a result of the recession. The oil spill galvanized the need for environmental engagement by local government and solidified the need and their commitment for the next decade. • I'm not going to go negative on people but for eras: any time there was a good economy and building boom such as pre-recession 2005,6,7 and somewhat now. Great things are happening with the flow of BP money, but it seems the focus on capital projects and project management has distracted our local and state governments from environmental permitting, compliance and enforcement. Also, the past state administration was extremely detrimental to environmental programs. 	

III. LOOKING AROUND

Tailwinds:

Members listed any factors enhancing the success and health of the Greater Pensacola Bay System. The list and table below are factors listed in order of frequency:

1. Growing public consciousness of the Bay's importance and health.
The Pensacola & Perdido Bays Estuary Program
Restore funding, restoration and awareness
2. Expansion of aquaculture in the region.
Cities are cool again.
3. Improving water quality.
New development regulations addressing run-off.

TAILWINDS-FACTORS ENHANCING THE HEALTH AND SUCCESS OF THE GREATER PENSACOLA BAY <i>Listed In order of frequency</i>	
Growing public consciousness of the Bay's importance and health <ul style="list-style-type: none"> • Understanding of the importance for the Bay System regarding recreation activities. • Access to Bays and Bayous (Bruce Beach - Escribano Point - Navy Point - Bayview - Sanders Beach) for the public and realization that access to recreation doesn't need to be at the beach (i.e., more public awareness of water quality issues); continued ECUA program to convert septic to sewer on water fronting neighborhoods. • Public sentiment wanting healthier water. News stories of people being injured by polluted water (Flesh eating bacteria etc.). • Forming of groups to help direct its protection. • Interest by local citizens including grass roots groups to promote planning and environmental conservation. 	
Pensacola & Perdido Bays Estuary Program <ul style="list-style-type: none"> • Estuary Program is the great hope for our bay systems. • Establishment of the Perdido, Pensacola Estuary Program. • Establishing an estuary program is a good start, but bringing light to beneficial habitat and how to protect, enhance and restore has been a key factor. • Formation of local estuary program post BP monies and projects. • The potential (as yet to be realized) of the Estuary Program. 	
Restore funding, restoration and awareness <ul style="list-style-type: none"> • Awareness and funds stemming from Deepwater Horizon. • BP funding is good for projects. • The potential (as yet to be realized) of RESTORE funding. • Successes of previous restoration efforts (Project Green Shores, Bayou Chico). • The installation of stormwater baffle boxes around Bayou Texar. 	
Expansion of aquaculture in the region <ul style="list-style-type: none"> • Shelling projects. • The expansion of aquaculture in the region. • Farm raised oysters. 	
Cities are cool again <ul style="list-style-type: none"> • Cities are cool again. • Focus on urban living with less automobile use. • Conversion of septic to sewer in the city limits. 	
Improving water quality <ul style="list-style-type: none"> • Reduction in industrial/commercial uses of the waterways and addressing issues caused by them. 	
New development regulations addressing run-off <ul style="list-style-type: none"> • New development regulations that require developers to account for run-off (silt screening, retention ponds). 	

Headwinds: Factors Impeding the Health and Success of the Greater Pensacola Bay

Members listed any factors impeding the health and success of the Greater Pensacola Bay System. The list and table below are factors listed in order of frequency:

1. Construction and development and habitat loss.
2. Water quality and habitat loss.
3. Regulation and enforcement.
Public and leaders lack of support and awareness of issues affecting the health of the Bay.
4. Stormwater discharge and runoff.
Funding for restoration and infrastructure.
5. Lack of unity on a plan of action.

HEADWINDS- FACTORS IMPEDING THE HEALTH AND SUCCESS OF THE GPBS <i>Listed In order of frequency</i>	
Construction and development and habitat loss	<ul style="list-style-type: none"> Continued sprawl and land loss. Urban development. Stormwater Runoff from rapid deforestation of the watershed caused by increased building developments. Coastal development. The focus on development, particularly residential development at all cost without putting it in context. Continued dense growth along the coastal zone. New developments outside of the city still use septic tanks and these are not maintained properly. Overall habitat loss associated with coastal development and water quality. Continued dense growth along the coastal zone.
Water quality and habitat loss	<ul style="list-style-type: none"> Water quality still subpar. Government inaction and lack of coordinated effort to protect water quality (Indian Bayou example of agency finger pointing); FDOT unwilling to prioritize environmental mission of road building. While water quality tends to improve in older areas, it is now declining as new land areas are developed. Many mitigation projects to address discharge problems are not adequate (or are not properly done). Successful outcome for water-quality improvements in the bay must start at the watershed boundary, not in the littoral zone. The scope of the impediments is so great that token efforts are more likely than ecologically significant outcomes. Legacy degradation in system holding back recovery of biota even as water quality has improved overall since 70s. Overall habitat loss associated with coastal development and water quality. Without much knowledge I would say water quality because I don't believe there's even very many being harvested at this point.
Regulation and enforcement	<ul style="list-style-type: none"> New citizen activism is exposing a huge lack of engagement, effective inspection and enforcement by the regulatory agencies. Poor state and federal guidelines for industry and lack of enforcement. Current industries that maybe affected with recommended changes being afraid of losing work or jobs. Environmental compliance for construction and land use is severely lacking at the FDEP, Water Management District and County.
Public and leaders lack of support and awareness of issues affecting the health of the Bay	<ul style="list-style-type: none"> Lack of awareness of the issues affecting the Bay. Broader, more diverse outreach needed. I don't feel there is political support for the Estuary Program and fear it is going to struggle and wither on the vine. I am pessimistic it will exist after the BP funding is expended. People's natural resistance to change. Folks spending the money are politicians not ecologists (e.g. building boat ramps rather than conducting restoration).

Stormwater discharge and runoff <ul style="list-style-type: none"> Recent excessive rains, and associated run-off, may be decreasing salinities in the estuaries and impacting both habitats and fisheries within. Stormwater Runoff from rapid deforestation of the watershed caused by increased building developments. Many mitigation projects to address discharge problems are not adequate (or are not properly done).
Funding for restoration and infrastructure <ul style="list-style-type: none"> RESTORE funding frittered away on projects that don't really improve the region. Funding large-scale projects not for optimal impact. Lack of funding to alter infrastructure where needed.
Lack of unity on a plan of action <ul style="list-style-type: none"> Lack of unity on plan of action, many directions.

Trends Affecting the Greater Pensacola Bay System

Members listed trends in the coming years affecting the Greater Pensacola Bay System. The list and table below are factors listed in order of frequency:

1. Population growth and development pressures.
2. Shift away from industrial economy to retail / tourism economy.
3. Political will and engagement to address ecosystem resilience.
Green infrastructure.
4. Rise of Aquaculture.
Use of non-native landscaping.
Marine debris.
Rise in pet ownership.

