National Estuarine
Research Reserve System
Science Collaborative

A ROADMAP FOR ADDRESSING MARINE DEBRIS IN THE NERRS

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This Roadmap, the outcome of a NERRS Science Collaborative Science Transfer project, aims to guide Reserves in driving behavior and policy changes to enhance marine debris remediation efforts. It outlines three key integrative approaches and detailed tactics to achieve common goals in debris reduction and management, featuring successful case studies from Reserves. Created as a resource, it empowers Reserves to make a meaningful impact on marine debris, contribute to a dynamic community of practice, and better protect estuaries.

We offer special thanks to the Project Advisory Committee (PAC) members for their contributions and guidance throughout this project and in developing this Roadmap.

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About the NERRS

The National Estuarine Research Reserve System (NERRS) is a network of 30 reserves located in 25 states and Puerto Rico. Each site includes programs focused on resource stewardship, research and scientific monitoring, training programs for the public and local officials, and education.

About the NERRS Science Collaborative

The NERRS Science Collaborative is a NOAA-funded program that provides grants and other support for user-driven collaborative research, assessment, and transfer activities that address critical coastal management needs identified by the reserves.

https://nerrssciencecollaborative.org

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Volunteers participating on the 40th Annual Coastal Cleanup Day. *Photo by Tijuana River NERR*

National Estuarine Research Reserve System Science Collaborative

Purpose: What is this Roadmap about and who is it for?

Estuaries in the National Estuarine Research Reserve System (NERRS) are located at the nexus of human communities and water bodies and benefit from the System's multi-sector approach and strong network of partners. As a result, they are uniquely positioned to address the issue of marine debris.

This Roadmap, which stems from a NERR Science Collaborative (NSC) Science Transfer project, aims to guide and support Reserves in promoting understanding, behavior change, and policy action to manage and reduce marine debris in estuaries.

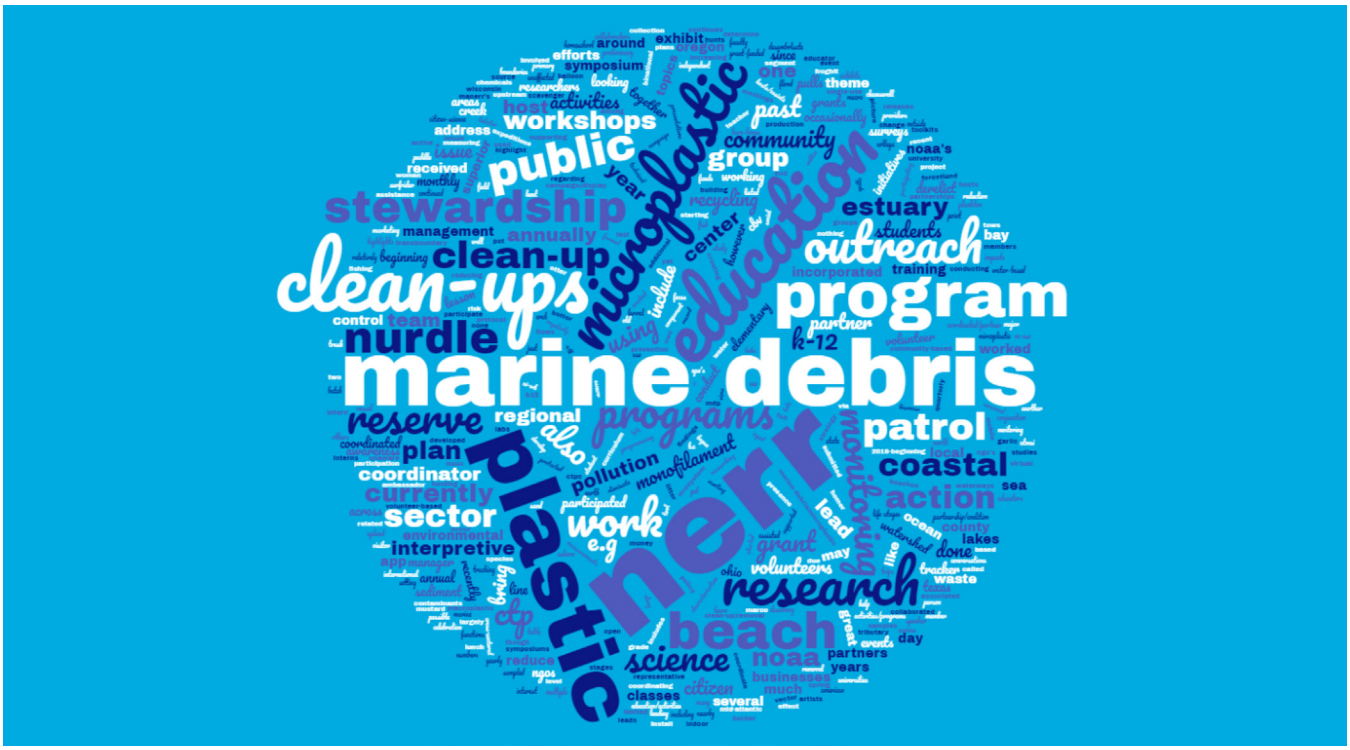
The project explored the NERRS's niche in marine debris—how the System can uniquely contribute to marine debris remediation efforts and effectively address the issue at national and local levels. Feedback from workshops across Reserves and with the Marine Debris Community of Practice (DCoP) shaped the Roadmap, identifying three main integrative approaches:

1. **Develop a national narrative for the NERRS.**
2. **Build relationships and partnerships with the DCoP.**
3. **Support each Reserve's work by sharing resources and opportunities.**

Each integrative approach detailed in this Roadmap includes application pathways and case studies that showcase the achievements of various Reserves. The Roadmap is a resource, both for Reserves and DCoP members to address marine debris in individual estuaries and for the NERRS to understand its unique role in the marine debris community, becoming more strategic and effective as a system.

The Roadmap also provides recommendations, next steps, considerations, and guidance for evaluating effectiveness. We hope it will help Reserves and their partners leverage existing efforts and start new initiatives to remove and reduce the impact of marine debris in estuaries.

Figure 1. Word cloud generated from 2020 survey of existing efforts by individual reserves addressing marine debris.



Foundations: Why do we need a Roadmap?

> *"Estuaries are an important link in the chain of trash becoming marine debris, and we should be involved in this."*
>
> *- Response from 2020 cross-sector survey of NERRS staff.*

The Issue

Marine debris is a significant issue affecting aquatic ecosystems, contaminating waterways, and impacting water quality and habitat resilience, all of which are strategic focus areas for the National Estuarine Research Reserve System (NERRS).[1] According to NOAA, marine debris is, "any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes."[2]

As a waste product of modern human society, marine debris in the environment originates entirely from terrestrial sources.[3] Wind, rain, runoff, and human activities transport this debris through watersheds into rivers, lakes, estuaries, and ultimately the ocean. Estuaries, situated between terrestrial systems (where marine debris is generated) and large water bodies (where it accumulates), are particularly vulnerable.

Plastics, which make up a significant portion of this debris, are especially problematic. Designed for durability, plastics remain in the environment indefinitely, endangering wildlife, absorbing and releasing harmful chemicals, breaking down into microplastics, releasing greenhouse gases as they degrade, entering the food web, and potentially posing risks to human health.[4,5,6,7] Plastic litter within 50 km of shorelines is highly likely to enter the ocean[8] and has even been found in the deep ocean.[9] Additionally, maritime activities like shipping and fishing generate debris that can wash up on shorelines.

Large debris, such as derelict vessels, lumber, and other human-made materials, can physically harm sensitive coastal habitats and aquatic life, and can introduce non-native species.[10] This is particularly concerning because estuaries are among the most productive ecosystems globally, they support coastal economies through fisheries and maritime ports, and they offer cultural ecosystem services like education, recreation, and cultural heritage.

The numerous, varied impacts of marine debris on estuaries affect both the environment and surrounding communities. While significant research exists on the impact of marine debris on estuarine ecosystems[11,12,13] much less focuses on the impact on humans living in and dependent on these systems.[14],[15] Regardless of type or source, marine debris threatens human health and well-being.

Moreover, marine debris pollution is intersectional with environmental justice. While some coastal communities are well-resourced, others, including those served by some Reserves, are historically disadvantaged and disproportionately impacted by marine debris and other pollution. Islands are particularly vulnerable, with Indigenous lifeways closely intertwined with threatened estuarine and ocean ecosystems.

Addressing debris in estuaries requires a collaborative, multi-pronged effort by scientists, educators, natural resource managers, policymakers, industry partners, local knowledge holders, and other community members.[16,17,18,19] Reserves are uniquely positioned to support the collaboration needed to co-develop solutions to marine debris that synthesize these multiple perspectives, including Indigenous knowledge.

The Roadmap advances these efforts by outlining broad integrative approaches and specific pathways that Reserves may take to reach the shared destination: a NERR System that effectively addresses the issue of marine debris at the national and local levels to promote resilient and thriving estuaries.

Tijuana River NERR Reserve Manager Chris Peregrin observing debris intercepted by a trash boom.
Photo courtesy of Tijuana River NERR.

Process: How was this Roadmap developed?

Emergence of User Needs

During the West Coast and Pacific Regional Session of the 2019 NERRA Annual Meeting in Charleston, South Carolina, the NERRS Plastics Workgroup was formed to address plastic trash and marine debris through research, stewardship, education, and community partnerships. The workgroup now includes over 65 members from all sectors, representing 27 Reserve staff (CTP: 11, Education: 19, Research: 18, Stewardship: 12, Manager: 2), NOAA Office for Coastal Management, and Reserve Friends network groups.

After the meeting, the workgroup surveyed all Reserves to assess needs and priorities for addressing plastics. Survey results (**Appendix A1**) were presented at the 2020 NERRA Annual Meeting (held virtually) in a cross-sector sharing session:

- Approximately 95% of respondents were aware of public concern for plastic pollution at their Reserve.
- Marine debris (any man-made object), macroplastic, and microplastic were all considered important or somewhat important to address.
- 21 Reserves have existing programs related to plastics, and all Reserves wish to expand or collaborate to synergize efforts.

Discussion at the 2020 sharing session, along with survey results, showed that all Reserves and sectors want to work together to address marine debris and suggested the following:

- Develop standardized protocol options and toolkits for long-term monitoring.
- Produce a collaborative national program involving all sectors.
- Create a shared repository of resources and standardized actions transferable across Reserves.

Despite clear goals, discussions revealed that each Reserve is at a different stage of program development, with varying needs and capacities. Some Reserves have existing programs (**Appendix A1**, while others want to start programs in coordination with the rest of the NERRS. Unique issues with plastics (e.g., nurdle spills, ocean debris) and differing monitoring methods based on purpose, material type, habitat, ecosystem characteristics, capacity, equipment, and target audience (e.g., community volunteers, K-12 educational audiences) also vary. Regions and states prioritize different policies, as well.

These differences make it challenging to create a standardized, System-wide program that benefits individual Reserves. While standardization may reveal general trends in marine debris and estuarine conditions, place-based efforts are needed for local behavior and policy change. Additionally, working relationships among sectors, communities, and decision-makers vary with each Reserve, and limitations in capacity (e.g., staff, resources) may affect implementation and utility.

