

Hawai'i



Marine Debris Action Plan

ACKNOWLEDGMENTS

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The time, energy, and input of the many government agencies, nongovernmental organizations, industry and academic partners, and private businesses making up the marine debris management community in Hawai'i was invaluable in developing this action plan that will guide all of our efforts over the next several years to address and reduce the environmental, socioeconomic, and human health and safety impacts of marine debris.

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ACRONYMS

CRED	NOAA PIFSC Coral Reef Ecosystem Division
CRON	Coral Reef Outreach Network
CZM	State of Hawai‘i, DBEDT, Coastal Zone Management Program
DAR	State of Hawai‘i, DLNR, Division of Aquatic Resources
DBEDT	State of Hawai‘i, Department of Business, Economic Development, and Tourism
DFG	Derelict fishing gear
DLNR	State of Hawai‘i, Department of Land and Natural Resources
DOCARE	State of Hawai‘i, DLNR, Division of Conservation and Resources Enforcement
DOH	State of Hawai‘i, Department of Health
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
GPS	Global Positioning System
HI-MDAP	Hawai‘i Marine Debris Action Plan
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
HPD	Honolulu Police Department
HPU	Hawai‘i Pacific University
ICC	International Coastal Cleanup
IMDCC	Interagency Marine Debris Coordinating Committee
MDRPRA	Marine Debris Research, Prevention, and Reduction Act
NGO	Nongovernmental organization
NOAA	National Oceanic and Atmospheric Administration
MDP	Marine Debris Program
NPDES	National Pollutant Discharge Elimination System
NWHI	Northwestern Hawaiian Islands
NWR	National Wildlife Refuge
PICO	EPA Pacific Islands Contact Office
PIFSC	Pacific Islands Fisheries Science Center
PMNM	Papahānaumokuākea Marine National Monument
POP	Pacific Ocean Producers Fishing and Marine
PSA	Public service announcement
UH	University of Hawai‘i
USCG	U.S. Coast Guard
WPFMC	Western Pacific Regional Fisheries Management Council

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1.0 INTRODUCTION

Marine debris is an ongoing problem worldwide. With increased use of synthetic materials like plastic, marine ecosystems have suffered from the impacts of marine debris. Tons of derelict fishing gear and trash may be found strewn along otherwise pristine Hawaiian beaches. Hawaiian monk seals, green sea turtles, and humpback whales become entangled in and injured from derelict fishing nets. These images highlight the need for increased marine debris efforts throughout the Hawaiian archipelago.

The Hawai'i Marine Debris Action Plan (HI-MDAP) was built on the significant ongoing and past efforts of Hawaii's marine debris community. The National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program (MDP) and the U.S. Environmental Protection Agency (EPA) facilitated the development of the HI-MDAP with active participation and input from Hawaii's marine debris community, from government agencies, nongovernmental organizations, academic institutions, and private entities.

"The problem of marine debris can be dealt with effectively only by ensuring a comprehensive approach that is local in scale and global in scope, directed at source prevention, and establishes an educated community that can be empowered to action." (NOAA, 2008)

1.1 Purpose of the Plan

The overall purpose of the HI-MDAP is to establish a comprehensive framework for strategic action to reduce the ecological, health and safety, and economic impacts of marine debris in Hawai'i by 2020. Due to the complexity of marine debris issues, there is a role for everyone in the implementation of this plan, including the private citizen who picks up litter from our beaches and watersheds; federal, state, and county government agencies that are mandated to address the threat of marine debris; private businesses and industry that get involved to serve the communities in which they operate; and nongovernmental and academic organizations that support a wide range activities like cleanup, research, education, and outreach. The HI-MDAP establishes threat reduction goals and strategies to promote coordinated action to address the significant threats posed by marine debris in the Hawaiian archipelago.

1.2 Marine Debris in the Hawaiian Archipelago

Marine debris in Hawaii takes a variety of forms, comes from our own islands as well as from across the Pacific, and causes damage to our natural resources and to human activities. Marine debris is defined as any persistent solid material that is manufactured or processed and directly or indirectly disposed of or abandoned into the marine environment. It may enter directly from a ship, or indirectly when washed out to sea from rivers, streams, or storm drains. Marine debris includes a wide variety of items, including plastic bags, glass bottles, rubber slippers, derelict fishing gear, and abandoned or derelict vessels. Activities that create marine debris occur both on land and on the ocean.

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Ocean-based sources of marine debris include fishing vessels, recreational boats, cargo ships, and other vessels. Marine debris may result from accidental loss of gear or cargo, illegal dumping, or abandonment of vessels themselves. Fishing gear may be lost from commercial fishing vessels as well as from recreational boats or shore-based fishing. Cargo lost overboard from freighters, cruise ships, and other vessels pose serious threats to marine navigation.

Waste generated on land can be blown or washed down to the shoreline and washed out to sea. Activities on land that can create marine debris include littering, dumping in rivers and streams, fishing from shore, improper waste management, and industrial losses such as spillage of plastic resin pellets during production, transportation, and processing. Storm water that flows along streets or along the ground can carry street litter into storm drains. Storm drains carry this water and debris to a nearby river, stream, canal, or even directly to the ocean. Marine debris from stormwater runoff includes street litter (e.g., cigarette butts and filters), food packaging, beverage containers, medical items (e.g., syringes), and other material that might have washed down a storm drain. During storms or other periods of strong winds or high waves, almost any kind of trash can be deposited into the ocean.