TRENDS- AFFECTING THE GREATER PENSACOLA BAY SYSTEM <i>Listed In order of frequency</i>
Population growth and development pressures <ul style="list-style-type: none"> Urban sprawl into coastal wetland areas, diverting. Challenges of accelerated population growth. Increasing population growth. Increasing conversion of marginal lands to residential developments. Growth of the population in Florida and the increase of people living on the water. Population growth. Increased growth and pressure for more roads to undeveloped areas. Continued human growth in the coastal areas will continue to stress the systems. Continued interest from the political community to continue intense coastal development.
Shift away from industrial economy to retail / tourism economy <ul style="list-style-type: none"> Shift away from industrial economy to retail / tourism economy is positive both in loss of point-source inputs (e.g. reduction in paper, textile & chemical industries in watershed as well as shift in energy production) as well as shift in public sentiment viewing ecological assets as attractant for economic growth. Tourism growth. Positive: Emphasis on quality of life/quality of place. Hopefully an increase interest in the nature-based tourism economy, which would increase interest in protecting estuarine habitats. I believe the time is right from an economic standpoint to do something because it seems there is currently some funding to work with. Improving trend: Better understanding/acknowledgement of linkages between ecosystem health and recreation activities and the economy. Environmental issues tied to economic issues. Folks focused on trying to improve the system (TNC, PPBEP etc.).

Political will and engagement to address ecosystem resilience <ul style="list-style-type: none"> Lack of political will and engagement by the City, County and State in climate change, GHG reductions and land use regulation for the County and State. Limited political, economic, and social will/ability to address underlying concerns that may improve ecosystem resilience.
Green infrastructure <ul style="list-style-type: none"> Hoping the increase use of green infrastructure methods will reduce the amount (and quality) of run-off into the bay. Storm water non treatment.
Rise of Aquaculture <ul style="list-style-type: none"> Increase interest in shellfish aquaculture as a source of local seafood, in lieu of wild harvest.
Use of non-native landscaping <ul style="list-style-type: none"> Non-native landscaping.
Marine debris <ul style="list-style-type: none"> Increased interest in reducing marine debris.
Rise in pet ownership <ul style="list-style-type: none"> Rise in pet ownership.

IV. KEY STRATEGIC ISSUES AND CHALLENGES

Members provided their sense of how critical each issue area will be to address in the plan and what challenges and issues are raised by the issue areas the Stakeholder Working Group should focus on in developing the plan. These issue areas were identified in the Stakeholder Assessment Report.

A. The Role of Oysters in a Healthy Greater Pensacola Bay System- How Critical

	<i>Very Critical</i>	<i>Critical</i>	<i>Less Critical</i>	<i>Not Critical</i>	<i>Don't Know</i>	<i>Average</i>
Rating Scale	4	3	2	1	0	
# of Responses	6	7	1	0	-	3.4 of 4

- What are the related issues as you see them and any options the Working Group should explore?

Oysters in the Greater Pensacola Bay System

- How and where to place parent oyster beds around the bay to adequately seed the bay for a sustainable oyster population.
- The Bay system's readiness to support an oyster industry and action necessary to get it ready.
- Identify current roadblocks to natural recovery and resilience of oyster ecosystems in GPBS (i.e., the ultimate drivers leading to loss, slow recovery, and long-term sustainability of wild oysters in the system) and find solutions to address, or at least reduce their impact prior to restoring or creating new oyster reef habitat.
- Rebuilding of wild populations.
- Restore oyster beds where they naturally have occurred in the past.
- Impact of sea level rise on oyster sites.

Enhancing water quality

- Oyster population, in my opinion, is more an indicator of water quality than a contributor to it. My view is that water quality improvement must address the watershed from top (seepage slope wetlands) to bottom (flatwoods and wet prairie) as well as conduits (streams).
- Efforts to restore and enhance the up-gradient ecosystems will make estuarine efforts (seagrass / oyster reef) more successful.
- Water quality impacts through land use and atmospheric deposition and climate change resulting in temperature changes, higher sea levels and salinity variations. The working group should also explore how to build support for the Estuary Program which in turn, if successful, will improve the bays ecology.
- Health of the entire ecosystem and water quality.
- Enhancing water quality.

Political will and citizen education and engagement

- Political will, responsibilities and action.
- Citizen education.

Land development codes to protect coastal wetlands

- Land Development Codes to protect coastal wetlands.

2. What key information do you think the Working Grouping needs to make informed recommendations to address issue(s)?

Mapping

- Navigable waterways.
- Existing current mapping.
- Salinity mapping.
- Methods to improve the health of the ecosystem.

Evidence of oysters enhancing fisheries

- Evidence that Oysters enhance fisheries.
- Include Aquaculture and wild oysters.

Green infrastructure alternatives

- Provide decision makers with sustainable development alternatives like Green Infrastructure other than clear cutting trees from coastal lands and adding impervious surfaces.

Lesson learned from previous oyster restoration efforts

- Details on successes and failures of previous oyster restoration efforts.

State-of-science quantitative data to support recommendations

- State-of-science quantitative data on focal point implementation strategies, if such exist, or to fund them if they do not. For example, one might intuit that septic tanks are bad and contribute to water quality degradation. However, they might actually have no measurable impact on water quality in certain situations. Parent geology, local edaphic conditions, proximity to surface waters, etc. are likely parameters that affect the impact of septic systems on down-gradient waters. I would hate to implement an expensive replacement strategy without positive quantification of the actual effect on water quality outcomes. Any recommended intervention, policy, restoration, etc. should be supported by good science. Accordingly, the proposed plan should be fully informed by the existing literature. Thus, that information should be collected and digested by scientists as a starting point for the working group.

Historical water quality data

- Historical water quality data

FDOT and County transportation plans and projects

- Road building plans (FDOT and County plans for growth).

Sewer/septic data

- ECUA (and other sewer providers) data on sewer/septic.

A. The Water-Land Interface for Sustainable Growth and Development- How Critical?

	<i>Very Critical</i>	<i>Critical</i>	<i>Less Critical</i>	<i>Not Critical</i>	<i>Don't Know</i>	<i>Average</i>
Rating Scale	4	3	2	1	0	
# of Responses	10	4	0	0	-	3.7 of 4

1. What are the related issues as you see them and any options the Working Group should explore?

Sustainable development, mitigation and water quality

- The land water interface is intrinsically tied to water quality – water quality won't be improved unless issues on the land are adequately addressed.
- Explore if “sustainable” growth and development is a reasonable goal within the context of “carrying capacity.”
- What do more sustainable, less harmful to water quality patterns of land use/development look like.
- Enhanced best practice setbacks.
- Long term land use plans that protect the water.
- Impacts of development on shellfish and ecosystem.

- Identification of impacts from growth and development on water quality and overall habitat loss, and ways to mitigate those impacts.
- If development was addressed in a comprehensive way that would include all the other issues on that list.

Stormwater and discharge

- The largest impact can be had by screening trash, and filtering pollutants from stormwater from streets and roadways, before discharging to the bay or waterways.
- Current land held by the local counties and municipalities that can be turned into storm water processing areas.

Green Infrastructure alternatives

- Convince community to consider (maybe require) green infrastructure methods to reduce impacts from development.

Conserve/Preserve open spaces

- We need big undeveloped open spaces to deliver clean water to our estuaries; and so, we need land use reform to reduce the amount of land we convert to development.

B. Water Quality Issues and Challenges – How Critical?

	<i>Very Critical</i>	<i>Critical</i>	<i>Less Critical</i>	<i>Not Critical</i>	<i>Don't Know</i>	<i>Average</i>
Rating Scale	4	3	2	1	0	
# of Responses	9	5	0	0	-	3.6 of 4

1. What are the related issues as you see them and any options the Working Group should explore?

Reduce sediment loading

- Establishing guidelines to prevent sediment loading of wetlands and other water bodies; holding local governments accountable for storm water repairs.
- Reduce sedimentation.
- Reduce bacteria levels.