Therefore, the workgroup determined that a national effort should focus on targeted knowledge exchanges to better understand individual and collective needs and actions. The workgroup also concluded that collaborating with existing marine debris programs and practitioners was key to developing a Roadmap for the NERRS to address the issue effectively without "reinventing the wheel" and to identify areas where the System could uniquely contribute. These exchanges among NERRs and the DCoP are described in the Roadmap, highlighting collaboration and knowledge transfer throughout the process.

Building Relationships with the Marine Debris Community of Practice (DCoP)

Many organizations have research, monitoring, or action programs for marine debris at local, national, and global levels, including the NOAA Marine Debris Program (NOAA MDP), Sea Grant, and various nonprofit foundations. We characterize these organizations as the Marine Debris Community of Practice (DCoP).

To enhance the DCoP, the core team engaged representatives already active in marine debris issues. Key partners, such as the MDP and the Hawai'i and California Sea Grant offices, helped scope how the NERRS could best contribute.

Initial discussions with the NOAA MDP highlighted the potential for synergistic efforts, like implementing an estuarine module for debris sampling under the NERRS to expand coverage and provide a comprehensive national overview of debris trends. Conversations with Hawai'i and California Sea Grant reinforced shared goals for community engagement and priority alignment.

These dialogues affirmed the importance of estuary monitoring and understanding individual Reserve needs within the broader Reserve system, underscoring the NERRS's unique capacity within the DCoP to address marine debris in estuaries through an interdisciplinary lens. Each Reserve's capabilities in research, stewardship, education, and coastal training, along with the public outreach of NERRA, position the NERRS to significantly impact the debris issue through long-term monitoring, data application, and influencing behavior and policy changes.

In 2022, the NERRS marine debris workgroup secured a NERRS Science Collaborative (NSC) Science Transfer grant to facilitate knowledge exchanges among Reserves and the DCoP, leading to the collaborative development of this Roadmap (**Appendix A2**). The project team, comprising a core leadership team, a Project Advisory Committee (PAC), and representatives from the DCoP (including the NERRS Plastics Workgroup, NERRA, NOAA MDP, and Sea Grant), established a Project Charter to define roles and processes (**Appendix A3**).

Knowledge Transfer Workshops

A series of knowledge transfer workshops were held to collaboratively create this Roadmap with the community described above (NERRs, NERRA, NOAA MDP, Sea Grant). During meetings with the PAC (**Appendix A3**), feedback was provided and directions were set for developing workshop aims and this Roadmap itself. PAC members contributed their insights from developing national strategic plans for marine debris programs (e.g., **NOAA**, **Sea Grant**). Each workshop focused on specific objectives, and their outcomes are incorporated into this Roadmap as follows.

Knowledge Transfer Workshop #1: Finding Common Ground (Virtual workshop, July 2023)

Objectives	Outcomes
• Develop mutual language to describe human-made debris in estuaries and the processes by which debris is transported in aquatic environments.	➔ The Reserves, including those from the Great Lakes, agreed on using the term **'marine debris'** as defined by NOAA MDP to describe the issue. Using an existing term was encouraged to demonstrate consistency with terminology used within the DCoP.
• Gain understanding of how workshop participants are already addressing marine debris and how a Roadmap to unify the Reserves could enhance their impact.	➔ Three main themes emerged for how a national Roadmap could enhance Reserve efforts and foster cross-sector efforts. These evolved into the three **integrative approaches** in this Roadmap: 1) National Narrative; 2) Partnership & Relationship Building; 3) Shared Resources & Opportunities (see **Appendix A4**).

Knowledge Transfer Workshop #2: Leveraging Strengths & Identifying Opportunities (in person during the Professional Sharing session, NERRS Annual Meeting 2023)

Objectives	Outcomes
• Engage the NERRS community in an analysis of the Strengths, Weaknesses, Opportunities, and Challenges (SWOC analysis) in pursuing the three Integrative Approaches identified during Knowledge Transfer Workshop #1.	➔ Participants articulated the NERRS' unique strengths in addressing estuarine habitats via efforts by multiple sectors (education, CTP, stewardship, research). Ample opportunities were identified for collaboration across sectors and DCoP institutions. Weaknesses included lack of direction, capacity, and mechanisms for standardization and harmonization with existing DCoP efforts. Challenges, highlighted at the beginning of each integrative approach section of the Roadmap, revolved around standardization, coordination, and lack of capacity (see **Appendix A5**). ➔ The strategic pathways laid out in this Roadmap provide actionable options for addressing challenges while leveraging strengths of the NERRS and the DCoP.

Knowledge Transfer Workshop #3: Communicating Marine Debris (Virtual workshop, March 2024)	
Objectives	**Outcomes**
• Learn and discuss the importance of communication when addressing marine debris.	➔ Participants gained insights from NOAA MDP on the importance of using effective communication techniques when addressing the challenges of marine debris. ➔ Participants applied their skills to develop application pathways involving communication strategies that are associated with integrative approaches of this Roadmap (see **Appendix A6**). ➔ Participants representing NERRA took lessons learned and drafted a 'NERRA Marine Debris & Plastics Messaging Guidance' document.

Knowledge Transfer Workshop #4: Product Dissemination (in person, NERRS Annual Meeting 2024)	
Objectives	**Outcomes**
• Share the final product (the Roadmap) and discuss the application pathways within each integrative approach.	➔ Participants will become familiarized with the Roadmap, identify options for collaboration, and explore mechanisms for continued capacity and longevity of marine debris efforts within the NERRS (e.g., additional / leverage funding)

Vision: Where are we trying to go?

The NERRS promotes resilient, thriving estuaries, integrating management, research, education, stewardship, and training to support innovative, collaborative approaches to address marine debris at national and local levels.

We envision the NERRS supporting innovative, collaborative approaches to address marine debris and national and local levels, integrating management, research, education, stewardship, and training to promote resilient, thriving estuaries.

This Roadmap was created to advance the System and individual Reserves toward optimal marine debris remediation, aiming for Reserve-specific impact that contributes to a unified national vision. It outlines three integrative approaches encompassing of each sector to enhance existing efforts and provides application pathways for each approach. Case studies from Reserves and the DCoP illustrate implementation examples.

Because each Reserve has unique needs, strengths, and challenges, the Roadmap was designed to guide rather than prescribe. It also provides recommendations, next steps, considerations, and metrics for evaluating its effectiveness.

The inaugural cohort of Tijuana River NERR's cross-border Marine Debris Leadership Academy.
Photo courtesy of Abraham Garcia, Kilómetro Uno.

Integrative Approaches

Previous surveys, meetings, and workgroup discussions identified a common interest amongst Reserves: to **leverage** and **integrate** cross-sector strengths and **collaboratively** address the issue of marine debris in estuaries across the NERRS.

Discussions from Science Transfer Workshop #1 (participants: NOAA MDP, NERRS representatives, NERRA, and Sea Grant) identified three 'integrative approaches' that leverage Reserve-specific differences to unify Reserves on the issue of marine debris. 'Integrative approaches' are meant to be opportunities recommended to the NERRS that focus different Reserves and sectors towards common goals. Furthermore, these approaches are meant to benefit the individual Reserves, the NERRS, and the DCoP.

The three Integrative Approaches to unify Reserve efforts in marine debris:

1. Create a **national narrative** that tells the story of marine debris in a diversity of estuaries and elevates the issue of marine debris;
2. Build **relationships and partnerships** for effective collaboration of intended partners and users at local to global scales; and
3. Establish, build, and maintain a repository of **shared resources and opportunities** for Reserves to voluntarily participate and collaborate with other Reserves and the greater marine debris community of practice.

A researcher walking through the eelgrass meadow at Padilla Bay NERR.
Photo courtesy of Heath Bohlmann.

Integrative Approach 1: National Narrative

A narrative is a way of presenting or talking about the marine debris issue and what Reserves are doing about it. Many Reserves are already taking local and regional action on marine debris, and crafting their own narratives around the topic. A ***national* narrative** is needed for the NERRS to collect the various stories and weave them together for greater visibility and impact through both *internal* and *external* narrative components.

Internal & External Narratives

Internal narratives are opportunities for Reserves to individually and collectively elevate the issue of marine debris within the NERRS. The NERRS has historically used three strategic focus areas at the national level. In the current draft of the NERRS Strategic Plan 2024-2029, the strategic focus areas are: Climate Change, Habitat Protection and Restoration, and Water Quality and Quantity. Aspects of marine debris intersect with each of these focus areas, and should be included within the Strategic Plan. Other large-scale ocean planning documents provide precedence for this approach. The California Sea Grant Strategic Plan for 2024-2027 lists marine debris, land-based sources of trash, and microplastics as examples of pollution that interact with the larger focus area of Healthy Coastal Ecosystems (one of five focus areas). A similar treatment of marine debris within the NERRS Strategic Plan would be helping to promote the issue internally within the NERRS.

Various other internal planning documents and priority lists are utilized within the NERRS at different levels, for example:

- Individual Reserve Management Plans
- Individual Reserve Management Needs and Priorities (e.g., used to inform Davidson Fellowship and NERRS Science Collaborative)
- Individual Reserve Education and CTP Market Analyses and Needs Assessments
- National Products & Strategic Concepts

While marine debris can be incorporated at the national scale, for example within the NERRS Strategic Plan, there are the other examples listed above that can be scaled more locally such as individual Reserve Management Plans. Other planning documents (not listed above) at the sector and regional levels may also present opportunities for inclusion of marine debris. For example, within the Research Sector many individual Reserves have conducted an assessment of research needs and gaps through the Site Profile. Additionally, engagement with students and the public about marine debris can be documented with interpretive and other plans.

There is a NERRS-wide need to understand and map how different dimensions of marine debris issues are represented within each of the different management and guidance documents. For example, large scale marine debris may be currently addressed under “habitat restoration” in some Reserve Management Plans, whereas microplastics may be addressed under “water quality.” This mapping process would help to identify potential ways to align efforts across regions, sectors, and system levels, shape language for internal calls for proposals, and inform how NERRS can weave together stories into a larger, more coherent narrative for external audiences.

External narratives are communication products to elevate awareness of marine debris in estuaries and the actions of the NERRS to address the issue. There is a need to outwardly communicate the unique impacts of marine debris on estuaries and highlight the research, education, and stewardship efforts that the NERRS is contributing in the area of marine debris. For a general public audience, an outward-facing national narrative around marine debris for the NERRS could:

- Generate support for policy solutions
- Drive consumer behavior change
- Shape public narratives around responsible corporate practices
- Encourage participation in local cleanup, prevention, and monitoring efforts
- Demonstrate the NERRS' commitment to the issue and highlight the need for additional resources

The target audience for an external national narrative may also include the research community. For example, presentations on the various marine debris research occurring within the NERRS through various formats (e.g., conferences, review papers, research digests) could encourage development of coordinated ecological studies research with an emphasis on research questions that pertain to impacts of marine debris.