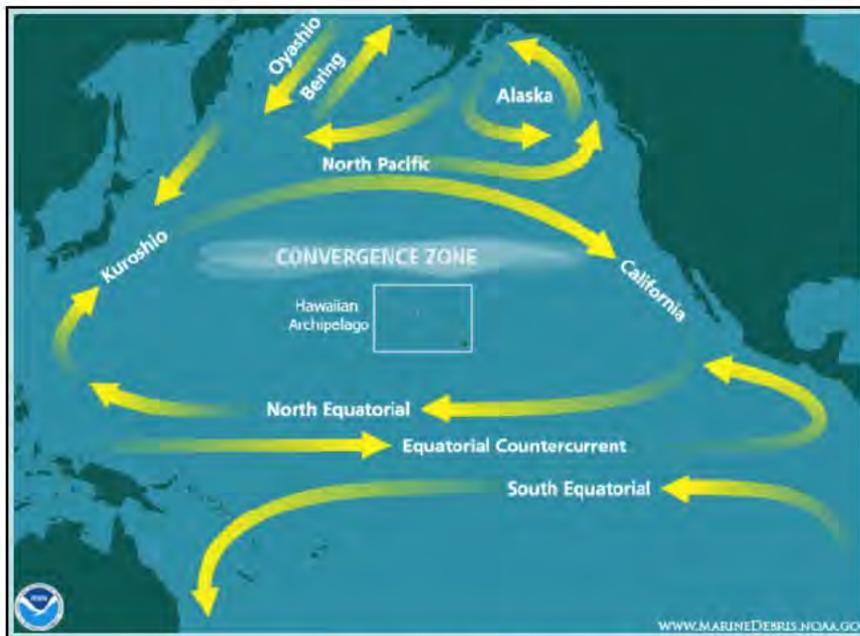


Figure 1. Location of the Hawaiian archipelago in the North Pacific Subtropical Gyre.

North Pacific Current, and the southward California Current. This gyre, along with other oceanographic and atmospheric features in the North Pacific, entrains trash and derelict fishing gear from the entire North Pacific Ocean and beyond. Across the Pacific, derelict fishing gear is now recognized as a major environmental threat to coastal and nearshore areas. The Hawaiian archipelago acts as a giant comb, collecting large pieces of marine debris in the shallow reefs and on the beaches across the entire island chain, especially along the windward, or east-facing, shores (Figure 2).

Much of Hawaii’s marine debris, especially derelict fishing gear (DFG), is generated from distant sources. Hawaii’s geographic position, at the center of the North Pacific Gyre (Figure 1), has the unfortunate distinction as a hotspot for the aggregation of marine debris. The North Pacific Subtropical Gyre flows in a clockwise pattern and consists of four prevailing ocean currents: the westward-traveling North Equatorial Current, the northward Kuroshio Current, the eastward



Figure 2. Marine debris accumulation along the coastline of the main Hawaiian Islands (results of 2006 NOAA aerial survey).

Marine debris results in ecological, human health and safety, and economic impacts in Hawai'i. Ecological impacts on seabirds, Hawaiian monk seals, green sea turtles, and other coastal and marine species occur from ingestion of and entanglement in marine debris. Large floating marine debris such as DFG continues to ensnare marine life (also called ghost fishing) and in at least one case to date has served as a vector for the introduction of alien species (Zabin et al., 2004). Marine debris causes physical abrasion, breakage, and shading of coral reef habitat. The few studies conducted on reefs outside of Hawai'i indicate that impacts to sessile marine

invertebrates include damage and death (Chiappone et al., 2005). Additionally, entanglement with derelict monofilament fishing line has been shown to cause significant coral mortality (Asoh et al., 2004). These effects have been shown to create long-lasting changes to the reefs they impact (Precht et al., 2001).

Marine debris is a navigation hazard, posing risks to human health and safety by disabling vessels at sea. While the impact of marine debris on navigation has yet to be quantified, anecdotal evidence comes from accounts of fishing vessels encountering marine debris, requiring crew to dive under water to remove debris wrapped around a propeller. This not only endangers human health and safety but also results in economic impacts. Economic impacts of marine debris have also yet to be well quantified. For example, Hawaii's beaches draw hundreds of thousands of visitors and residents alike. Litter on Hawaii's beaches degrades the aesthetic quality of Hawaii's environment, a major source of Hawaii's economic revenue.

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The issue of marine debris in Hawai‘i has garnered increasing attention over the last decade and even more within the last few years. In 1982, NOAA began to address this pervasive problem by incorporating marine debris removal from beaches into its activities in the Northwestern Hawaiian Islands (NWHI). In-water removal of derelict fishing gear began in 1996. Since 1996, 700 tons of derelict fishing gear have been removed from the NWHI, the majority of which has been incinerated to generate energy for Hawai‘i residents (Figure 3).

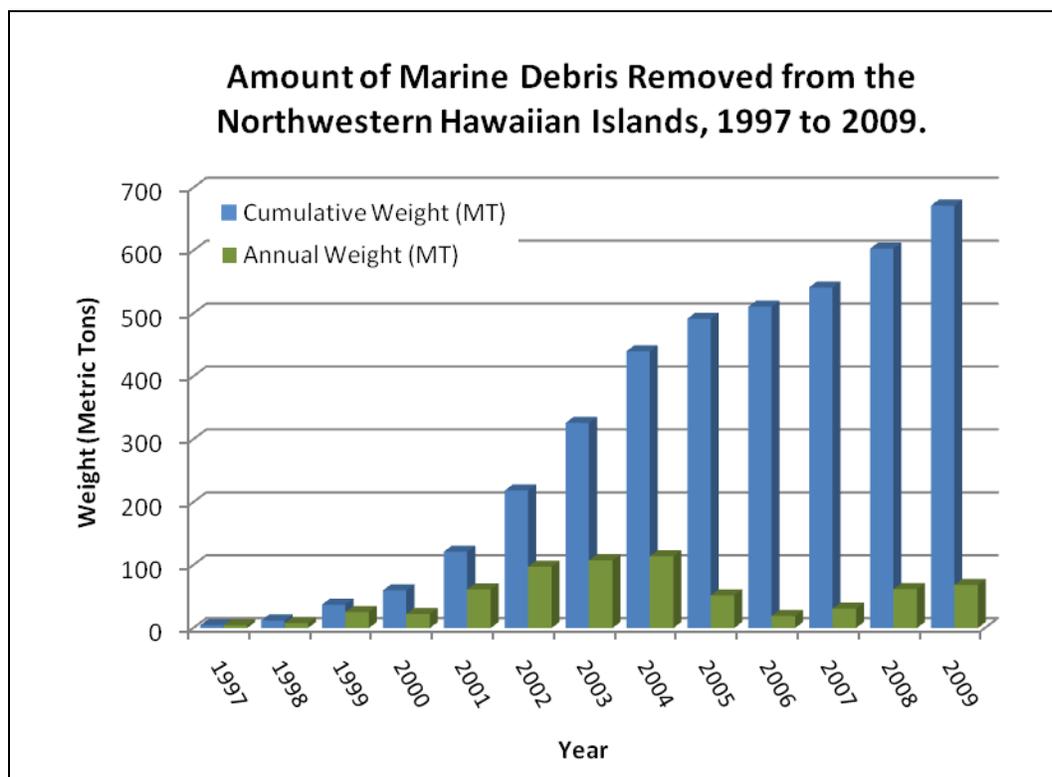


Figure 3. Quantity of derelict nets and other debris removed from the Northwestern Hawaiian Islands, 1997-2009 (NOAA PIFSC-CRED, unpublished).