Water quality/pollution

- Identification of major (followed by moderate/minor) pollution sources and solutions to address them at local and state levels.
- Water quality in general.

Climate and restoration

- Climate change and SLR in terms of considering plans and activities that comes out of this effort. E.g., a planned restoration activity should include a projection on how it will fare short-term (5 years out) and long-term (20-50 years out).
- Continue to improve runoff and nutrient loading.

Green Infrastructure

- County and municipalities mandating the cutting of native (weeds) in an effort to have yards with mono-crop sod covered ground; making the need for excessive chemical spraying a necessity.

2. What key information do you think the Working Group needs to make informed recommendations to address issue(s)?

- Water quality trend data.
- Microbial source tracking of pathogens to determine source species
- What pollutants are getting into the water and where are they coming from? What non-natural products are getting into the water encouraging unhealthy bacteria growth.
- Impacts from impervious surface cover and changing water quality parameters.

C. Public and Leadership Education and Outreach Challenges – How Critical?

	<i>Very Critical</i>	<i>Critical</i>	<i>Less Critical</i>	<i>Not Critical</i>	<i>Don't Know</i>	<i>Average</i>
--	----------------------	-----------------	----------------------	---------------------	-------------------	----------------

Rating Scale	4	3	2	1	0	
# of Responses	6	6	1	1	-	3.2 of 4

1. What are the related issues as you see them and any options the Working Group should explore?

Education of the public

- Community engagement through periodic public meetings to highlight the goals, progress, and successes of the project. Promotes buy-in to recovery, restoration, and future efforts.
- Engagement of the public, particularly through support of growth management activities to improve water quality.
- Using this public engagement to push for better decisions by politicians and local, state and federal governments.
- Mesh education/outreach plans with those of the Pensacola-Perdido Bay Estuary Program education/outreach efforts.

Political support

- Find/develop a local “champion” from the business community.
- No plan will work if the politicians don't support. The working group must create a burning platform so that others see the urgency of getting behind the plan what is the harm of doing nothing? What is the benefit of getting it right? If this is supposed to be an Eco-friendly place, then we have to protect the eco part of it.
- Collaborate with PPBEP Policy Committee.

Changing behavior

- Impacts of residents and tourists on the ecosystem.
- Changing the behavior of people is important and a part of any positive growth; however, the need to revise and or delete systems like code issues the encourage water body pollution will have the quickest effect.

Informed communication

- Informed communication, emanating from technically adept leaders is essential from cultivating logical public sentiment and yields meaningful outcomes. Unfortunately, most "environmental" initiatives are ill conceived and frequently ecologically damaging.

Green Infrastructure (2)

2. What key information do you think the Working Group needs to make informed recommendations to address issue(s)?

- I.D. the conflicts with existing laws / codes and the group's recommendations. Identified conflicts should have resolutions thought out at the same time.

D. Research and Data Gaps- How Critical?

	<i>Very Critical</i>	<i>Critical</i>	<i>Less Critical</i>	<i>Not Critical</i>	<i>Don't Know</i>	<i>Average</i>
Rating Scale	4	3	2	1	0	
# of Responses	6	4	4	0	-	3.1 of 4

1. What are the related issues as you see them and any options the Working Group should explore?

- Comprehensive integration of existing data is needed in order to identify gaps.
- This integration will inform the next steps – what data is needed to perform HS, etc.
- A positive outcome of the work group may be identifying and subsequently funding research to fill data gaps.
- Connectivity of the data.
- Date on water quality trends.
- Concentrate on experimentation with new techniques and approaches.
- Adaptive Restoration plan.
- Adaptive Management plan: Community- and workgroup-supported management options that are within the framework of resource management for wild harvest and aquaculture.

- Routine, standardized, and timely monitoring to evaluate the status of oyster populations and inform oyster management.
 - More long-term monitoring of water quality stressors to determine which are the largest barriers to oyster restoration.
 - Habitat suitability modeling for restoration efforts.
 - Aquaculture opportunities, as well as non-harvestable reefs.
 - Data on green infrastructure.
 - Where were oyster beds historically? Restoring in locations oysters do not naturally prefer would be unsuccessful.
2. What key information do you think the Working Group needs to make informed recommendations to address issue(s)?
- Failure of past restoration efforts-why?
 - What data do we currently have available? What data do we need? Where do we go to acquire needed data? How do we pay for the data collection and processing into a usable format?
 - Water quality trends.
 - What do we have now (water quality data); what is needed to make this work?

V. LOOKING FORWARD- ENVISIONING A SUCCESSFUL FUTURE FOR THE GREATER PENSACOLA BAY SYSTEM IN 2030

A. Describe a very undesirable future for the Greater Pensacola Bay System in 2030

Take a moment to think of the year 2030. Please describe what a very undesirable future look like for the oysters and people in the Greater Pensacola Bay System?

- **Submerged aquatic vegetation dead.** All the submerged aquatic vegetation is killed off.
- **Diminished, nonexistent wild oyster population-** keystone.
- No oysters: reduces self-sustaining natural processes that improve water quality and support diverse recreational and commercial fisheries.
- Oysters stressed by decreased salinities and illegal harvest by locals.
- I think a very undesirable future would definitely be a lack of oysters, whether it be wild, or farm raised.
- **Harmful algal blooms increase and public wary of getting in the water.** An estuary with increased occurrences of harmful algal blooms.
- HAB persistent in the area closing all of the Bay system to be off limits to oyster harvesting.
- People afraid to get in the water due to HABs, water born disease including potential Vibrio infections.
- Lack of action increases algal blooms and fish kills.
- An estuary with increased occurrences of harmful algal blooms.
- **Diminished and degraded water quality.** Diminished water quality and oysters.
- Degraded water quality and unbalanced ecosystem.
- Unusable or unsafe water for public resource, pollution, bacteria, etc.
- **The current path we are on** – more people with no comprehensive plan to minimize their impacts.
- **Public indifferent to collapse of the watershed.** Continued ignorance of existing and potential future issues within the watershed.
- **Economy sputters.** Economy based on a healthy bay system suffers.

B. Envision A Successful Future for the Greater Pensacola Bay System in 2030

Now envision a successful future in 2030 in which everything is going right for a healthy Greater Pensacola Bay System and the Oyster Ecosystem-Based Fishery Management Plan is being funded, implemented and meeting its targets. Describe what this ideal future would look like by answering either or both of the following questions:

1. It's 2030. You are drafting a column for a special combined edition of the Pensacola News Journal and the Santa Rosa's Press Gazette on the stellar accomplishments in improving the health of the Greater Pensacola Bay System and implementing the Oyster Ecosystem-Based Fishery Management Plan. What would be the headline? What would you say?