Individual Reserves are already conducting integrative efforts related to marine debris (see **Appendix A1**) that could be drawn together as case studies to form a national narrative that speaks to the far-reaching nature of the marine debris issue and the diversity of possible responses at local, regional, and national levels:

- Local cleanup volunteer efforts (e.g., roadside cleanups)
- Targeted debris removal efforts in collaboration with specific sectors or industries (e.g., crab pot remote sensing and removal)
- Community science efforts, both local and regional (e.g., Nurdle Patrol)
- Workshops for local coastal businesses on plastic reduction (e.g., marina restaurants, bars)

Challenges

During the SWOC analysis conducted at the Knowledge Transfer Workshop #2, several challenges to the development and implementation of a national narrative were identified (see **Appendix A5**). Similarly to what has already been discussed in this section, having a national narrative that speaks to/supports both the NERRS collectively and at the individual Reserve-level is inherently challenging due to the uniqueness of each Reserve. Specific challenges identified include:

- Varying land management practices
- Diversity of type, magnitude and priority of marine debris related issues
- Overlap with DCoP programs such as NOAA MDP and the Environmental Protection Agency's Trash Free Water and Estuary programs
- Public perception of marine debris primarily focused on the ocean or beaches, rather than estuaries
- Funding for national/regional/multi-Reserve projects is limited

While these challenges add to the complexity of identifying and establishing a national narrative, they also provide more perspective on what gaps a national narrative could address to help foster stronger collective messaging and support of marine debris-related projects.

Knowledge Transfer Workshop #2 at Jaqcues Cousteau NERR.
Photo courtesy of MeganSpitzer, TRNERR California Sea Grant Fellow

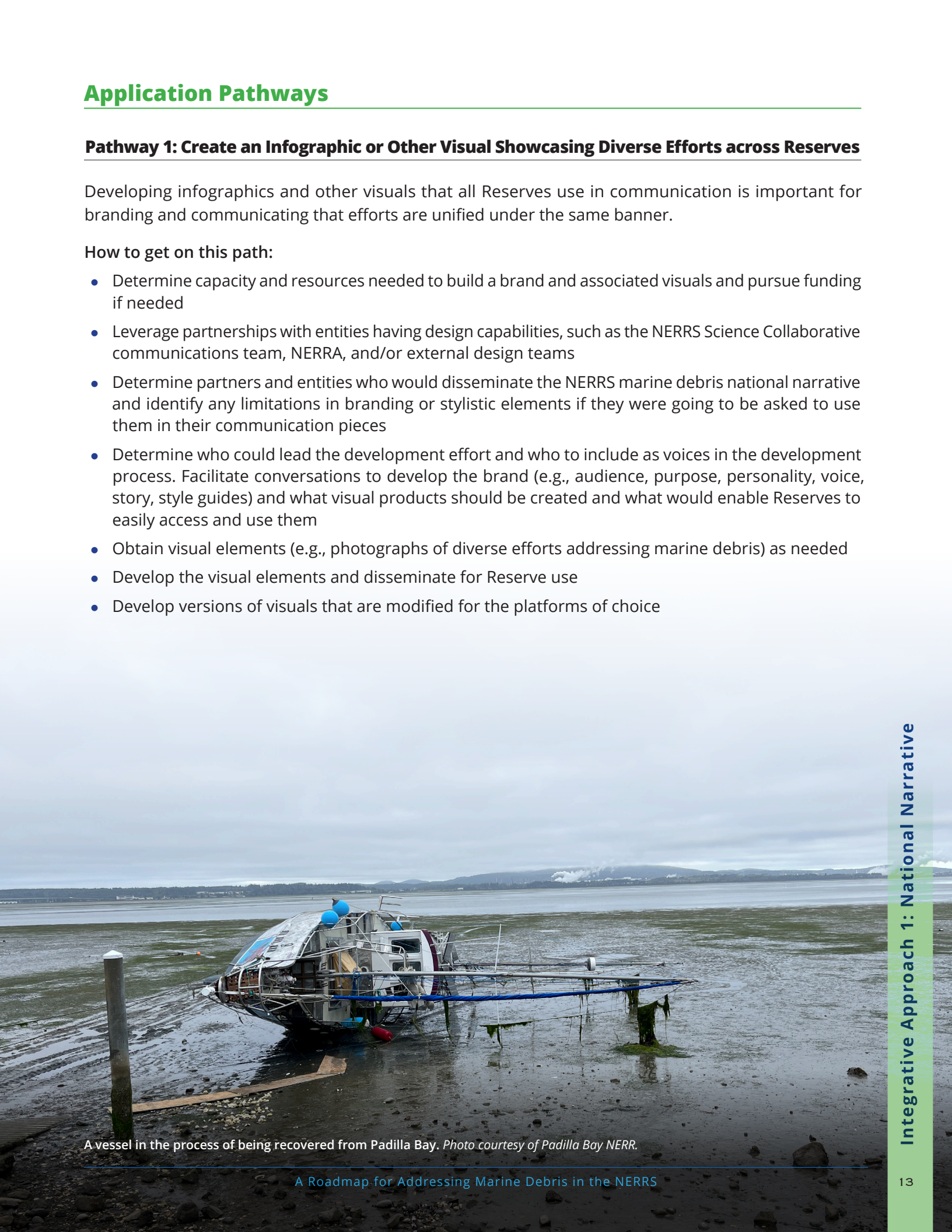
Application Pathways

Pathway 1: Create an Infographic or Other Visual Showcasing Diverse Efforts across Reserves

Developing infographics and other visuals that all Reserves use in communication is important for branding and communicating that efforts are unified under the same banner.

How to get on this path:

- Determine capacity and resources needed to build a brand and associated visuals and pursue funding if needed
- Leverage partnerships with entities having design capabilities, such as the NERRS Science Collaborative communications team, NERRA, and/or external design teams
- Determine partners and entities who would disseminate the NERRS marine debris national narrative and identify any limitations in branding or stylistic elements if they were going to be asked to use them in their communication pieces
- Determine who could lead the development effort and who to include as voices in the development process. Facilitate conversations to develop the brand (e.g., audience, purpose, personality, voice, story, style guides) and what visual products should be created and what would enable Reserves to easily access and use them
- Obtain visual elements (e.g., photographs of diverse efforts addressing marine debris) as needed
- Develop the visual elements and disseminate for Reserve use
- Develop versions of visuals that are modified for the platforms of choice



A vessel in the process of being recovered from Padilla Bay. *Photo courtesy of Padilla Bay NERR.*

Pathway 2: Utilize Social Media

Building on Pathway 1, utilizing social media may be a relatively low-effort but high-impact way to broadcast visuals and messages. Some Reserves already maintain a social media presence to amplify their messages about marine debris, from derelict crab trap removal to shoreline debris monitoring, but there is much untapped potential. Strategies to build a national narrative around marine debris in estuaries might include:

- Social media campaigns which can include all Reserves posting at once and using a shared unique hashtag (e.g. #estuarydebris) so that anyone can easily find all NERR posts related to marine debris. Posts can also piggyback on already-popular hashtags. As of this writing, some of those include:
  - #plasticpollution – *1.2 million posts*
  - #beachcleanup – *583k posts*
  - #breakfreefromplastic – *322k posts*
  - #plasticpollutes – *183k posts*
  - #microplastics – *154k posts*
  - #oceanplastic – *153k posts*
  - #marinedebris – *126k posts*
  - #nurdles – *11k posts*
- Mentioning local collaborators and like-minded groups in posts. It is good practice is to check with them ahead of posting and tagging them. Some suggestions are:
  - Nonprofits (NGO/CBO)
    - Papahānaumokuākea Marine Debris Project | @pmdp on Instagram
    - I Love a Clean San Diego | @iloveacleansd on Instagram
    - Zero Waste Washington on Facebook
    - Nurdle Patrol Facebook group
  - Government agencies
    - NOAA Marine Debris Program | @noaadebris on Instagram
  - Academic institutions
    - Center for Marine Debris Research at Hawai'i Pacific University | @debrisresearch on Instagram
  - Industry
    - Hawai'i Longline Association | @hawaiilonglineassociation on Instagram

How to get on this path:

- Visualizations
  - See **Integrative Approach 1, Pathway 1**
- Communication Strategy
  - A more comprehensive list of marine debris programs, agencies, and research groups active on social media, broken down by region
  - Agreement on a common hashtag or phrase to use
  - Clear communication techniques (see Integrative **Approach 1, Case Study 2**)

Pathway 3: Utilize NERRA as a Mechanism for Communicating a National Narrative

NERRA produces regular communication pieces highlighting Reserve activities to inspire and inform. These communication pieces have already featured stories of individual Reserve efforts addressing marine debris. Some examples are:

Some examples of these communication pieces are:

- Happy Earth Day 2024
- NERRA Board Members Talk Plastics in Mexico City
- Reducing Plastics in the Great Lakes
- Tijuana Bans Plastic Bags
- Nurdle Patrol is Growing
- Nurdle Patrol Without Borders
- Talk Nurdle to Me: Jace Tunnell
- NERRds + Volunteer Power = Global Action
- Nurdles no match for Texas NERRd Power
- Ready to Talk Some Trash?
- Hey Tijuana, You Clean Up Nice!
- Eye in the Sky Helps Coastal Clean Up
- Power partnership tackles debris
- Creating Value from Waste
- Local Knowledge Strengthens Flood Resilience
- Derelict is Dangerous & Weeks Bay Cleans It Up
- Storm Prep Never Stops at Florida's Rookery Bay
- Kids of All Kinds Clean Up the Hudson
- Little Help from Our Friends: Tony Amos

Most recently, NERRA has drafted the NERRS Marine Debris & Plastics Messaging Guidance document, which was inspired by breakout activities and communication techniques modeled in **Knowledge Transfer Workshop #3**. This will be a useful tool to help maintain consistent communications around the NERRS regarding work surrounding the challenges of marine debris.