In 1998, a marine debris group consisting of federal, state, and local government agencies and industrial, academic, and nongovernmental organizations formed around the need to collectively address the marine debris issue in the Northwestern Hawaiian Islands. Since then, this group of partners has grown and the removal effort has gained momentum, expanding to include projects in the main Hawaiian Islands and incinerating marine debris to create electricity. One of the group’s newest partners is the NOAA Marine Debris Program (MDP), which was created in 2005. In addition to these group efforts, numerous agencies and organizations across the state have been involved in addressing marine debris. From small beach cleanups to the multi-partner Hawai‘i Nets to Energy Program, many activities and entities are addressing marine debris in Hawai‘i. Despite extensive efforts over the past 10 years, marine debris is a chronic threat to Hawaii’s marine ecosystem as well as human health, navigation safety, and the economy. A more strategic

approach is needed to maintain efforts to reduce the backlog of marine debris as well as increase efforts for debris prevention.

2.0 PLAN DEVELOPMENT

The Marine Debris Research, Prevention, and Reduction Act (MDRPRA) was signed into law on December 22, 2006. The MDRPRA established a Marine Debris Prevention and Removal Program (Marine Debris Program) within the National Oceanic and Atmospheric Administration (NOAA), provided directives for the U.S. Coast Guard (USCG), and re-established the Interagency Marine Debris Coordinating Committee (IMDCC). To fulfill certain directives outlined in the Act, NOAA organized regional workshops in marine debris “hot spot” areas—regions where marine debris activities have been occurring for many years and where marine debris has adversely affected trust resources or navigation. The HI-MDAP was developed with participation from Hawaii’s marine debris community, including government agencies, academic institutions, nongovernmental organizations, and the private sector. The individuals and organizations that contributed to the development of the plan are listed in Appendix A.

2.1 *Engaging Stakeholders*

In 2007 and 2008, the NOAA MDP, with the assistance of EPA, organized a series of meetings and workshops to bring together government, nongovernmental, academic, and private sector stakeholders engaged in marine debris issues in Hawai‘i. An initial meeting with members of Hawaii’s marine debris community was conducted on June 21, 2007. Twenty-one marine debris experts in Hawai‘i—from state and federal government agencies, academia, and the private sector—convened to discuss marine debris issues, potential topics for a Hawai‘i regional workshop, and anticipated outputs from the workshop. Participants highlighted the need for a comprehensive approach and strategies to address marine debris issues that include the following topic areas:

- Research and assessment
- In-water debris removal and prevention
- Beach cleanup
- Land-based debris prevention
- Outreach and education

In addition, participants recommended that the Hawai‘i workshop result in specific outputs, such as a preliminary plan to prioritize marine debris efforts in the main Hawaiian Islands (MHI) as well as the Northwestern Hawaiian Islands (NWHI).

The Hawai‘i Marine Debris Workshop was held on January 16 and 17, 2008. Thirty-four members of the marine debris management community in Hawai‘i, from federal, state, and local government agencies, nongovernmental organizations, academia, and the private sector, met to identify and prioritize a range of ongoing and potential new actions for the next 10 years. The objectives of the workshop were to:

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- Share current best practices, ongoing activities, and success stories from experiences in both the main Hawaiian Islands and the Northwestern Hawaiian Islands.
- Identify marine debris priority actions for the next 10 years.
- Begin the development of a Hawai‘i Marine Debris Action Plan.
- Obtain commitment from participants to stay engaged in plan development and implementation.

Following the Hawai‘i Marine Debris Workshop, 3 one-day workshops were held to further characterize new actions needed for each strategy. These topic area-specific planning workshops were held in 2008 on October 22 (Outreach and education), November 5 (Land-based debris prevention and Beach cleanup), and November 14 (Research and assessment and In-water removal and prevention). Participants, working in small groups, discussed priority actions identified in the January workshop as well as additional actions and prepared detailed descriptions of each action using standardized templates. These completed action templates are provided in Appendix B.

2.2 Defining Threat Reduction Goals and Strategies

Threat reduction goals and strategies are important components of developing effective actions to address marine debris. Threat reduction goals and strategies are two key components of a natural resource management planning tool being undertaken by a variety of groups around the world (see Figure 4).

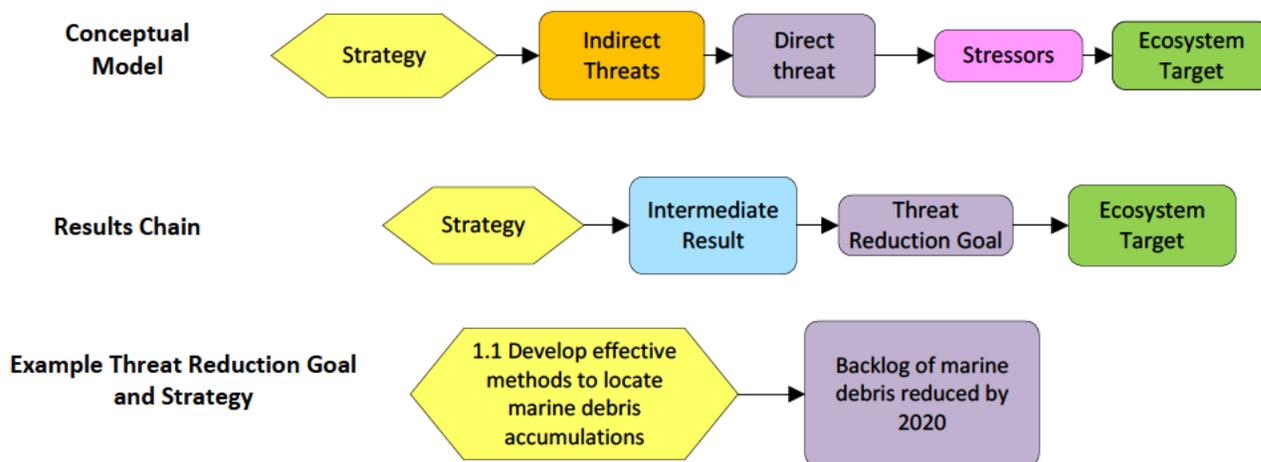


Figure 4. Schematic diagram of a conceptual model and results chain and example threat reduction goal and strategy pair.