- **Oyster Ecosystem-Based Fishery Management Plan is a Success!** What a difference a decade makes! Ten years ago, when the Pensacola Bay System and the Oyster Ecosystem-Based Fishery Management Plan was presented, the Bays could barely support a fledgling oyster industry, now based on the efforts of local government and industry partners, the Bays are teaming with oysters.
 - For a management plan to be successful in the future there has to be good management of wild caught oysters and reasonable regulations for oyster farmers.
 - 50% of the oyster population has recovered since the early 1930's.
 - Oyster populations return to their historic levels.
 - Wearing Tee Shirts, the say eat Pensacola Bay Oysters best in the world.
 - Local restaurant wins James Beard award and Michelin stars with locally grown Pensacola Oysters.
 - Pensacola Bay Thriving with Wild and Farm Raised Oysters.
 - We are sustainably harvesting and eating oysters in all water bodies.
 - Crab harvest improves with the help of restored oysters.
 - **From most polluted water in the country to most pristine in only ten years!**
 - Water quality is such that oysters can thrive.
 - Oysters help increase water clarity – seagrasses and fish returning.
 - **Ecosystem and the Economy.** Ecosystem is thriving and healthy and is an important economic engine for the community.
 - The article would explain how the recovery of the Pensacola bay oyster (both through aquaculture and a managed fishery) further enhanced Pensacola as a great place to live. It would also explain the interaction between a healthy environment and a thriving economy. It would make the point that this was not a given 11 years ago.
 - **Public education and engagement** promote connection to the Bay system. Public schools learning more about oysters and estuarine ecology by helping local oyster restoration.
2. What would those managing, using and enjoying the Greater Pensacola Bay System be doing in 2030 that is different from what they are doing today?
- **Quality over quantity.** Economic development model based on endless growth would be gone, replaced by one based on quality over quantity.
 - **Recreation, swimming and Access to the Water without health worries.** All citizens would be enjoying greater public access to the water and swimming without any health worries.
 - More underwater recreation in Santa Rosa Sound and Big Lagoon.
 - Safety signs on the shoreline warning of the dangers of getting into the Bay.
 - **Appreciation of connection to the Bays.** Connection to the bay and understanding of impacts.
 - **Water quality job #1.** Actually, putting water quality ahead of other competing priorities.
 - Informed boaters would know not to plow through seagrass beds.
 - **Fish and oysters have returned sustainable wild harvest is back.** Fisherman seeing record catches of speckled trout and redfish.
 - Talk by managers that Gulf sturgeon are doing so well, there might be a limited season on them in 5 years if trends continue.
 - Wild harvest commercial and recreational is back.
 - Maybe the scallop harvest would return.

C. Draft Vision of Success Themes (drawn from the responses)

1. **Managing for Sustainability.** *The Bays are teaming with oysters, crabs and finfish. Sustainable harvesting and eating oysters, crabs and fish in all water bodies (both through aquaculture and a managed fishery).* The management and restoration of the oyster resource is conducted by working collaboratively with stakeholders to create a plan that ensures that protection of the fishery and habitat and is implemented in a fair and equitable manner supported by science, data and field experience and observation.
2. **Healthy and Productive Ecosystem.** *Water quality is job #1. Dramatic enhancement in water quality, clarity and the return of seagrasses*

3. **Shifting and Thriving Economy connected to the Bay.** *Economic development model based on sustaining quality over quantity. A healthy ecosystem = a thriving economy for the community.* The Greater Pensacola Bay System is managed and conducted in a manner that ensures the fishery is sustainable, provides access to recreation and adds economic value for the fishery and community stakeholders.
4. **Public engagement and education.** *Public engagement and education in the schools and on the water on the oyster's role in water quality, resilience, and restoration result in an appreciation of connections with Bay system and an understanding of impacts.*

STAKEHOLDER WORKING GROUP QUESTIONNAIRE RESPONDENTS

<i>Building/Development</i> Shelby Johnson Glen Miley	<i>Seafood Industry</i> Josh Neese
<i>Business/Real Estate/Economic Development/Tourism</i> Will Dunaway	<i>University/Research</i> Jane Caffrey Rick O'Conner
<i>Local Government</i> Shelley Alexander Jim Trifilio Keith Wilkins	<i>State Government</i> Beth Fugate Mike Norberg Portia Sapp Kent Smith/Katie Konchar
<i>Recreational Fishing</i> Chris Phillips	<i>Environmental/Citizen</i> Christian Wagley

Appendix C: Stakeholder Working Group Members and Alternates

Affiliation	Primary Working Group Members	Alternate Members
Aquaculture	Josh Neese	
Aquaculture	Donnie McMahon	Thomas Derbes II (June-Sept. 2020)
City of Pensacola	Mark Jackson	Chris Maulden Cynthia Cannon
Community	Christian Wagley	
Community	Will Dunaway	Barbara Albrecht
Development	Glen A. Miley, MS, PWS	
Development	Shelby Johnson	
Escambia County	Chips Kirschenfeld	Mark Nicholas Tim Day
FDACS	Portia Sapp	Michelle Smith
FDEP	Beth Fugate	
FWC	Kent Smith	Katie Konchar
FWC	Alan Peirce (filled M. Norberg's seat in Jan. 2021)	
IFAS-Escambia	Rick O'Connor	Carrie Stevenson
IFAS-SRC/Watermen Liaison	Chris Verlinde	
NWFWMD	Paul Thurman	
Okaloosa County	Michael Norberg (represented FWC through Dec. 2020)	
PPBEP	Matt Posner	Whitney Scheffel/ Donald Killorn
Recreational Fishing	Chris Phillips	
Santa Rosa County	Shelley Alexander	Naisy Dolar Tanya Linzy
University of West Florida	Jane Caffrey	Amanda Croteau
Visit Pensacola	Shawn Brown	
Waterman	Pasco Gibson	
Waterman	LD Henderson	
Waterman	Pete Nichols	
Waterman	Tommy Pugh	
Waterman	Phil Rollo	
Waterman	Calvin Sullivan	

Appendix D: Web Links to Meeting Recordings and Presentations

All meeting recordings and presentations are stored in a Box folder managed by The Nature Conservancy. Table 1 is a list of the meeting dates and links to the recording of the meetings held via Zoom. Table 2 is a list of links to the PowerPoint presentations as pdf files.

Table 1. Web Links to Meeting Recordings

Meeting #	Meeting Date	Meeting Location	Recording Link for Zoom Platform meetings, except where noted
I	Oct. 9, 2019	Studer Institute	N/A
II	Nov. 15, 2019	UF/IFAS SRC Extension	N/A
III	Jan. 15, 2020	SRC Sanders Beach Community Center	N/A
IV	April 9, 2020	Zoom Platform	Unavailable
V	May 19, 2020	Zoom Platform	https://tnc.box.com/s/q6m438p9hampetl9t8kztqd8xyfw09dt
Watermen Workshop	June 4, 2020	Zoom Platform	https://tnc.box.com/s/bdt5m4067j7je18zm4zrdm6edf0jckiu
TNC Present to PPBEP TAC	July 14, 2020	Zoom Platform	Meeting hosted by the PPBEP
VI	July 22, 2020	Zoom Platform	https://tnc.box.com/s/uw0obavg4giy7cuqhtcb0y8xu6nnnyh0a
VII	Sept. 28, 2020	Zoom Platform	https://tnc.box.com/s/09ihpvzrpwld0dwq3h20qib5gra1gxv
TNC Present to PPBEP Policy Board	Oct. 7, 2020	Zoom Platform	Meeting hosted by the PPBEP
VIII	Oct. 21, 2020	Zoom Platform	https://tnc.box.com/s/fi3d5v57r8m57n99w4tqolyy76z3kh0o
IX	Nov. 18, 2020	Zoom Platform	https://tnc.box.com/s/9radiqs5dynhyjlpvuy4yr1giohkh5ok
Watermen Workshop	Dec. 8, 2020	Zoom Platform	https://tnc.box.com/s/466wugv0nq3ggbrph47azkmix0b1odu5
X	Jan. 21, 2021	Zoom Platform	https://tnc.box.com/s/5xao4s0dnjrphtlmijcc4m61909c89z9
XI	Feb. 17, 2021	Zoom Platform	https://tnc.box.com/s/ile954jbidospne3y5kiik20tgtgwsln
XII	March 17, 2021	Zoom Platform	https://tnc.box.com/s/bzwxmbarhwqzmm8ybtvbxw2zpnlk7lfy9

Table 2. Web Links to SWG Meeting Presentations

For those meetings with multiple presenters there are separate links to each presentation.