How to get on this path:

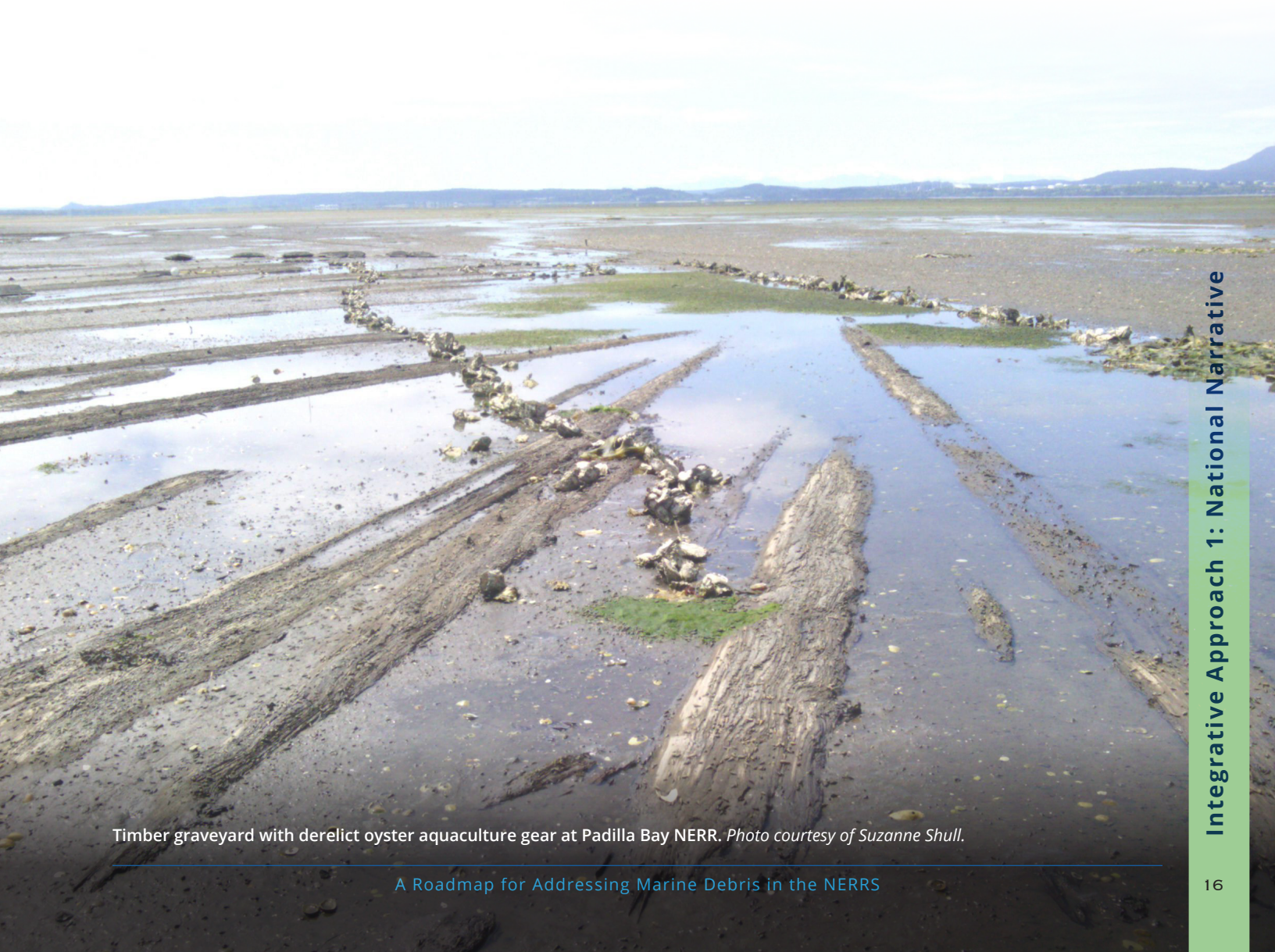
- Strengthen coordination with NERRA on marine debris communication. Discuss potential avenues for bundling communication pieces about marine debris efforts into a national narrative and for regular features of Reserves undertaking marine debris work.

Case Studies

Case Study 1: NOAA Marine Debris Program Strategic Plan

The NOAA MDP Strategic Plan is an example of a national strategy that utilizes collective goals and messaging while supporting regional and local implementation. Lessons learned from it could help signify the importance of a national narrative and how it should be developed and operationalized.

The plan explains that, "The fiscal year 2021-2025 Strategic Plan highlights how the MDP will work with dedicated staff and partners for the next five years to make a measurable change toward reaching our vision: the global ocean and its coasts free from the impacts of marine debris. Six goals will guide the next five years: prevention, removal, research, response, coordination, and a new goal: monitoring and detection. The fiscal year 2021-2025 Strategic Plan also includes a new focus on using innovative technology and a commitment to diversity, inclusion, and equity [...] This plan will drive daily operations, set annual milestones, and challenge the MDP to reach more ambitious goals than ever previously set. The path forward is one filled with hope for a healthier ocean and healthier planet."



Timber graveyard with derelict oyster aquaculture gear at Padilla Bay NERR. *Photo courtesy of Suzanne Shull.*

Case Study 2: NOAA Marine Debris Program Communication Techniques

When developing a national narrative, language used by NOAA MDP is an example of how to communicate about the issue of marine debris externally, and also how to better understand it internally. We urge practitioners to consider the 'what, why, how to help' method.

When communicating the 'what,' NOAA's explanation of the topic starts broadly, "Our oceans are filled with items that do not belong there. Huge amounts of plastics, metals, rubber, paper, textiles, derelict fishing gear, derelict vessels, and other lost or discarded items enter the marine environment every day. This makes marine debris one of the most widespread pollution problems facing the ocean and waterways." It then gets specific, "Some of the most common and harmful types of marine debris include plastic, such as cigarette butts, plastic bags, and food wrappers, and derelict fishing gear. Marine debris can also range greatly in size from the smallest plastic pieces, called microplastics, that can be too small to be seen with the human eye…" The clear language is effective for anyone having little to no understanding of what marine debris actually is.

When communicating the 'why,' NOAA is clear that the impact of marine debris is cross-cutting, impacting humans and the natural systems we depend on. Visualizations of a crab wrapped in a yellow net (presumably from entanglement) can be moving and impactful enough to get the point across – humans depend on fishing for sustenance and jobs, yet when the gear is lost ocean ecosystems can be impacted by ghost fishing or entanglement.

When communicating on 'how to help,' you will find that NOAA specifically describes how, "There is no "one-size-fits-all" solution to marine debris, and communities around the country are affected by marine debris in different ways," and that, "Finding solutions that work for your community makes the fight against marine debris more effective." This language does not place too much pressure on the individual. In the context of the Reserve system, this messaging encourages a community to look to its closest Reserve for guidance on how to do this. This could lead to future partnerships and stewardship opportunities.

Volunteers removing debris. *Photo courtesy of NOAA.*

Integrative Approach 2: Relationship & Partnership Building

The NERRS is built on successful relationships with key partners and communities within the Reserves and beyond. Through relationship and partnership-building, Reserves can develop and maintain strong networks, exchange knowledge and best practices, and work collaboratively to implement relevant actions.

This integrative approach suggests entities that would be beneficial to develop partnerships at the NERRS-level to enhance cross-sector collaborative efforts, and provides a starting point for Reserves to consider Reserve-level relationships. Then, examples of national, cross-sector efforts are provided to demonstrate possible benefits from NERRS-level relationships with DCoP entities. Each example below provides suggestions on the types of partnerships and relationships that would need to be established for successful co-development and co-creation of solutions.

Priority Partnerships within the Debris Community of Practice (DCoP)

Within NOAA

1. **Marine Debris Program (MDP)**:

   A partnership with NOAA MDP allows Reserves to leverage existing resources, become part of a coordinated effort with NOAA monitoring activities and protocols, and develop a shared database and educational tools tailored for the Reserves. Collaboration can help build a strong network of coastal decision-makers who are equipped to address marine debris issues effectively and strengthen the Reserves' capacity to monitor and manage marine debris by:

   - Aligning Reserve priorities and strategic planning to address marine debris with NOAA MDP's program pillars of Prevention, Removal, Research, Monitoring and Detection, Response, and Coordination;
   - Utilizing and promoting NOAA's established tools (e.g., NOAA's MDMAP, University of Georgia's Debris Tracker App and Ocean Conservancy's TIDES);
   - Integrating NERRS efforts with existing NOAA state and regional marine debris action plans;
   - Leveraging and validating the importance of NERRS for legislative and administrative bodies; and
   - Identifying emergency response guides and tips through NOAA MDP.

2. **National Sea Grant College Program** and **Sea Grant Program Network**:

The National Sea Grant and the state-based Sea Grant network have supported coastal, marine, and Great Lakes communities through various research, education, outreach, and extension programming such as their specific working group for marine debris. Sea Grant is a Federal-University partnership, aimed at finding solutions for issues that impact coastal communities. There are 34 university-based programs across the nation, with marine debris as a priority issue for many of the programs. Recently, $16 million has been appropriated through the Bipartisan Infrastructure Law to Sea Grant to work on marine debris coalition building and research. Examples of this are:

- California Sea Grant strengthening the inclusivity and diversity focus and capacity of the **California Ocean Litter Prevention Strategy** through coalition building and collaborative efforts with the University of Southern California Sea Grant, the California Ocean Protection Council, and the NOAA MDP.

- Hawai'i Sea Grant College Program, which was funded to develop a Pacific Islands Marine Debris Community Action Coalition including US Territories and affiliates, to address associated impacts related to land-based pollutants. The Pacific Islander Coalition Project, which focuses on climate resilience and education and outreach focused on prevention.

3. Other **Reserves**:

Engagement and exchange of ideas and practices with other Reserves, regionally or nationally, enable the Reserves to learn from one another. These opportunities for knowledge transfer allow Reserves to discuss their experiences and challenges to adapt best practices for their specific contexts. This collaboration helps Reserves to implement effective strategies for marine debris management, such as monitoring and analysis, debris removal, and public engagement programs. The NERRA, NSC, and NOAA Office for Coastal Management (OCM) can facilitate connecting, collaborating, and sharing information related to marine debris management between Reserves through:

- Communication about addressing impact of marine debris on estuary habitat, organisms, and environments;
- Examples of project implementation and evaluation; and
- Sharing lessons learned from pilot programs.

Roadmap core team members clearing debris during a Laulima Day at He'eia NERR. *Photo courtesy of Tijuana River NERR.*

Other Priority Partnerships

Each of the Reserves engage with a unique community of coastal decision-makers including:

1. **Reserve communities:**

   Local communities, such as volunteers for community science projects, adopt-a-highway programs, and local resident advocacy groups can provide capacity for obtaining data as well as increasing awareness around prevention and behavior change for marine debris.

2. **Indigenous Peoples and Local Communities with Place-Based Knowledge:**

   It is important to recognize the traditional lands on which our Reserves are currently placed, and to prioritize engaging with Indigenous communities that lived sustainably on their land for millennia

prior to colonization and development. While the respective Indigenous peoples may not always be obvious or have organized representation, opportunities and forums should be provided and advertised broadly in different networks (e.g., tribal colleges, K-12 schools, community centers, health centers). There are also local communities with deep place-based knowledge about waterways and land use change that will provide unique and important perspectives on how to manage resources as well as debris. In developing these partnerships, it is important to seek advice and support to be respectful, humble, observe traditional protocols if possible, and approach with a mindset to listen first without acting. This is more commonly referred to as **meaningful engagement**, and it is encouraged to seek out organizations with trusted indigenous relationships to provide guidance on this.

State and other Federal Agencies:

Various state government management and regulatory agencies can play important roles in co-developing effective programs with Reserves, while leveraging existing resources and helping to raise awareness. Typically, wastewater, recycling, and trash is under the jurisdiction of the state, county, or the city's environmental services or refuse branch. Collaborating with them for education and workshops on how recycled materials are broken down or transported would increase prevention. Engaging with the state or city Department of Health can help with monitoring for pathogens or other microbial agents associated with trash and debris. Furthermore, working with the state or city Department of Land and Natural Resources can also help to monitor key taxa as biological indicators impacted by pollution. It would also be useful to leverage existing resources or programming with federal agencies such as U.S. Geological Survey to examine effects of pollution such as microplastics on groundwater and hydrology, and with the U.S. Environmental Protection Agency to align with their **National Strategy to Prevent Plastic Pollution**.