The marine debris results chains (Appendix B) are basically diagrams that show in detail how a particular action will lead to some desired result. They are depicted as a chain of causal statements that link short-, medium-, and long-term results in an “if...then” fashion. For example, if more people replace conventional with hybrid vehicles, then the amount of CO₂ emissions will decrease. For planning purposes, a results chain clarifies assumptions

about how strategies will contribute to reducing important threats, leading to the conservation of ecosystem targets.

Results chains are often derived from conceptual models. A conceptual model is another tool that helps depict the relationship among various threats believed to impact one or more ecosystem targets (Figures 5 and 6). Over the last two decades, conceptual models have been used in a variety of fields including international development, public health, and environmental management. Conceptual models have been used in an environmental context to depict fate and transport of contaminants through the ecosystem, such as through bioaccumulation. Currently, this tool is being used as part of the conservation planning cycle to visually depict the causal links between direct and indirect threats on threatened and endangered species, habitats, and other components of an ecosystem of interest (FOS, 2009).

Ecosystem targets in the Marine Debris Conceptual Model include coastal and marine species, coral reefs, human health and safety, and the economy (see Figures 5 and 6). Direct threats to these targets include accidental loss of fishing gear, illegal dumping of fishing gear and solid waste at sea, abandoned vessels, continuing backlog of marine debris, debris generated by severe storms, improper disposal of solid waste in streams, rivers, and stormwater systems, and litter from beachgoers. Indirect threats include social, political, economic, and technological constraints or obstacles contributing to the direct threats.

Results chains differ from conceptual models in that conceptual models show the state of the world before a particular action takes place, while a results chain shows the state of the world expected to result from the proposed strategy. Results chains are similar to the logic models used by many organizations, but results chains have the added benefit of showing more detail and the direct relationship between one result and another.

3.0 CONCEPTUAL MODEL OF THREATS FROM MARINE DEBRIS

In order to capture the complexities of the threats from marine debris in the Hawaiian archipelago, a conceptual model was developed to illustrate causal links between the types, sources, and, locations of marine debris in the environment with the direct and indirect threats on specific ecosystem targets in Hawai'i (Figures 5 and 6). This conceptual model was developed to facilitate the identification of threat reduction goals and strategies to reduce the impacts of marine debris in the Hawaiian archipelago and to document the assumptions made in developing the strategies to address marine debris threats.

3.1 *Ecosystem Targets and Stressors*

The ecosystem targets for the HI-MDAP include coastal and marine species, coral reefs, human health and safety, and the economy. Ecosystem targets are components of an ecosystem that are the focus of planned strategies or actions. Stressors are the biophysical consequences of a direct threat on an ecosystem target. These ecosystem targets and stressors are described below and shown in green and pink boxes in Figures 5 and 6.

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Coastal and Marine Species: Species in Hawai'i particularly threatened by marine debris include endangered Hawaiian monk seals and threatened green sea turtles. Ingestion and entanglement are primary stressors on these species; however, increasing evidence suggests that degraded plastics may affect biological processes and enter the food chain.

The Hawaiian monk seal is one of the rarest marine mammals in the world. Hawaiian monk seals are distributed predominantly in six NWHI subpopulations at French Frigate Shoals, Laysan and Lisianski Islands, Pearl and Hermes Reef, and Midway and Kure Atolls. Small numbers also occur at Necker, Nihoa, and the main Hawaiian Islands. The current estimate of the total remaining population size is approximately 1,200 individuals (NOAA, 2009). Hawaiian monk seals become entangled in derelict fishing gear and other marine debris at rates higher than reported for other pinnipeds (Henderson, 2001). A total of 268 cases of seals entangled in fishing gear or other debris were observed through 2006 (Henderson, 2001; NMFS, unpubl. data), including seven documented deaths resulting from entanglement in fisheries-related debris.

Threatened green sea turtles are distributed along the coastlines of O'ahu, Moloka'i, Maui, Lana'i, and Hawai'i, as well as at Lisianski Island and Pearl and Hermes Reef. Entanglement and ingestion of marine debris were identified as a primary threat to green sea turtle recovery (NOAA and USFWS, 1998).

Coral Reefs: Coral reefs along the length of the Hawaiian archipelago serve as the primary habitat for marine species. Coral reefs are abraded and shaded by marine debris, resulting in degraded habitat for other species. Marine debris, such as derelict nets, may snag on coral, and with wave action, break and damage coral heads.

Human Health and Safety: Marine debris threatens health and safety. Marine debris can get wrapped around vessels' propellers, endangering commercial and recreational vessel operators by rendering the vessel inoperable or by requiring the removal of the fouling debris.

Economy: Marine debris threatens the economy of coastal areas that depend on tourism. Litter on beaches threatens degrades the quality of the tourism experience. State and county government agencies must continue to allocate funds to remove marine debris and clean up beaches. Marine debris also results in economic impacts to commercial fishers when marine debris fouls gear or fishing vessels and to the maritime transportation industry when debris affects vessel operations at sea.

3.2 Direct and Indirect Threats

Marine debris poses a variety of direct and indirect threats to the ecosystem by stressing marine species and habitats as well as human health, safety, and the economy. Direct threats are human actions or unsustainable uses that immediately degrade one or more ecosystem targets. These direct threats stress the various components of the ecosystem. Indirect threats are underlying causes or drivers of direct threats and are often "entry

points” for conservation strategies. The causal linkages of threats and ecosystem targets are summarized below and shown in orange, purple, and pink boxes, respectively, in Figures 5 and 6.