Meeting #	Meeting Date	Link to PowerPoint File as a pdf
I	Oct. 9, 2019	https://tnc.box.com/s/qltqneigyqe9gls01ynun73yavln0ial
II	Nov. 15, 2019	https://tnc.box.com/s/wpqyf8q422eo183mtywfwk7w5cvn4v0v https://tnc.box.com/s/v9r7mjkj8eqp5qv759j6swwn6f5w6r9d
III	Jan. 15, 2020	https://tnc.box.com/s/ojh7qq71d5d644dkro5xzxfr9hhmcuxa
IV	April 9, 2020	https://tnc.box.com/s/03052o899p3o6rblkml24agl2p24auv1 https://tnc.box.com/s/f5hjgsxsttr85358cvd0u6mylldoc82u https://tnc.box.com/s/gf2ycxucd3j5r9ww2x3891oq0fdjo7j2
V	May 19, 2020	https://tnc.box.com/s/rijsfa1c6kpheynpimk1mv3hn6i268sv https://tnc.box.com/s/zsmakmi14p83zzjzpdprwa0z33ici5f https://tnc.box.com/s/khgy5cs1jiaj8sylv32em57te8m3em4g https://tnc.box.com/s/luucuz23xig513t968usf6zuofyilcl8
Watermen Workshop	June 4, 2020	No presentations
VI	July 22, 2020	https://tnc.box.com/s/obzhnyo1k20kz9tqz1khyuugj6ld31ux
VII	Sept. 28, 2020	https://tnc.box.com/s/tltl09jtmqhhle1yhnxrkgdkmkm14b4x https://tnc.box.com/s/dnhcxero94vo2hbhsbglreceklesxvuv
VIII	Oct. 21, 2020	https://tnc.box.com/s/tvki7rn0jcv4taskbl5fmh9u50gw0n8y https://tnc.box.com/s/boki9i4748x5nl2j77z4rlfuookyh9wp
IX	Nov. 18, 2020	No presentations
Watermen Workshop	Dec. 8, 2020	No presentations
X	Jan. 21, 2021	https://tnc.box.com/s/p4no88w3vvc0lw3z5ls2rmeauidx69l https://tnc.box.com/s/upgwrn7t6ittqruc093wl5xnnfs4uvbp https://tnc.box.com/s/3957k7xmyjvy0lxcpm33j2m9sc5aysj6
XI	Feb. 17, 2021	https://tnc.box.com/s/hspci60z6rxfh1j1686lsh17ezsrwhev https://tnc.box.com/s/6n8k4gzexxhi64w4r2bsvew8u2ist2yh
XII	March 17, 2021	No presentations

Appendix E: Leads, Partners and Resources for Strategies and Actions

Table 1: Priority 1 Strategies and Actions

Table 2: Priority 2 Strategies and Actions

The strategies (bolded) are followed by the actions (unbolded) in the left column.

Table 1. Priority 1 Strategies and Actions

Theme A: Ecological		
Strategy and Actions	Lead/Partners	Resources
A1. Use data collection, monitoring, annual status of oyster assessment data, and comprehensive shell budget models to inform management of oyster populations. <i>NOTE: this strategy and S2A and S3A should be completed first</i>	Lead: FWC/FWRI Partners: PPBEP, NFWFMD, DEP/Aquatic Preserves, universities, local data collectors/citizen scientists, watermen	Student help from universities (UWF/UF),
A1.1 Develop and implement a monitoring plan that references methodologies used.	Lead: FWC/FWRI Partners:	(In Apalachicola, expand)
A1.2 Develop shell budget model scenarios.	Lead: FWC/FWRI Partners:	Available models (LA)
A1.3 Implement a spat collection program throughout the bay to inform restoration of the habitat and fishery	Lead: BFA Partners: UF/IFAS/Sea Grant	Project Oyster Pensacola (spat collection on docks)
A2. Enhance the monitoring and accuracy of harvested and non-harvested reefs and aquaculture stock data collection and reporting methods for inclusion in recovery targets (restoration and management). <i>NOTE: this strategy and S21 and S3A should be completed first</i>	Lead: FWC/FDACS/PPBEP Partners: Local Gov'ts, aquaculture/harvesting industry (Cluster), universities	Watermen, GC Seafood Cluster, Student help from universities (UWF/UF),
A2.1. Design and implement a program(s) to supplement state monitoring activities (e.g., Oyster Corps).	Lead: TBD Partners: TBD	
A3. Establish restoration and management targets for functional harvested and non-harvested oyster reefs using 1-3 ecological health indicators (e.g., amount of water filtered by oysters, amount of juvenile fish enhancement by reefs; seagrass habitat and other adjacent ecosystems established or restored). <i>NOTE: this strategy and S1A and S2A should be completed first</i>	Lead: FWC Partners: FDEP/Aquatic Preserve	Ryan Gandy/Alan Pierce project; citizen science program UWF
A3.1 Create and manage a prioritized list with spatially explicit maps of restoration projects for the bay system based on the Habitat Suitability Model and restoration and management targets.	Lead: TBD Partners: TBD	

Table 1. Priority 1 Strategies and Actions (con't)

Theme A: Ecological		
Strategy and Actions	Lead/Partners	Resources
A3.2. Establish ecosystem service targets to manage the Bay System (e.g., water filtration, rec. fishing, and denitrification).	Lead: TBD Partners: TBD	
A4. Implement policies and programs for the return of sufficient oyster shell back to the PBS to support sustainable oyster populations and demographic targets and thresholds.	Lead: PPBEP and local gov. Partners: FWC/FDACS aquaculture industry, watermen	Use of FDACS' USACE permit
A4.1 Examine existing laws and create novel policies and programs to support return of shell back to the system (e.g., TX law requires return of material to the water).	Lead: FWC/FDACS Partners: UF Levin College of Law, Sea Grant/PPBEP	
A4.2 Examine if policies should also apply to the State's fossil shell sources.	Lead: TBD Partners: TBD	
A4.3 Demonstrate the benefits of shell recycling programs to return shell back into the System.	Lead: TBD Partners: TBD	
A4.4 Identify the current location, quantity, and fate of shell material as a by-product of shucking.	Lead: Local Gov'ts Partners: UF, DOH	
A5. Manage and remediate sources of sedimentation to the estuary and sediment sinks in the estuary impacting the oyster reef ecosystem.	Lead: NFWFMD Partners: U.S. Geological Survey, local governments, FDOT, FDEP, EPA, NRCS	
A5.1 Identify sources of sediment into estuary.	Lead: TBD Partners: TBD	Citizen scientists, sport fishers, county monitoring
A5.2 Identify how sediment sinks in the bay system affects oysters	Lead: TBD Partners: TBD	University student projects, Citizen scientists
A6. Restore and create reef structures suitable for sustained oyster settlement that enhance ecosystem services in designated restoration areas.	Lead: FWC and UF Partners: PPBEP, universities, local governments, FDOT, NGOs, coastal property owners, DEP, TNC, UF/IFAS/Sea Grant, universities	Watermen, private industry/business, engineering/environmental firms, habitat structure makers, oyster shell recycling programs, Student projects
A6.1 Design and implement projects to achieve multiple ecosystem service targets (e.g., recreational fishing, shoreline protection).	Lead: TBD Partners: TBD	
A6.2 Implement restoration projects simultaneously rather than sequentially.	Lead: TBD Partners: TBD:	