3. **Educational institutions:**

   Educational institutions, from pre-K to community colleges, workforce development programs, and universities, can be excellent partners for co-creating and co-implementing projects related to marine debris with a focus on awareness and prevention, and research to further understand plastic trash and impacts on the ecosystem. Collaborating with academic researchers can help to conduct baseline research and monitoring of key regions impacted by debris and pollution. This is also an opportunity for the Reserve Coastal Training Program to partner with educational institutions to offer workshops or training regarding plastic prevention, emergency response, and awareness about hazardous waste and interesting research.

4. **Nonprofits and private companies:**

   Nonprofit organizations, such as foundations, "Friends of" organizations, non-governmental organizations (NGOs), and community-based organizations (CBOs) are beneficial partners with Reserves. For example, NERRA is a nonprofit organization that leverages individual Reserves and their Friends groups for priority actions on behalf of the Reserves. Nonprofits like the Surfrider Foundation, Audubon Society, Ocean Conservancy, National Wildlife Refuge Association, Sierra Club, National Marine Sanctuaries Foundations, and Clean Ocean Action are active within communities as well as in partnership with government initiatives to address the issue of marine debris. Other opportunities for collaboration include private companies committed to reducing debris and pollution, such as Patagonia, REI, and potentially food industry organizations.

Challenges

During the SWOC analysis conducted at the Knowledge Transfer Workshop #2, several challenges to relationship- and partnership-building were identified (see **Appendix A5**). Specific challenges identified include:

- Standardizing methods for estuary plastic sampling between Reserves and partners
- Integration of Reserve specific goals that align with the NOAA MDP Strategic Plan
- Identifying metrics to demonstrate the impact of socio economic factors on marine debris and pollution, such as population size, housing, food availability, etc.
- Consolidating data in one digital storage location for multiple DCoP users to both add to and utilize

Application Pathways

Pathway 1: Create and Maintain a 'Living' Reserve Partners List

A resource to facilitate and foster Reserve partnerships could be through creating a 'living' list of Reserve partners to be shared NERRS-wide. The aforementioned list of priority DCoP partners are a start, but they are not exhaustive. The site-specificity of each Reserve demands that partnerships are largely place-based, but inspiration and lessons learned from partners at various scales can be beneficial.

How to get on this path:

- Determine priority projects to pursue and relationships needing to be built or strengthened; list; and
- A method of collecting data of priority partners to each Reserve to be compiled into the living partner list; and
- Determine a location to host the list so it is available to each of the NERRs and their partners.

*For more on this pathway see **Integrative Approach 3. Shared Resources & Opportunities**.

Microplastics accumulated at the mouth of He'eia Stream. *Photo credit: Shimi Rii.*

Pathway 2: Develop an Understanding through Interdisciplinary Research

To strengthen our collective understanding of both marine debris impacts and actions to reduce it, collaborative research is needed.

Potential partnerships:

- Nonprofit organizations
- Community based organizations
- Government agencies
- Academic institutions
- Technology industry

How to get on this path:

- Identifying point sources of marine debris, such as: major inputs/sources, determining major types of debris found in different areas of the estuary, and inclusion of citizen science monitoring alongside existing NERRS monitoring
- Assessing social science and behavior change through community-based social marketing, such as understanding barriers to behavior change related to personal plastic use, and impact of visitor center exhibits that teach people about behaviors that reduce plastic inputs into estuaries
- Finding innovative technological solutions (e.g., microplastic vacuums and plastic digestion tools)

Pathway 3: Influence Broader Action through Boundary Spanning

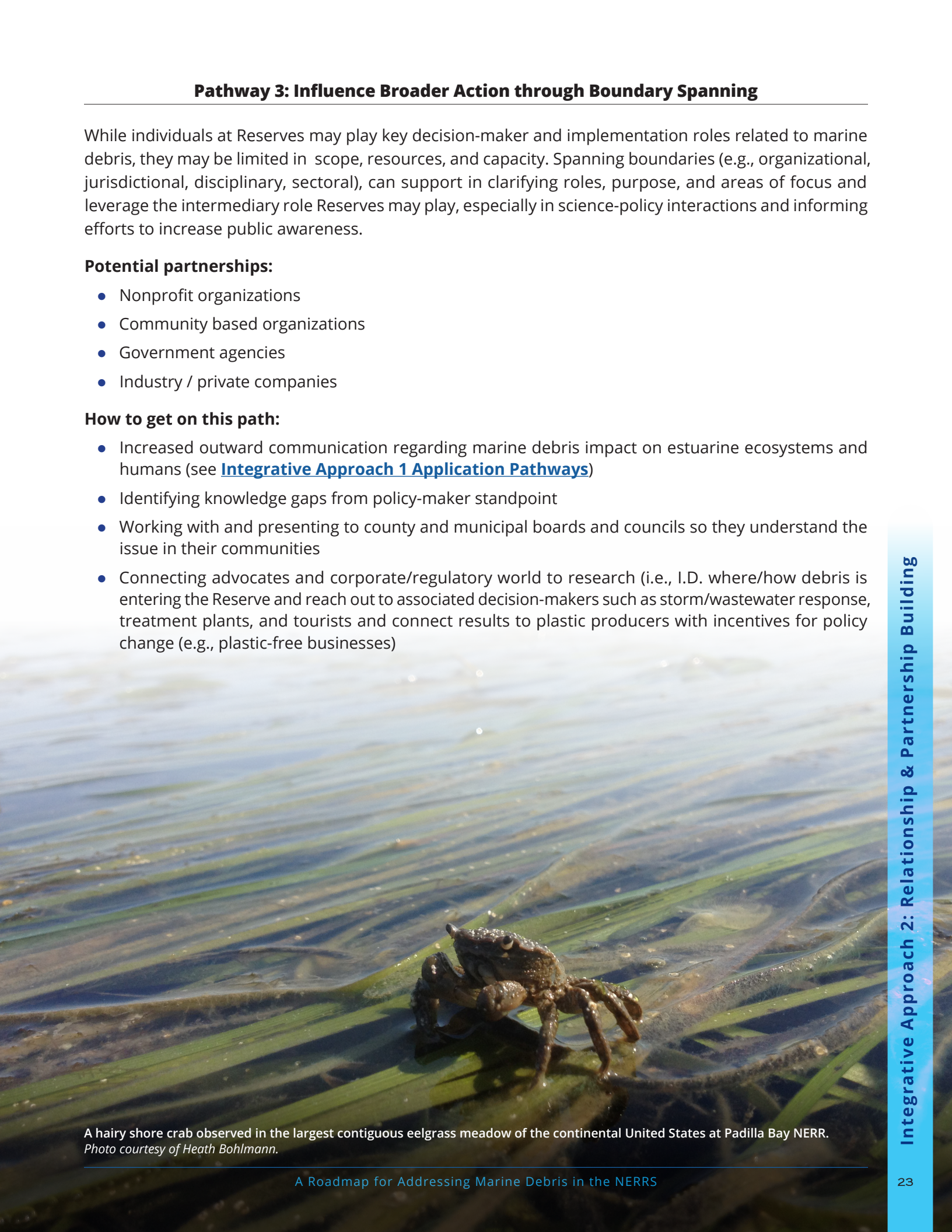
While individuals at Reserves may play key decision-maker and implementation roles related to marine debris, they may be limited in scope, resources, and capacity. Spanning boundaries (e.g., organizational, jurisdictional, disciplinary, sectoral), can support in clarifying roles, purpose, and areas of focus and leverage the intermediary role Reserves may play, especially in science-policy interactions and informing efforts to increase public awareness.

Potential partnerships:

- Nonprofit organizations
- Community based organizations
- Government agencies
- Industry / private companies

How to get on this path:

- Increased outward communication regarding marine debris impact on estuarine ecosystems and humans (see **Integrative Approach 1 Application Pathways**)
- Identifying knowledge gaps from policy-maker standpoint
- Working with and presenting to county and municipal boards and councils so they understand the issue in their communities
- Connecting advocates and corporate/regulatory world to research (i.e., I.D. where/how debris is entering the Reserve and reach out to associated decision-makers such as storm/wastewater response, treatment plants, and tourists and connect results to plastic producers with incentives for policy change (e.g., plastic-free businesses)



A hairy shore crab observed in the largest contiguous eelgrass meadow of the continental United States at Padilla Bay NERR.
Photo courtesy of Heath Bohlmann.

Pathway 4: Emphasize Prevention through Education

Education serves as a powerful tool to not only increase public awareness of issues such as marine debris, but also support prevention strategies. Through sharing success, impact stories, and information on plastic alternatives, the education sector can utilize both programming and communication tools to promote the prevention of marine debris at estuaries.

Potential partnerships:

- Education institutions
- Community based organizations
- Industry / private companies
- Nonprofit organizations

How to get on this path:

- Increase public awareness to local community members about methods of prevention (i.e., plastic alternatives)
- Exchange of knowledge with Reserve and potential partners on actionable solutions to communicate to students
- Place-based experiences and education on impact of marine debris on local communities
- Conservation action education programming (see **Appendix A7**) centered around marine debris for prevention and removal efforts (e.g., community-based social marketing)
- Promotion of marine debris topics at teacher workshops (e.g., TOTE)
- Participate in larger efforts like **Nurdle Patrol**, and creating sharable resources like lesson plans

Teachers engaged during a climate focused Teachers on the Estuary (TOTE) training. *Photo courtesy of Tijuana River NERR.*

Case Studies

Case Study 1: Tijuana River NERR support in banning plastic bags in Tijuana, Mexico

In 2018, the Tijuana River NERR (TRNERR) played a critical role in providing the training and technical assistance needed to inform policy which resulted in a ban of plastic bags in the city of Tijuana, Mexico. TRNERR's CTP Binational Liaison Ana Eguiarte coordinated the Desembolsate BC effort, which translates to "Baja California: Get Rid of Your Bags." As part of the Border 2020 Program, and leveraging NOAA MDP investments, it sustained cross-border work with the City of Tijuana to stem the flow of marine debris into the Tijuana Estuary downstream.