Dumping of solid waste and fishing gear at sea: As an example of the relationship between direct and indirect threats, loss of fishing gear is a direct threat, but faulty gear or fishing practices that led to its loss would be indirect threats. As a result of those indirect threats, fishermen must cut the gear from the vessel and release it to the sea for health and safety reasons. The majority of derelict fishing gear found in Hawaii comes from trawl and seine fisheries, which are fishing methods that Hawaii’s fishing fleet does not use. Thus, actions to prevent dumping of fishing gear from distant fleets must be undertaken in cooperation with other regions and nations. Another direct threat and source of marine debris is illegal dumping of solid waste at sea. Solid waste and damaged gear are illegally discarded at sea during a variety of maritime operations from cruise ships, cargo ships, and fishing vessels. Factors (i.e., indirect threats) contributing to the illegal dumping include limited capacity to store solid waste and damaged gear on vessels at sea and the cost for proper disposal once the vessels return to port. In addition, vessel operators may be unaware of ocean dumping laws and the ecological impacts and navigational hazards they create by illegal dumping. Lastly, enforcement of these laws is difficult at sea.

Lack of removal of backlog of marine debris: Marine debris, including derelict fishing gear, lost cargo, and other solid waste, has accumulated in the North Pacific as a result of years of accidental loss and illegal dumping. This backlog of marine debris washes up on to beaches and reefs along the length of the Hawaiian archipelago, especially on the windward side of islands. The North Pacific Ocean covers an enormous area, and at sea-detection and removal are difficult and costly.

Abandonment of vessels: Vessels abandoned at sea and on reefs are sources of marine debris. Abandoned vessels abrade benthic habitats creating disturbed areas that can be settled by opportunistic or alien species thereby altering ecosystem structure. The incidence of vessel abandonment is exacerbated by the high cost of removing vessels that no longer operate. Further, vessel insurance is often insufficient or nonexistent to cover the cost of removing a vessel that no longer operates.

Debris from improper disposal of waste on land: Marine debris is generated from regulated and non-regulated land-based activities. Improperly disposed-of solid waste on land can be eventually carried down streams, rivers, and the stormwater system to beaches and the sea. Stormwater permits are required for activities that generate nonpoint source pollution. Lack of compliance with and enforcement of the conditions of stormwater permits can generate debris that enters the stormwater system. Improper disposal of solid waste by the public results from lack of awareness of the impacts of marine debris, combined with the increasing use of plastics and other non-biodegradable products and a lack of recycling and disposal options. Finally, in urban areas, engineering solutions are often needed to keep land-based debris from entering waterways; however, these interventions are limited by the cost of the infrastructure and resources to maintain it.

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Extreme natural events, including storms, hurricanes, and tsunamis, can generate land-based debris and can transport debris floating at sea onto beaches and reefs. A natural disaster may result in loss of life, destruction of property, and loss of critical infrastructure such as power and water. The removal of marine debris may be a low priority after a storm event, and rapid removal is impeded by the cost, lack of capacity, and lack of clear mandates and procedures for marine debris response.

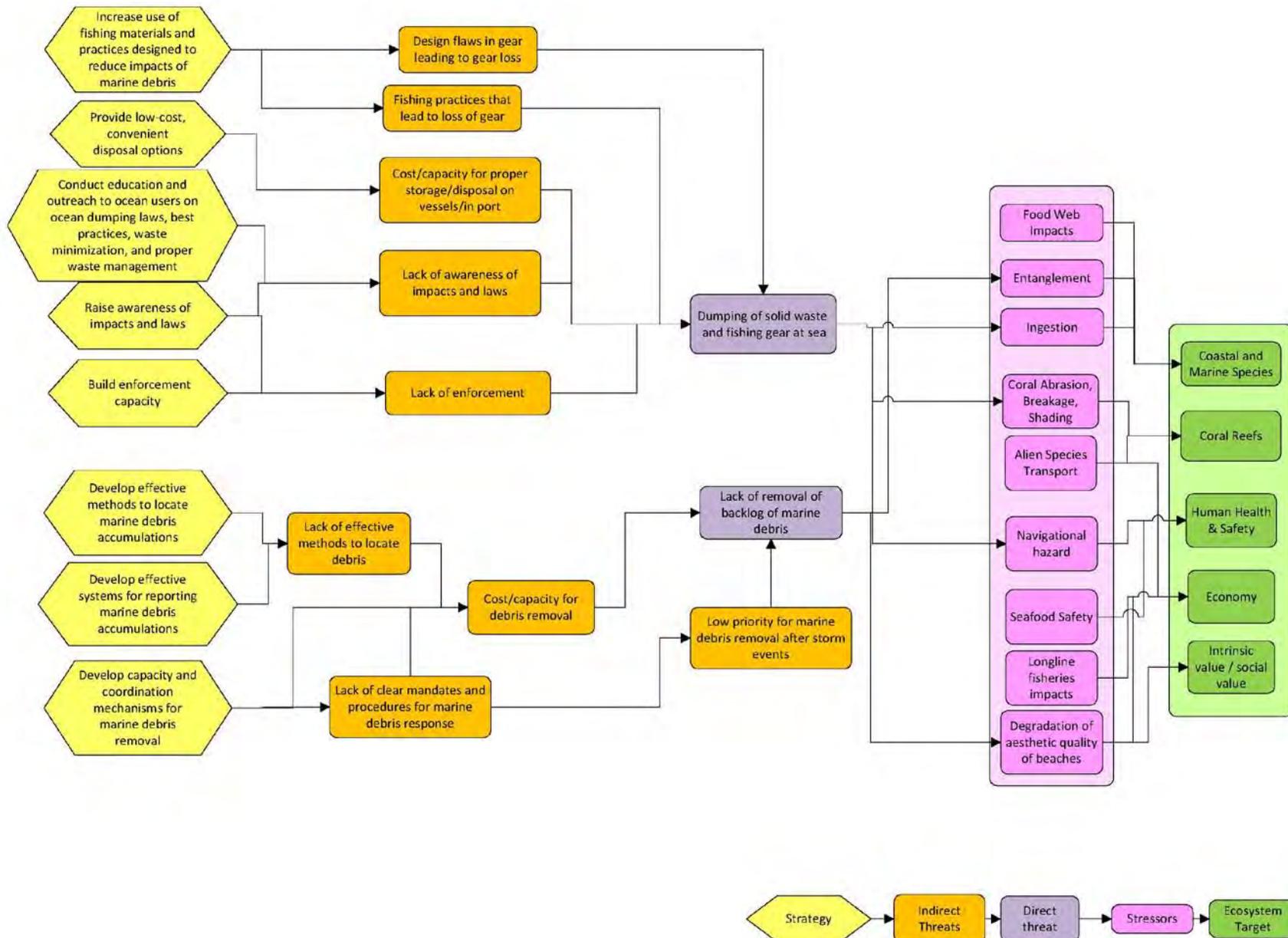


Figure 5. Conceptual model of direct and indirect threats of marine debris in Hawai'i - Part 1.