Table 1. Priority 1 Strategies and Actions (con't)

Theme A: Ecological		
Strategy and Actions	Lead/Partners	Resources
A7. Evaluate the effects of land use changes in the watershed on the health of oysters (e.g., floodplain forests, marshes, open spaces).	Lead: Local Governments Partners: NWFMD, FDOT, RPC, universities, development community, private sector	Student projects
A7.1 Track land use changes over time (retrospectively and prospectively) to determine if future changes could adversely affect oyster viability in the system.	Lead: TBD Partners: TBD	
A7.2 Proactively address potential adverse impacts.	Lead: TBD Partners: TBD	

Theme B: Wild Harvest and Aquaculture		
Strategy and Actions	Lead/Partners	Resources
B1. Annually assess the status of oysters in the PBS and provide regular updates. <i>NOTE: this strategy and S2B and S3B should be completed first</i>	Lead: FWC Partners: FDACS, universities, NGOs, citizen scientists	FDACS water quality data
B2. Develop a shell budget model No Actions Yet Identified <i>NOTE: this strategy and S1B and S3B should be completed first</i>	Lead: Partners:	
B3 Develop oyster population and demographic targets and biological thresholds (at the smallest scale that makes sense to inform harvest targets). <i>NOTE: this strategy and S1B and 2SB should be completed first</i>	Lead: FWC Partners: universities	
B3.1 Apply routine monitoring data and shell budget models.	Lead: Partners:	
B3.2 Define the scale used for the specific boundaries.	Lead: Partners:	
B4. Manage the commercial oyster industry and recreational oyster fishing to provide for sustainable spat production and spawning and the recovery of oyster populations.	Lead: FWC Partners: PPBEP, universities, Sea Grant, watermen	
B4.1 Evaluate management scenarios (e.g., closures, rotational harvest, non-harvested spawning reefs, Territorial Use Rights of Fishing, limited entry, regulations, transferable license program).	Lead: Partners:	

Table 1. Priority 1 Strategies and Actions (con't)

Theme B: Wild Harvest and Aquaculture (con't)		
Strategy and Actions	Lead/Partners	Resources
B4.2 Evaluate existing allowable and minimally destructive alternative gear type options and harvest methods, including the use of experimental gear for wild oyster harvesting.	Lead: Partners:	
B5 Enhance the monitoring and accuracy of commercial and recreational oyster harvest and aquaculture stock data collection and reporting methods for inclusion in fisheries management targets.	Lead: FWC Partners: universities, Sea Grant, IFAS	
B5.1 Develop and implement a monitoring plan that references methodologies used.	Lead: Partners:	
B5.2 Develop shell budget model scenarios.	Lead: FWC Partners:	
B5.3 Collect annual estimate of aquaculture harvest (implement via FDACS).	Lead: FDACS Partners:	
B5.4 Evaluate whether recreational data should be monitored, how it would be implemented, and in relation to a cost/benefit analysis for collecting the data.	Lead: Partners:	
B6. Restore and create reef structures suitable for sustained oyster settlement and production for harvesting.	Lead: state agencies, NGOs, oyster industry Partners:	Students/universities; DWH funding
S6B-A1. Work with watermen to evaluate cultching techniques for growing oysters (e.g., historical non-traditional, trees).	Lead: FWC Partners: universities, Sea Grant, watermen and aquaculture organizations, local county programs	
B6.1. Design and implement projects to achieve oyster fishery production targets.	Lead: FWC Partners: TNC, universities, NOAA for funding	
B6.2 Design projects that include both fished and non-fished reefs.	Lead: FWC Partners: TNC, universities, NOAA for funding	

Table 1. Priority 1 Strategies and Actions (con't)

Theme B: Wild Harvest and Aquaculture (con't)		
Strategy and Actions	Lead/Partners	Resources
B7. Support and prepare for the expected growth of aquaculture in the PBS.	Lead: FDACS/FWC Partners: counties, Sea Grant, NRCS, stakeholders (watermen), GC Seafood Cluster	UWF economic group (HAAS Center)
B7.1 Develop an aquaculture growth plan that outlines and defines optimal expansion of the aquaculture industry.	Lead: Partners:	
B7.2 Develop Spatial Area Management Plan that maps ideal areas for current and future growth using abiotic (DO, salinity, temperature, etc.) and social variables (proximity to docks, exclusion zones, etc.).	Lead: PPBEP Partners:	
B7.3 Establish Aquaculture Use Zones (AUZ).	Lead: FOTC Partners:	
B8. Characterize and quantify current biological (e.g., red tide) and chemical hotspots (e.g., pesticides, heavy metals) and inputs into the PBS and their effect on oysters.	Lead: FDEP Partners: FWC/FDACS, universities, EPA	Citizen scientists
B8.1 Commission studies to collect and analyze data.	Lead: Partners:	
Additional Resources: <ul style="list-style-type: none"> • Santa Rosa County is working with the BOCC to provide funding for oyster leases and wild oyster harvest assistance. • FDACS is working on providing virtual training and cost-share programs for equipment purchase for aquaculture start-ups. 		

Table 1. Priority 1 Strategies and Actions (con't)

Theme C: Thriving Economy		
Strategy and Actions	Lead/Partners	Resources
C1. Demonstrate the economic and social benefits derived from the ecosystem services provided by oyster fisheries and restored/natural reef habitat.	Lead: PPBEP Partners: universities, Sea Grant, Visit Pensacola, Chamber of Commerce (for the private sector);	TNC in quantifying the ecosystem services; EPA lab
C1.1 Compile information on the economic and social benefits accruing from restored reefs (fished and non-fished).	Lead: Partners:	
C1.2 Seek out partnerships with researchers that have been doing this work.	Lead: Partners:	
C2 Align local and state government policies and practices that support oyster restoration, fisheries and aquaculture.	Lead: PPBEP Partners: FWC, counties, stakeholders, local governments; development community; NGOs	Chamber could bring economic development and private resources to the table; FL West and economic arms of local governments.
C2.1 Evaluate existing policies and practices and recommend adjustments.	Lead: Partners:	

Table 1. Priority 1 Strategies and Actions (con't)