Ana Eguiarte, Margarita Diaz of Proyecto Fronterizo, and Cristhabel Verdugo at a Desembolsate BC event.
Photo courtesy of Tijuana River NERR

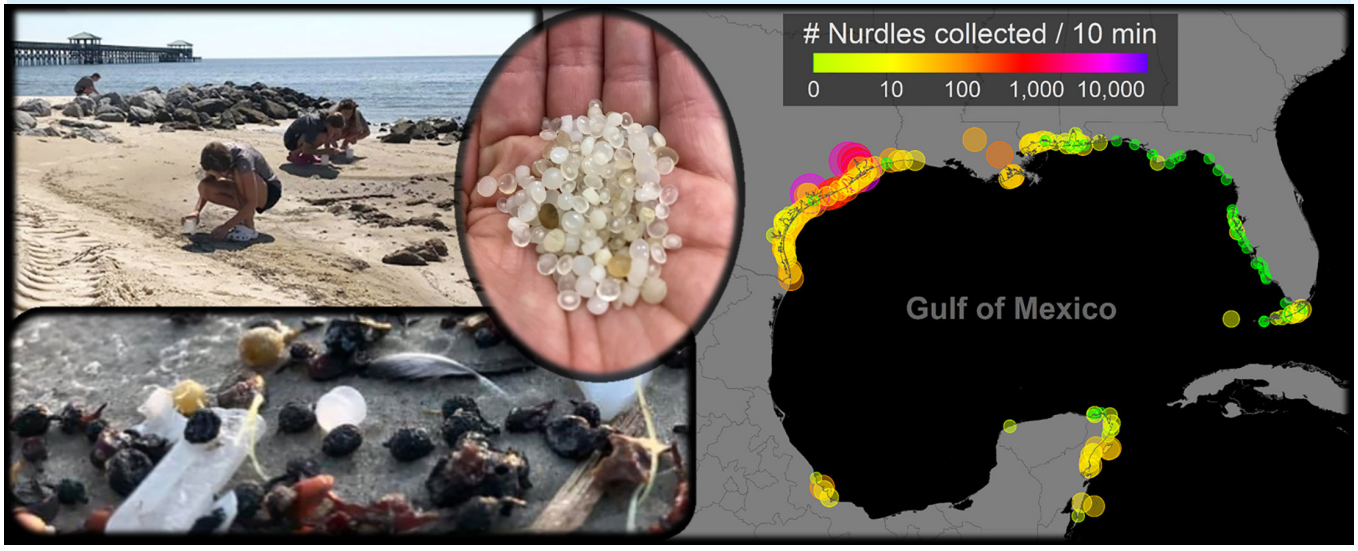
Case Study 2: Tijuana River NERR's Marine Debris Leadership Academy

The Tijuana River NERR launched the **Marine Debris Leadership Academy (MDLA)** in 2023 to connect and provide leadership training to a cohort from various backgrounds working on environmental conservation, stewardship, and marine debris on both sides of the US-Mexico border. Building on the TRNERR's existing clean-up, education, training and technical assistance programs, the MDLA also provides information and tools, and cultivates relationships, to strengthen environmental conservation and stewardship leadership ability on both sides of the border.

MDLA participants on a site visit. *Photo by Megan Spitzer*.

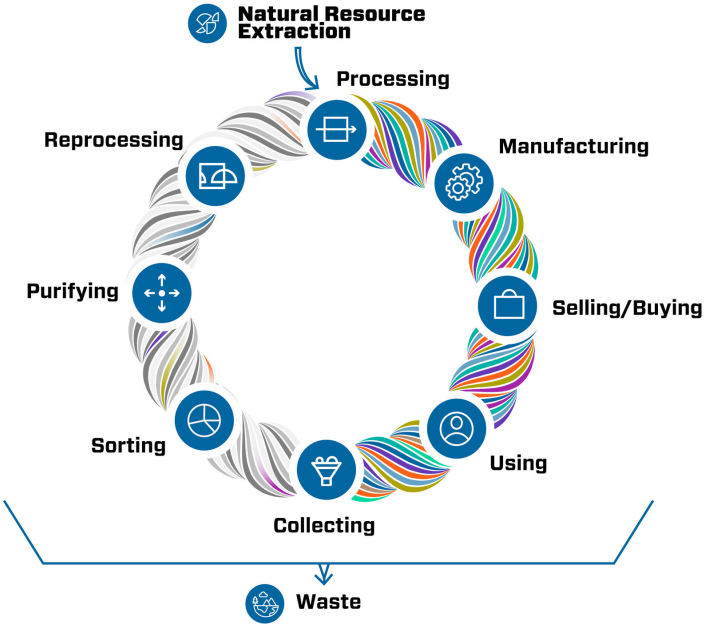
Case Study 3: Mission-Aransas NERR's Nurdle Patrol

Mission-Aransas NERR runs the **Nurdle Patrol**, a community science project that brings together scientists, landowners, policy-makers, other Reserves, and the public to gather information of nurdle locations, create awareness, and increase prevention. Their partners include non profit organizations such as Surfrider Foundation and Friends of San Juans, schools, and trans-national organizations.

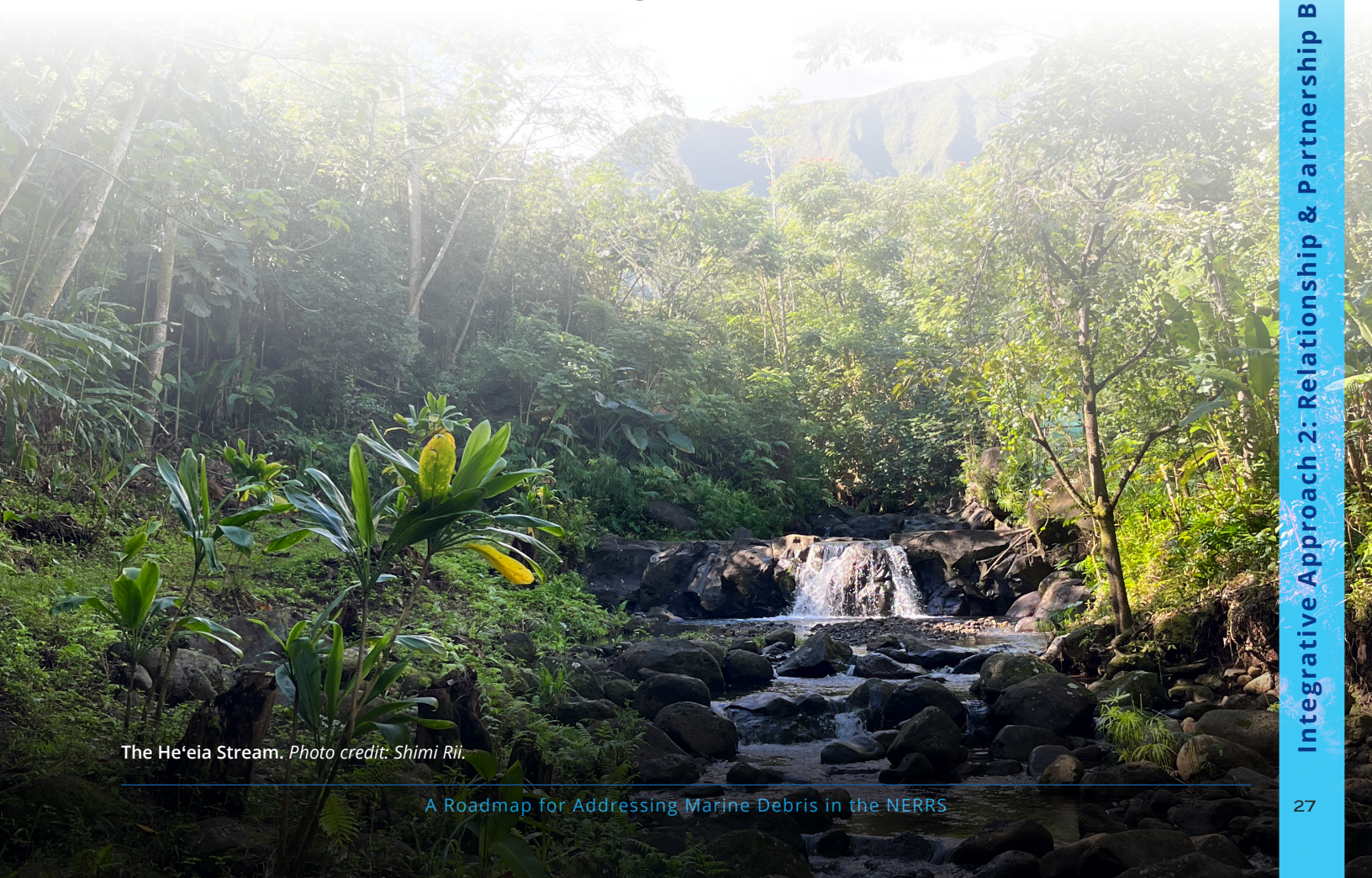


Case Study 4: He‘eia NERR’s Circular Economy Program to Minimize Global Waste

The **Center for Marine Debris Research** (CMDR) at the Hawai‘i Pacific University specializes in high quality chemical characterization of microplastics and also supports the National Institute of Standards and Technology (NIST) Circular Economy Program that aims to minimize global waste. He□eia NERR has partnered with CMDR in the past to submit proposals to examine microplastics in the environment, air, and animals within the estuary.



A graphic depicting the circular economy processes through He‘eia NERR’s program. *Image courtesy of He‘eia NERR.*



The He‘eia Stream. *Photo credit: Shimi Rii.*

Integrative Approach 3: Shared Resources & Opportunities

Although some Reserves have already implemented marine debris programs, other Reserves are looking to build on existing efforts and integrate marine debris as a priority issue. Input from the NERRS Plastics workgroup, survey respondents, and Science Transfer workshop #1 identified a need to build and maintain consolidated, shared resource repositories and opportunities for reserves to learn about what other reserves are doing and find materials and information needed to be able to implement/participate in existing programs at their Reserves if they choose.

Shared resources facilitate knowledge exchange between Reserves. A database to house these resources allow Reserves to access existing programmatic materials and learn from each other to choose opportunities that resonate with applicable stakeholder groups and ages. This addresses barriers such as a lack of capacity at the reserve level to develop new educational and monitoring programs, resources, and methodologies.

Challenges

During the SWOC analysis conducted at the Knowledge Transfer Workshop #2, several challenges to developing and implementing shared resources and opportunities were identified (see **Appendix A5**). Specific challenges identified include:

- Uniformed measurement collected data
- Uniformed reporting of data
- Collective understanding of marine debris prevention and removal
- Organization of varying marine debris recovery projects and strategies
- Difficulty of plastics detection and possible response options

Volunteers working to remove large woody debris. *Photo courtesy of the Rachel Carson NERR.*

Application Pathways

Pathway 1: Leverage Existing Organizations and Workgroups

By aligning with relevant organizations or workgroups, Reserves can tap into individuals who have expertise and in-depth knowledge of the specific challenges and issues related to marine debris in a particular region. In addition, Reserves can lend their expertise to the effort. Joint efforts can foster a sense of shared responsibility and develop effective and efficient management strategies. Working together also allows for the pooling of resources, both financial and social, making it possible to address marine debris more comprehensively.

Local & regional work groups:

- **Tijuana River NERR Marine Debris Leadership Academy** (MDLA): Deepens knowledge and relationships towards cross border-action.
- **California Ocean Litter Prevention Strategy**: Identifies a broad range of actions aimed at preventing and reducing marine debris, and has been informed and implemented by a wide range of governmental, non-governmental, industry, academic and community partners working to address the issue.
- **Hawai'i Marine Debris Action Plan** (HIMDAP) is a collaborative effort hosted by NOAA MDP to convene groups of people to address prevention, removal, and research surrounding marine debris. Similarly, NOAA MDP has similar working groups throughout the nation that tackles marine debris as it applies to various regions throughout the United States.
- **Sustainable Coastlines Hawaii** is a small grassroots nonprofit based in Hawai'i that organizes beach cleanups, educational programs, and public awareness campaigns with an additional goal of using cleanups to educate about consumer behavior and choices.