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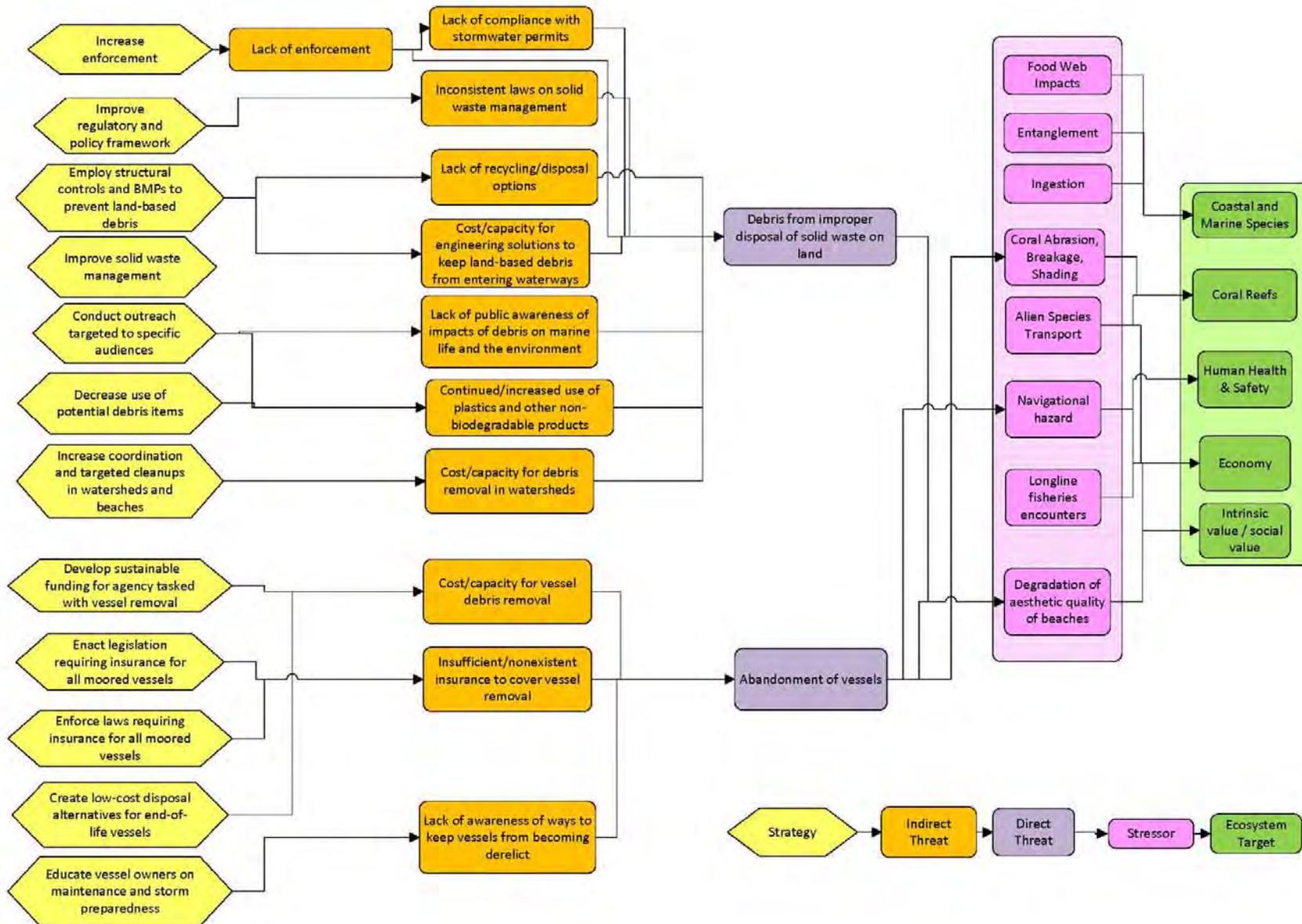


Figure 6. Conceptual model of direct and indirect threats of marine debris in Hawai'i - Part 2.

4.0 THREAT REDUCTION GOALS AND STRATEGIES TO REDUCE IMPACTS OF MARINE DEBRIS

The overall goal of the HI-MDAP is to reduce ecological, health and safety, and economic impacts of marine debris in Hawai‘i by 2020. A set of threat reduction goals and strategies to achieve this overarching goal was defined based on a consideration of past and ongoing actions and the conceptual model described in Figures 5 and 6. Each strategy is causally linked by a set of intermediate results that lead to the threat reduction goal. The threat reduction goals and key strategies are described below and illustrated in results chains in Appendix B. These results chains represent a set of assumptions that describe the expected outcomes if the strategies are carried out. Results chains also provide a tool to monitor performance of plan implementation through the year 2020.

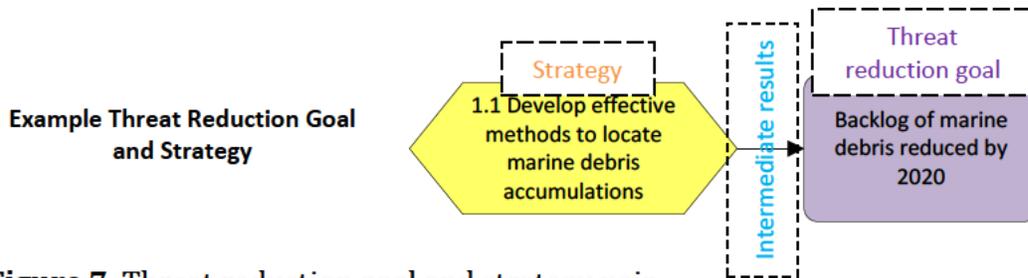


Figure 7. Threat reduction goal and strategy pair.

The HI-MDAP has a set of four *general results chains* by goal. Each is described in more detail below. *Site-specific results chains* will be created by organizations and agencies as activities and projects are carried out. These site specific results chains will build upon a strategy within one of the four general results chains.