Theme D: Public Education and Communication		
Strategy and Actions	Lead/Partners	Resources
D1. Build a broad constituency to support outreach efforts that generate and increase public awareness and support for a healthy and well-managed oyster habitat and fisheries and the ecosystem services they provide. <i>NOTE: this strategy and SD3 should be completed first</i>	Lead: PPBEP Partners: Local gov'ts, local partners, Sea Grant, Visit Pensacola, Escambia Co School district/Santa Rosa; private industry, DEP	Students, oyster farmers and harvesters, watermen; B-WET Grants
D1.1 Engage businesses, industries, non-profits, and local governments to gain their support and include them in outreach and education efforts.	Lead: Partners: FOTC	
D1.2 Address both positive and negative consequences of depleted/lost oyster reef habitat respectively.	Lead: Partners:	
D1.3 Seek public buy-in for supporting restoration efforts by highlighting the benefits to and enlisting the support of recreational fishing, ecotourism, and water sports interests.	Lead: Partners:	
D1.4 Establish an oral history project to document the history, present day circumstances, and future visions for oysters by the community in the Pensacola Bay System.	Lead: Partners:	
D5. Expand existing or create new mentoring and education programs focused on restoration and monitoring of oyster habitat and fisheries and training for aquaculture farming that involves all sectors of the community.	Lead: Sea Grant Partners: FWC, FDACS, universities, K-12, watermen, local governments/counties, career source, OysterCorps	4H Ag programs, FFA; FAITC; Gulf Coast Seafood Cluster
D5.1 Develop and support new and existing volunteer citizen-science programs for monitoring, data collection, and restoration efforts for oyster restoration projects at all levels (e.g., youth, adult, K-12, and colleges and universities).	Lead: Partners:	
D5.2 Demonstrate the benefits of shell recycling programs to return shell back into the System.	Lead: Partners:	

Table 1. Priority 1 Strategies and Actions (con't)

Theme D: Public Education and Communication (con't)		
Strategy and Actions	Lead/Partners	Resources
S2D5.3 Develop and support education programs that focus on oysters as drivers of restoration and management of the PBS.	Lead: Partners:	
D5.4 Develop education and mentoring programs to create a new oyster workforce for restoration and monitoring, wild harvest, and aquaculture industries.	Lead: Partners:	
D5.5 Design and implement local community initiatives for growing oysters for their ecosystem services (i.e., Mobile Bay oyster gardening), ensuring that science-based best practices are utilized	Lead: Partners:	
D5.6 Develop a “future farmers” program that helps locals in the area learn about aquaculture and the potential for making a living by growing oysters in the PBS. (e.g., Partner with existing programs such as Sea Grant MS/AL programs).	Lead: Partners:	
D3. Promote sustainable wild harvest and cultured oysters and the value of ecosystem services provided by restored oyster populations in the PBS. <i>NOTE: this strategy and SD1 should be completed first</i>	Lead: PPBEP Partners: FDACS, universities (UWF), Sea Grant, EPA Lab, Gulf Coast Seafood Cluster, watermen and other stakeholders	
D3.1 Develop and implement a marketing and communication plan, which celebrates oysters as an important feature of the area’s cultural heritage.	Lead: Partners:	
D3.2 Promote and market certification programs and engage with certification agencies and organizations to certify Pensacola Bay oysters.	Lead: Partners:	
Additional Resources: <ul style="list-style-type: none"> Visit Pensacola can assist with making presentations to the hospitality industry and to the public. They also have e-mail newsletters and social media platforms that can be used to convey specific messages to the public and industry. 		

Table 2: Priority 2 Strategies and Actions (con't)

THEME A: Ecological		
Strategy and Actions	Lead/Partners	Resources
A8. Develop and seek a long-term funding source for the development of a dashboard with key metrics and indicators for monitoring ecosystem health that is used across programs and projects.	Lead: PPBEP Partners: FWC, universities, local governments, citizen scientists	
No Actions Yet Identified	Lead: TBD Partners: TBD	
A9. Evaluate the development of a policy that would require setting sustainable harvest goals and placing limitations on or a complete closure to harvesting based on the results of data (e.g., stock assessment) collected and evaluated under a comprehensive monitoring program designed to sustainably manage the resource.	Lead: TBD Partners: TBD	
A9.1 Co-management advisory committee assess and make a recommendation to the State.	Lead: FWC Partners: FDACS, PPBEP, universities, local governments	

Theme B: Wild Harvest and Aquaculture		
Strategy and Actions	Lead/Partners	Resources
B9. Promote opportunities for agencies, law enforcement and watermen to work together on enforcement of oyster resource regulations.	Lead: FWC Partners: universities, watermen, and aquaculture organizations	
B9.1 Evaluate strategies for increasing the capacity of enforcement agencies.	Lead: Partners:	
B9.2 Track law enforcement capacity over time.	Lead: Partners:	
B9.3 Evaluate, and if needed, improve the process for watermen to communicate with law enforcement.	Lead: Partners:	
B9.4 Develop a process for managers and watermen to work with state attorneys and judges on enhancing enforcement and evaluating appropriate penalties.	Lead: Partners:	

Table 2: Priority 2 Strategies and Actions (con't)

Theme B: Wild Harvest and Aquaculture (con't)		
Strategy and Actions	Lead/Partners	Resources
B10. Investigate oyster shell and oyster relay programs to move both cultch and live oysters to more favorable habitat.	Lead: FDACS/FWC Partners: universities, Sea Grant, FDEP, FDOH, stakeholders (watermen)	
B10.1 Use the HSM, information on larval source areas and environmental conditions to inform the potential programs.	Lead: Partners:	
B10.2 Research similar relay programs in other areas as potential models and cautionary tales.	Lead: Partners:	
B11. Create public/seafood industry stakeholder programs to cooperatively manage harvested reefs.	Lead: Partners:	
B11.1 Evaluate relaying oysters and/or distributing seed programs.	Lead: Partners:	

Theme C: Thriving Economy		
Strategy and Actions	Lead/Partners	Resources
C9. Monitor key economic indicators for changes over time based on restoration efforts in the PBS.	Lead: PPBEP Partners: universities (UWF), Sea Grant, EPA Lab, stakeholders	
C9.1. Characterize the connection between enhanced recreational fishing and tourism opportunities and oyster reef habitat quality and quantity.	Lead: Partners:	
C9.2 Identify which economic indicators will be most valuable to monitor.	Lead: Partners:	
C9.3 Include indicators that characterize and track the following: key ecosystem services of oyster habitat (e.g., water quality and sport fisheries enhancement), oyster fishery and oyster aquaculture industries.	Lead: Partners:	

Appendix F: Charts of Leads and Partners of the Priority 1 and 2 Strategies and Actions

Table 1: Priority 1 Strategies and Actions

Table 2: Priority 2 Strategies and Actions

Table 1. Leads and Partners of the Priority 1 Strategies and Actions

This table displays a simple way for the Leads and Partners to identify the Strategies (bold numbers in left column) and Actions (numbers following each strategy in the left column) that they have a role in implementing. Leads are identified in purple and Partners in green. The numbering system for the Strategies and Actions correspond to the same used in Tables 4 and 5 in the main body of the plan. The names listed in some of these columns are not meant to be exclusive (e.g., under universities where UF is written in as a partner does not mean that UWF or others might not also participate in that action.)