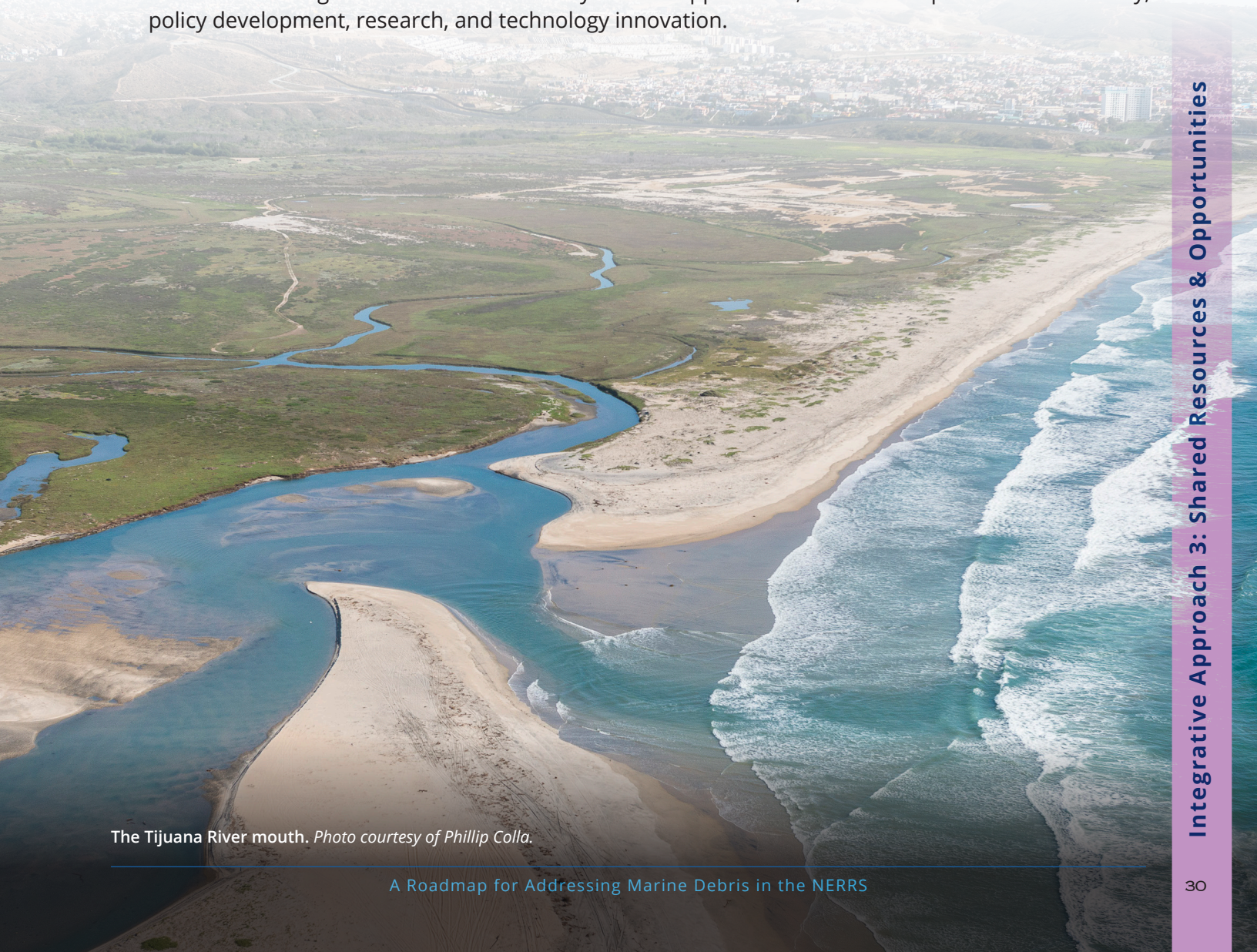
National & global work groups:

- The **NERRS Plastics** working group has cross-sector Reserve representatives that exchange knowledge and share resources.
- **Nurdle Patrol:** A community science project developed by the Mission-Aransas NERR. Since its establishment, the project has expanded across the NERRS and among partners.
- **NOAA Interagency Marine Debris Coordinating Committee:** A multi-agency body responsible for coordinating a comprehensive program of marine debris research and activities.
- **NOAA Marine Debris Program** (NOAA MDP): The National Oceanic and Atmospheric Administration (NOAA) runs the MDP, which focuses on researching, preventing, and reducing the impacts of marine debris in the United States. The program collaborates with partners to address marine debris at local, regional, and national levels.
- **Ocean Conservancy's Trash Free Seas Alliance**: A nonprofit organization that works on various ocean conservation issues, including marine debris. Their annual event, the International Coastal Cleanup, is the world's largest volunteer effort for ocean health and it provides valuable data which informs policy and management decisions.
- **Surfrider Foundation**: A nonprofit organization dedicated to the protection and enjoyment of the world's oceans, waves, and beaches. They have campaigns focused on reducing plastic pollution, including efforts to ban single-use plastics and promote policies for better waste management.
- **Sea Grant Marine Debris Community of Practice**: A bi-monthly virtual gathering of people working on marine debris across the Sea Grant network available upon request for joint NERR DCoP-SG MDCoP meetings, information sharing and scoping of partnerships.

- **Plastic Pollution Coalition**: A global alliance of organizations, businesses, and thought leaders works to stop plastic pollution and its toxic impacts on humans, animals, waterways, oceans, and the environment.
- **United Nations Environment Programme** (UNEP): UNEP leads global efforts to address environmental challenges, including marine debris. They coordinate initiatives like the Global Partnership on Marine Litter and support countries in developing policies and strategies to tackle marine pollution.
- **The Ocean Cleanup**: The Ocean Cleanup develops advanced technologies to rid the world's oceans of plastic. Their innovative systems aim to capture plastic debris from ocean gyres, preventing further pollution and harm to marine life.
- The **Marine Debris Information Clearinghouse**, first launched in 2013, is designed to provide the marine debris community direct access to projects completed or underway that can inform and improve their own work. The Clearinghouse allows researchers and other active or interested stakeholders to find projects and their results based on different project information, including location, project type, time frame, partner, or debris type. With many new groups joining the marine debris community and interest growing rapidly, collaboration and coordination are more important than ever in sharing successes, identifying gaps, and confirming best practices.

How to get on this path:

- An understanding that these initiatives vary in their approaches, from cleanup efforts to advocacy, policy development, research, and technology innovation.



The Tijuana River mouth. *Photo courtesy of Phillip Colla.*

Pathway 2: Create a Resource Repository

Building further on a need for a 'living' partners list as mentioned in *Integrative Approach 2) Relationship & Partnership Building* is also a need for a platform where other resources live as well. Many existing resources such as educational materials and monitoring programs are already in place for Reserves to utilize. However, a single hub of compiled and consolidated resources as a central resource database would promote engagement in the marine debris effort and decrease the barrier of entry. In addition, the use of a resource repository which optimizes the use of available resources could also avoid the duplication of efforts.

Examples of current resources:

- **NOAA's Marine Debris Program**, Includes a monitoring protocol that can be conducted by community scientists, data management infrastructure, and educational lesson materials
- **Non-TOTE programming**: Currently being delivered in the NERRS. Lesson resources have not yet been compiled
- **Marine Debris Tracker**: Encourages community members to use a free app to record data on marine debris as they encounter it during their daily lives or for community clean ups
- **TIDES (Trash Information and Data for Education and Solutions) Ocean Conservancy Tool**: A global database of debris collection as part of the Ocean Conservancy's Trash Free Seas program
- **Mid Atlantic Ocean Data Portal**: A database for beach cleanups at six sites recurring since 2016
- **Integrated Marine Debris Observing System**: An organization working to inform policy and decision making
- **The Ocean Cleanup**: The Ocean Cleanup develops advanced technologies to rid the world's oceans of plastic. Their innovative systems aim to capture plastic debris from ocean gyres, preventing further pollution and harm to marine lifes
- **NOAA Marine Debris Program Clearinghouse**, first launched in 2013, is designed to provide the marine debris community direct access to projects completed or underway that can inform and improve their own work. The Clearinghouse allows researchers and other active or interested stakeholders to find projects and their results based on different project information, including location, project type, time frame, partner, or debris type. With many new groups joining the marine debris community and interest growing rapidly, collaboration and coordination are more important than ever in sharing successes, identifying gaps, and confirming best practices.

How to get on this path:

- Resources need to be congregated to a central resource repository where they can be widely distributed, accessed, and used by organizations and agencies to elevate the marine debris issue.
- Solving logistical concerns such as:
  - Where will this database be housed? On which platform?
  - How will the database be maintained? Who will be responsible for maintaining it?
  - How will it be shared? Who will have access to it?

Pathway 3: Explore and Develop Shared Opportunities for Monitoring Marine Debris

Monitoring programs have already been developed by the DCoP, such as NOAA MDP's Marine Debris Monitoring and Assessment project (including their **Regional Action Plans**), Ocean Conservancy's Cleanswell program, or U.S. EPA's Escaped Trash Assessment Program, Nurdle Patrol, and many others. Reserves can voluntarily participate in any of those programs, but there is opportunity to coordinate amongst Reserves to participate in the same monitoring program so comparisons could be made across estuaries. Community programs could be coordinated amongst Reserves, or common shared resource kits could be made available.

By partnering with the DCoP, there is potential to develop estuary specific monitoring protocols that could nest within existing monitoring programs for mutual benefit. For example, knowledge transfer workshop conversations have identified the potential for the NERRS to work with NOAA MDP to develop an estuary monitoring protocol 'module' that is tailored for implementation in estuaries. NOAA MDP would aquire additional data while performing data management functions for data submitted by the Reserves.