4.1 Goal 1 - Backlog of Marine Debris Reduced

Reduction in the backlog of marine debris at sea and on reefs and beaches will reduce stressors on all ecosystem targets. Results chains were developed for Goal 1 by linking strategies with a set of intermediate results (Appendix B, Figure B-1). Three strategies are identified to achieve this goal:

- Strategy 1.1: Develop effective methods to locate marine debris accumulations
- Strategy 1.2: Develop effective systems for reporting marine debris accumulations
- Strategy 1.3: Develop capacity and coordination mechanisms for marine debris removal

The enormous area of the North Pacific and remoteness of the Hawaiian archipelago require increased efficiency for locating marine debris. Research activities are needed to design, test, and develop standardized and effective survey methods that can be used effectively for detection at sea, on reefs, and on beaches (Strategy 1.1). The use of satellite technology and unmanned and manned aerial surveys are some of the survey methods that need to be explored to increase the efficiency and lower the cost of locating and tracking marine debris. Using a combination of methods, we will be able to reduce the physical area that needs to be surveyed and target removal operations more effectively. Once these

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methods have been developed, regular investment is needed not only to locate marine debris but to monitor changes over time.

Commercial and recreational fishermen, cargo ships, beachgoers, and a variety of other ocean users observe marine debris accumulations on beaches, reefs, and at sea. The development of effective reporting systems is needed to increase the ability of these ocean users to report the location of marine debris accumulations (Strategy 1.2). Increased reporting of marine debris accumulations must be facilitated through education and outreach activities targeted to appropriate audiences and supported by clear and responsive reporting mechanisms. With the increased efficiency of locating debris combined with increased reporting, it is assumed that the cost of locating and removing marine debris will be reduced.

The removal of the backlog of marine debris will require continuous support into the foreseeable future until the backlog is substantially reduced and debris prevention measures are implemented throughout the North Pacific. The removal of derelict fishing gear and other large debris on beaches, reefs, and at sea is a costly endeavor that requires specialized skills and equipment. Agencies responsible for debris removal in coastal areas are underfunded and often lack the proper equipment. This causes delays in debris removal, especially following natural disasters when public resources are focused on human health and safety and maintaining services. If we increase coordination and cost sharing among responsible entities, the effectiveness of marine debris removal operations will be increased (Strategy 1.3).

With the establishment of the Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands, enhanced coordination among co-trustee agencies—NOAA, USFWS, and the State—will facilitate the reduction of marine debris that threatens the Hawaiian monk seal and green sea turtles. In the main Hawaiian Islands, the development of a rapid response protocol for marine debris removal is needed to improve coordination and share resources and costs among U.S. Coast Guard (USCG), EPA, state government, counties, nongovernmental organizations, the private sector, and community groups.

4.2 Goal 2 - Introduction of Solid Waste and Fishing Gear at Sea and Coastal Areas Decreased

Reducing the incidence of dumping of solid waste and fishing gear at sea will reduce stressors on all ecosystem targets. Results chains were developed for Goal 2 by linking strategies with a set of intermediate results (Appendix B, Figure B-2). Five strategies are identified to achieve this goal:

Strategy 2.1: Conduct education and outreach to ocean users on ocean dumping laws and proper waste management

Strategy 2.2: Provide low-cost and convenient disposal options for gear and solid waste

Strategy 2.3: Increase use of fishing materials and practices designed to reduce impacts of marine debris

Strategy 2.4: Amend ocean dumping laws to prohibit disposal of solid waste resulting from operations at sea

Strategy 2.5: Build capacity to monitor and enforce ocean dumping laws

The legal framework governing ocean dumping is in place at both international and U.S. levels. Reinforcing existing rules and regulations through education and outreach will increase vessel captains' and crews' awareness of the consequences of dumping and best practices for gear and waste management (Strategy 2.1). Existing education and outreach activities conducted by the USCG need to be continued. Education and outreach activities should be expanded to state and private harbors and ports and describe the benefits of pollution prevention, use of biodegradable products, and impacts of marine debris on navigation and marine resources.

The capacity for on-vessel storage and cost of disposal of unwanted fishing gear and solid waste is one of the primary deterrents to proper waste management. On-vessel management options need to be explored and communicated to vessel operators. Low-cost and convenient disposal options for fishing gear and solid waste need to be improved at all port and harbor facilities (Strategy 2.2). State and private harbors and ports need to provide low-cost disposal options to encourage proper waste management.

Some fishing practices incorporate intentional loss of gear (e.g., slidebait fishing). By modifying the practices or using less harmful, perhaps biodegradable, materials, "dumped" gear can do less harm. Fishing materials and practices that minimize the impacts of marine debris need to be explored with gear producers and users (Strategy 2.3). While this strategy will not necessarily decrease the amount of debris generated, it will render it less harmful.

The disposal of plastic at sea is prohibited by international and national laws. However, the disposal of solid waste other than plastic generated from operations of vessels at sea is not currently prohibited in all areas by ocean dumping laws. Amendment of ocean dumping laws to prohibit disposal of solid waste from operations at sea is needed to reduce the incidence of dumping (Strategy 2.4).

Monitoring and enforcement of ocean dumping laws is needed to improve compliance (Strategy 2.5). While enforcement at sea is difficult, dock-side inspections and monitoring fishing gear and solid waste streams from vessels leaving and returning to state and private harbors and ports can improve compliance.

With increased awareness of the laws, fines, and impacts of marine debris on navigational hazards and marine life, improved disposal options, and monitoring and enforcement, ocean users will reduce the incidence of dumping solid waste and fishing gear in the sea.

4.3 Goal 3 - Number of Abandoned and Derelict Vessels Decreased

Decreasing abandoned and derelict vessels will reduce coral abrasion and breakage, disruption of ecosystems, and navigation hazards. Results chains were developed for Goal 3 by linking strategies with a set of intermediate results (Appendix B, Figure B-3). Two strategies are identified to achieve this goal:

Strategy 3.1: Educate vessel owners on maintenance and maritime preparedness

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Strategy 3.2: Develop capacity and coordination mechanisms for abandoned vessel removal

Strategy 3.3: Develop sustainable funding mechanisms and resources for vessel removal

Vessels are abandoned when damaged by storms, swamping, or grounding or when owners can no longer keep up with maintenance required to keep the vessel operational and in compliance with USCG safety inspections. Hawaii’s boat owners and transiting vessels need to be prepared to maintain their vessels in operating condition and understand the steps that should be taken to prepare a vessel for severe storms (Strategy 3.1). Education and outreach to vessel owners should include maintenance programs and maritime-readiness training.