	FWC/ FWRI	PPBEP	NWF- WMD	FDEP	UNIV.	CITIZEN SCIENTISTS	OYSTER INDUSTRY	FEDERAL AGENCIES	UF/IFAS/ SEA GRANT	FDACS	LOCAL GOVTS	STATE AGEN- CIES	NGOs	OTHER
Theme A: Ecological - Priority 1 Strategies/Actions														
A1														
A1.1														
A1.2														
A1.3						BFA								
A2														
A2.1														
A3														
A3.1														
A3.2														
A4														
A4.1					UF Levin College of Law									
A4.2														
A4.3														
A4.4					UF			DOH						
A5								USGS, EPA, NRCS				FDOT		
A5.1														
A5.2														

	FWC/ FWRI	PPBEP	NWF- WMD	FDEP	UNIV.	CITIZEN SCIENTISTS	OYSTER INDUSTRY	FEDERAL AGENCIES	UF/IFAS/ SEA GRANT	FDACS	LOCAL GOVTS	STATE AGEN- CIES	NGOs	OTHER
A6					UF							FDOT	TNC	Property Owners
A6.1														
A6.2														
A7												FDOT RPC		Development Community, Private Sector
A7.1														
A7.2														
Theme B: Wild Harvest and Aquaculture - Priority 1 Strategies/Actions														
B1														
B2														
B3														
B3.1														
B3.2														
B4														
B4.1														
B4.2														
B5														
B5.1														
B5.2														
B5.3														
B5.4														
B6														
B6.1														County Programs
B6.2								NOAA					TNC	
B6.3								NOAA					TNC	
B7								NRCS						Counties
B7.1														
B7.2														
B7.3							FOTC							

	FWC/ FWRI	PPBEP	NWF- WMD	FDEP	UNIV.	CITIZEN SCIENTISTS	OYSTER INDUSTRY	FEDERAL AGENCIES	UF/IFAS/ SEA GRANT	FDACS	LOCAL GOVTS	STATE AGEN- CIES	NGOs	OTHER
B8								EPA						
B8.1														
Theme C: Thriving Economy - Priority 1 Strategies/Actions														
C1													Visit Pensa cola	Chamber of Commerce
C1.1														
C1.2														
C2														Counties, Development Community
C2.1														
Theme D Public Education Communication- Priority 1 Strategies/Actions														
D1													Visit Pensa cola	Schools, Private Industry (restaurants)
D1.1							FOTC							
D1.2														
D1.3														
D1.4														
D2														K-12, Counties
D2.1														
D2.2														
D2.3														
D2.4														
D2.5														
D2.6														
D3					UWF			EPA Lab						
D3.1														
D3.2														

Table 2. Leads and Partners of the Priority 2 Strategies and Actions

This table displays a simple way for the Leads and Partners to identify the Strategies and Actions that they have a role in implementing. Leads are identified in purple and Partners in green.

	FWC/ FWRI	PPBEP	NWF- WMD	FDEP	UNIV.	CITIZEN SCIENTISTS	OYSTER INDUSTRY	FEDERAL AGENCIES	UF/IFAS/ SEA GRANT	FDACS	LOCAL GOVTS	STATE AGEN- CIES	NGOs	OTHER
Theme A: Ecological - Priority 2 Strategies/Actions														
A8														
A9														
A9.1														
Theme B: Wild Harvest and Aquaculture - Priority 2 Strategies/Actions														
B9														
B9.1														
B9.2														
B9.3														
B9.4														
B10								DOH						
B10.1														
B10.2														
B10.3														
Theme C: Thriving Economy - Priority 2 Strategies/Actions														
C9					UWF			EPA Lab						
C9.1														
C9.2														
C9.3														

Appendix G

Projects Currently Planned or Underway

Table 1. List of projects in the PBS related to recovery of oyster health that are currently underway or in the planning stage. This is not a comprehensive list and will be added to by the PPBEP as other projects are identified and new projects initiated.

Lead Agency	Funding Source	Project Title	Purpose/Theme	Funding Allocated	O-EBFM Goal/Strategy/Action
PPBEP	FDEP State App.	National Coastal Condition Assessment	Water Quality, Sediment, Fish, Human Health	\$65 K	Goal A
PPBEP	FDEP State App.	National Wetlands Condition Assessment	Habitat condition	\$75 K	Goal A
PPBEP	FDEP State App.	Escambia County – Oyster Mapping (Escambia/Pensacola Bays)	Oyster habitat extent; condition	\$100 K	Goal A, B
TNC/SRC	RESTORE (Pot 1)	Santa Rosa County – Oyster Mapping (East/Blackwater Bays)	Oyster habitat extent; condition	\$150 K	Goal A, B
Escambia	NFWF	Navy Point Living Shoreline	Habitat restoration	\$180 K	Goal A
Escambia	RESTORE (Pot 2)	Pensacola Bay Living Shoreline	Habitat restoration	\$13 M	Goal A
Escambia	NFWF (Phase II)	Bayou Chico Water Quality Improvements	Water Quality	\$11 M	Goal A
Escambia	RESTORE (Pot I)	Carpenter Creek/Bayou Texar Watershed Management Plan	Water Quality; Habitat restoration	\$1.3 M	Goals A, C
TNC	NFWF GEBF	East Bay Oyster Habitat Restoration – Phase II	Habitat restoration	\$15.1 M	Goal B
Escambia	RESTORE (Pots 2/3)	Bayou Chico Contaminated Sediment Remediation	Sediment Quality	\$12 M	Goals A, C
FDEP	Various	Project GreenShores - Phase I (2003, 2007)	Habitat restoration	TBD	Goal A
FDEP	NRDA	Project Greenshores - Phase II (2021)	Habitat restoration	\$10 M	Goal A
USA/DISL	FDEP (Mini Grant)	Fish Community Video Surveys	Habitat restoration; Fish & Wildlife	\$18 K	Goals A, B
FDEP	USFWS	Residential Living Shorelines (Big Lagoon, Bayou Texar, Bayou Grande, Santa Rosa Sound, Yellow River Marsh AP)	Shoreline protection; habitat	\$35 K	Goals A, D

FDEP	NA	Oyster Restoration - Garcon to White Point	Habitat restoration	TBD	Goal A
ACF		Oyster Shell Recycling Program (Baldwin)	Habitat restoration; Education/Outreach	NA	Goals B, C, D
Escambia County		Oyster Shell Recycling Program (Escambia)	Habitat restoration; Education/Outreach	NA	Goals B, C, D
Sea Grant/SRC		Oyster Shell Recycling Program (Santa Rosa)	Habitat restoration; Education/Outreach	NA	Goals B, C, D
SRC	FDEP	Floridatown Living Shoreline Project	Shoreline protection; Habitat	\$125 K	Goal A
FWC/FDACS	NRDA	FL Oyster Cultch Placement Project	Habitat Restoration; Fish & Wildlife	\$5.3 M	Goal B
FWC	NRDA	FL Gulf Coast Habitat Suitability – Oyster Restoration	Oyster restoration & monitoring	\$2.8 M	Goal A
DOI	NRDA	Seagrass Recovery Project @ GUIS – Naval Live Oaks	Seagrass restoration	\$136 K	Goal A
SRC/UWF	RESTORE (Pot 3)	Navarre Beach Effluent Relocation Project & Pre/Post Monitoring	Water Quality	\$12 M	Goal A
SRC/Milton	Various	New Wastewater Treatment Plant - Milton	Water Quality	\$28 M	Goals A, C
FDEP	NRDA	Pensacola Bay Unpaved Roads Initiative	Water Quality; Sediment	\$705 K	Goal A
SRC	RESTORE	Yellow River Marsh Preserve State Park Restoration	Habitat restoration	\$75 K	Goal A
BFA/UWF/PBOC	Various	Project Oyster Pensacola	Water Quality; Oyster condition	TBD	Goal A, D
TNC/EPA	TNC	Oyster Ecosystem Service Model	Water Quality; Oyster Restoration	\$10 K	Goal A/Strategy C/Action C-2