How to get on this path:

Should there be desire to collaborate to develop an estuary-specific module as an option to participate in, implementation actions include:

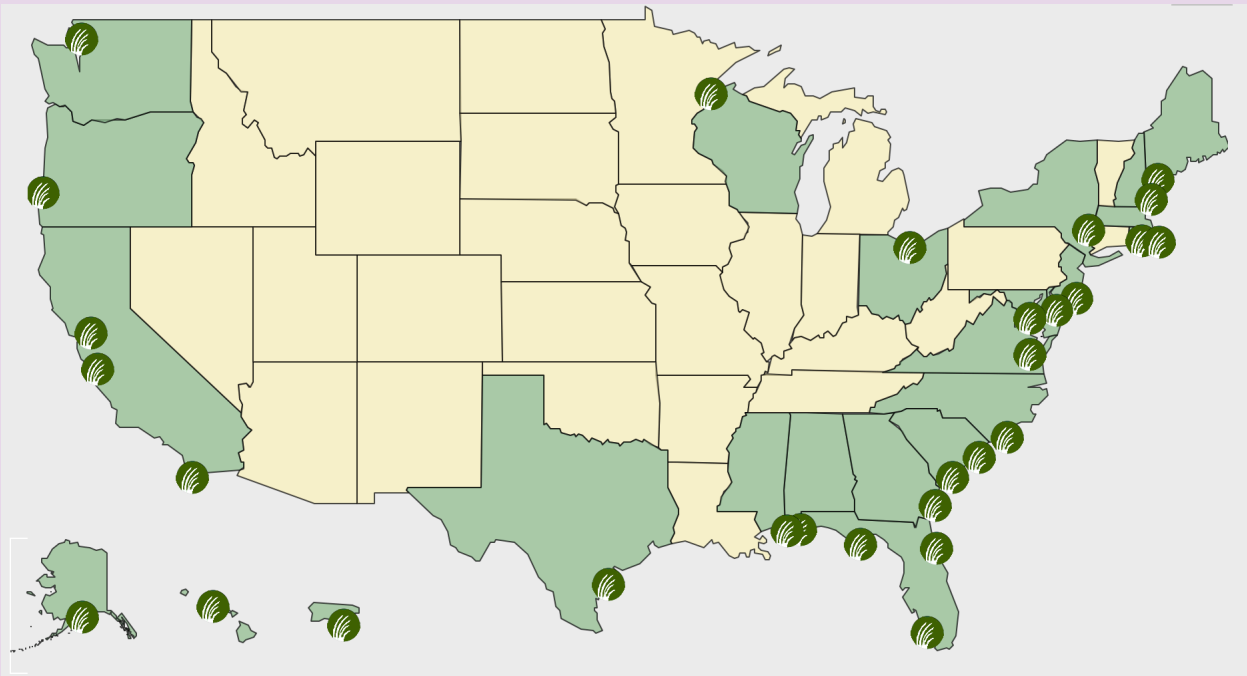
- Identify project lead and advisory team to develop the partnership and project. Determine roles of the Reserves and partner agency during the development process. While a variety of partners may be present in any particular area, be sure to assess and, if available, leverage the expertise and efforts of other NOAA entities (MDP, Sea Grant programs)
- Determine capacity and funding needed to develop and pilot the protocol and supporting materials, including data collection protocols
- Assemble needs from prior surveys and new surveys to articulate individual Reserve needs for monitoring: debris categories, habitat types being monitored, size of debris, purpose for monitoring. From these surveys, determine 'least common denominator' parameters for which all Reserves overlap and comprehensive debris category lists to encompass all Reserves needs, while fitting into the system and protocols of the parent monitoring agency
- Determine needs and cross-sector possibilities for data sharing, management, synthesis, use, and education, develop education and training materials, leveraging existing resources
- Reserves decide whether to participate in the monitoring program and which sector will lead the effort. Research, Stewardship, Education, or CTP would be appropriate for programs which utilize community science volunteers

Case Studies

Case Study 1: NERRS Data and Project Repositories

Lessons from these examples can guide design ideas for a NERRS-wide repository.

NERRS Centralized Data Management System for System-Wide Monitoring Program: The CDMO is an example of a database which maintains a large amount of data. Its real time data transmission and data graphing capabilities offer a valuable resource to those working in the Reserve sectors, but it is also friendly enough to use for those outside of the NERRS, such as educators, students, partnering NGOs, and members of the public with varying interests.



The System Wide Monitoring Program website allows for viewing data from all NERRs.
Image courtesy of the Centralized Database Monitoring Office (CDMO)

NERRS Science Collaborative Project Catalog: The NSC project catalog is a clear and easy to navigate database. A benefit of its design is its project searchability by keyword, project type, Reserve name, project region, and focus area. The search feature is especially useful as it currently contains 144 pages with over 1,700 projects.

NERRS Estuary Education Resources Catalog: Users of this catalog are educators looking for information they can integrate into lesson plans as easily as possible. This database is another example of a clearly organized suite of tools and, similar to the NSC catalog, results can be categorized by various fields such as grade, topic, phenomena (important for some state education standards), Reserve, and lessons in Spanish.

Case Study 2: NOAA Marine Debris Program Resources Database

The NOAA Marine Debris Program maintains **database** which efficiently displays their suite of free resources available to any user. In one place, users have access to information on funding opportunities, curricula, reports, topical memos, and workshop summaries, emergency response guides, educational activities, and field datasheets among much more. Resources cover a range of topics such as different types of marine debris, the impact it has on ecosystems, and engagement activities.

Funding Opportunities

The NOAA Marine Debris Program offers several nationwide, competitive funding opportunities for marine debris projects. Check out open competitions and access resources to help applicants prepare a strong proposal.

Abandoned and Derelict Vessels Info Hub

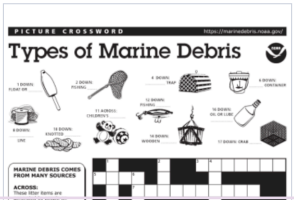
Abandoned and derelict vessels litter ports, waterways and estuaries, creating a threat to navigation, recreation, and the environment. This InfoHub was created as a central source of information on ADVs and the policies surrounding them.

Tropical Islands Partnering on Solutions for Marine Debris Webinar Series

Tropical Islands Partnering on Solutions for Marine Debris (TIPS) is a bimonthly online webinar series hosted by the NOAA Marine Debris Program. The goal of the TIPS series is to help tropical island communities connect and share perspectives from across the tropics on common marine debris issues and proposed solutions.

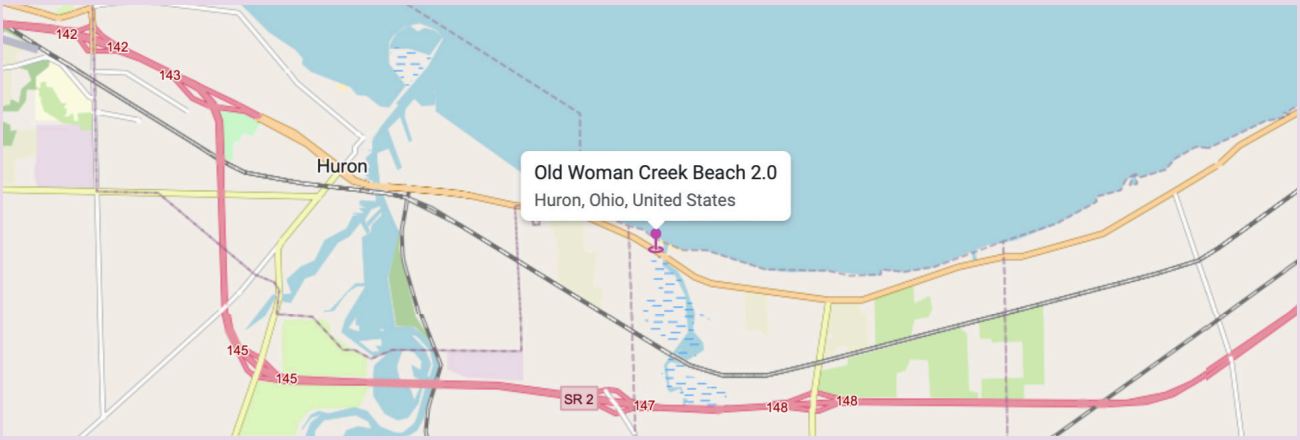
Fact Sheets

Download and print fast information on marine debris, storm preparedness, and other hot topics.



Case Study 3: Old Woman Creek NERR Monitoring Efforts through NOAA's MDMAP

Old Woman Creek NERR is an example of an estuary that has been utilizing monitoring efforts through **NOAA's Marine Debris Monitoring and Assessment Project** (MDMAP). With seven unique sites that are surveyed regularly, MDMAP serves as a tool to support monitoring marine debris through its surveying techniques, data management, and visualization to assess the marine debris surveyed.



Final Thoughts

This Roadmap aims to serve as a guide for approaches the NERRS and individual Reserves can take to unify marine debris efforts under a national banner while being option-oriented so each Reserve can choose pathways and activities best tailored for their Reserve's needs. Common threads for implementation involve developing partnerships, increasing capacity within the Reserves, and obtaining funding and other resources. The project team hopes this document serves as a starting framework for which Reserves can form collaborative groups around projects of common interest and pursue pathways towards the greater vision of strengthening NERRS visibility and contributions to the greater DCoP.

Guidance for Evaluation Development

To evaluate the effectiveness of this Roadmap for Reserves that choose to implement any aspect of it, the following questions are offered to inspire development of indicators and metrics to be used by interested groups (e.g., NERRS plastic working group, DCoP:

1. Has your Reserve seen an increase in collaborative projects on marine debris (# / type of project)?
2. Have your Reserve and Reserve partners listed marine debris as a priority issue and/or focus area in their strategic and/or management plans (e.g. Davidson Fellowship, Science Collaborative management priorities)? (# of documents / statements)
3. Have additional partnerships been established at your Reserve for projects related to marine debris (# of new partnerships)?
4. Have resources been shared at your Reserve on the topic of marine debris (# of resources / exchanges)?
5. Has your Reserve and its partners leveraged the Plastics workgroup as a platform for sharing lessons learned or transferring knowledge about marine debris programming? (# of resources shared / meetings attended)
6. Has your Reserve developed messaging / communications around marine debris? (# communication products / social media posts)

These can also be tailored for individual Reserve use, for example, by integrating in existing programmatic or operational evaluations, or stand-alone in association with marine debris-specific strategies.

Next Steps

A communication plan is a critical next step. This Roadmap has touched on the challenges and benefits of implementation. With support from the NSC and NOAA MDP communication team, strategies such as workshops, listservs, and social media will be utilized to ensure the availability and accessibility of the Roadmap to Reserves, their communities, and the DCoP.

Considerations

Lastly, this Roadmap concludes by asking each Reserve and DCoP member to reflect on both the importance of addressing marine debris and the uniqueness of being in partnership with the NERRS. The Roadmap is not a one-size-fits-all approach, but rather offers many different application pathways and highlights accomplishments by Reserves as DCoP members. In the spirit of transferring knowledge, this Roadmap focuses on the chosen integrative approaches to exemplify how investing in a national narrative, building partnerships and relationships, and sharing resources and opportunities will not only strengthen how Reserves operate as a system with our partners, but also amplify the work being done to protect and enhance the environment and community at each Reserve.

Volunteers clearing debris during a Tijuana River Action Month event. *Photo courtesy of the Tijuana River NERR.*

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Glossary

Coastal Training | Local and state officials are better equipped to introduce local data into the decision-making process as a result of reserve training efforts (**NOAA**).

DCoP | Debris Community of Practice; agencies, organizations, and individuals already engaged with and collaborating on issues regarding marine debris.

Education | Thousands of children and adults are served through hands-on laboratory and field-based experiences. School curriculums are provided online (**NOAA**).

Estuary | Estuaries and their surrounding wetlands are bodies of water usually found where rivers meet the sea. Estuaries are home to unique plant and animal communities that have adapted to brackish water—a mixture of fresh water draining from the land and salty seawater (**NOAA**).

Marine Debris | Any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes (**NOAA**).

PAC | Project advisory committee

Research | Reserve-based research and monitoring data are used to aid conservation and management efforts on local and national levels (**NOAA**).

Stewardship | Each site undertakes the initiatives needed to keep the estuary healthy (**NOAA**).

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