Different agencies may be aware of or have distinct responsibilities regarding abandoned, grounded, or drifting vessels. Improved communication and coordination would result in faster response, before vessels break apart or damage is done, and lower costs (Strategy 3.2).

Sustainable funding mechanisms (a special fund, registration fees, insurance requirements) are needed to provide the capacity for agencies and vessel owners to remove and dispose of abandoned or non-operational vessels in a timely and cost-effective manner (Strategy 3.3). Coordination among agencies is needed to provide the assets and resources to remove and properly dispose of these vessels. Enacting legislation to require insurance coverage for removal of vessels that become non-operational would further decrease the incidence of abandonment. Low-cost disposal alternative are needed for end-of-life vessels.

Increased awareness of vessel owners on maintenance and maritime preparedness coupled with improved communication and sustainable financing mechanisms will result in a decrease in the number of vessels abandoned due to weather, groundings, or lack of maintenance.

4.4 Goal 4 - Land-based Debris in Waterways Reduced

Reduction in land-based debris in Hawaii’s waterways, including rivers, streams, and the stormwater system, will reduce stress primarily on coastal and marine species and the economy. Results chains were developed for Goal 4 by linking strategies with a set of intermediate results (Appendix B, Figure B-4). Seven strategies will contribute to achieving this goal:

Strategy 4.1: Conduct education and outreach targeted to specific audiences

Strategy 4.2: Improve effectiveness of stormwater permitting system

Strategy 4.3: Establish Total Maximum Daily Load for trash for priority watersheds

Strategy 4.4: Build capacity to enforce water quality permits and laws

Strategy 4.5: Employ structural controls and BMPs to prevent land-based debris from entering the ocean

Strategy 4.6: Increase coordination and targeted cleanups in watersheds and on beaches

Strategy 4.7: Decrease use of potential debris items

Strategy 4.8: Improve solid waste management

Education and outreach is a crosscutting strategy required to achieve the overall goal of reducing land-based debris in Hawaii's waterways. Education and outreach activities must be targeted to specific audiences and incorporate both social marketing and mobilization techniques (Strategy 4.1). Target audiences include both the regulated community, to improve compliance with stormwater permit conditions, and the general public, to increase volunteer efforts for cleanup activities, decrease littering and dumping, and shift buying behavior away from non-reusable and non-biodegradable products.

Stormwater permits are required for state agencies and private entities that discharge to the stormwater system. The effectiveness of the stormwater permitting system can be improved by streamlining the permit process and incorporating provisions that address solid waste (Strategy 4.2). Emphasizing debris prevention with the regulated community will reduce the amount of land-based debris that is carried through Hawaii's waterways to the sea where it becomes marine debris. The incorporation of trash into the Total Maximum Daily Load (TMDL) allocation for priority watersheds will focus effort and resources to reduce this load (Strategy 4.3).

Enforcement of water quality permits and laws is needed not only for the regulated community, those with stormwater permits, but for the general public. Roadside dumping violators need to be caught and fined. The capacity to enforce water quality laws and permit conditions needs to be strengthened to prevent land-based debris from entering Hawaii's waterways (Strategy 4.4).

Structural controls and best management practices need to be employed to prevent land-based debris from entering the ocean (Strategy 4.5). Structural controls, such as trash collectors in stormwater drains and waterways, collect floatable material. Human resources and funding are required to maintain these controls. Increased emphasis on the use of best management practices is needed to prevent land-based debris from entering waterways. Providing sufficient trash receptacles and timely disposal services in high-use areas, for example, is critical.

Many community organizations conduct regular cleanups in watersheds and beaches (Strategy 4.6). Their efforts need to be supported and recognized as one of the most important activities to reduce land-based debris in Hawaii's waterways. Many individuals have taken it upon themselves to clean up trash on our beaches as a daily regimen. This has substantial benefits to protected species and coral reefs. Resources and tools to support coordination and increased participation in voluntary cleanup efforts are needed to expand current activities to all watersheds and beaches. A statewide watershed cleanup can be strategically scheduled at the end of summer prior to rainy weather conditions.

The Hawaiian Islands have limited disposal options for solid waste. Non-biodegradable items are disposed of in landfills, burned for H-Power, or end up as trash in watersheds and on beaches, and eventually as marine debris. Ultimately, we need to decrease our use of disposable items in general and reduce the importation and use of non-biodegradable items (Strategy 4.7). Consumers and suppliers of non-reusable and non-biodegradable

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items will be the target of education and outreach activities to increase the use of reusable and biodegradable products and decrease the use and importation of non-biodegradable products.

Use of best management practices from homeowners to businesses to waste haulers can decrease the accidental loss of waste into the land and, ultimately, marine environment (Strategy 4.8). Covered containers, covered loads, a collection schedule that does not allow containers to be overfull, and other best practices can minimize the amount of solid waste that is lost before it arrives at a disposal facility.

A multipronged approach is needed to reduce land-based debris in Hawaii’s waterways. Education and outreach targeted to specific audiences is a crosscutting need to increase awareness of laws, best practices, and consumer options.

5.0 TWO-YEAR ACTIVITY PLAN

Priority activities under each threat reduction goal and strategy that should be implemented over the next two years are listed in Table 2. These activities were identified in the context of the results chains (Appendix B) and building on the review of past and ongoing activities (Table 1) and new activities identified during workshops with the marine debris community in Hawai‘i (Appendix C).

Table 1. Illustrative two-year activity plan for 2010 to 2012.

Activities	Possible Implementation & Support Partners
Goal 1 - Backlog of Marine Debris at Sea Reduced	
Strategy 1.1: Develop effective methods to locate marine debris accumulations	NOAA, NASA
<ul style="list-style-type: none"> Implement at-sea detection strategy 	
Strategy 1.2: Develop effective systems for reporting marine debris accumulations	NOAA, DLNR, Counties, NGOs
<ul style="list-style-type: none"> Review existing reporting mechanisms 	
<ul style="list-style-type: none"> Enhance reporting mechanisms to improve ease and responsiveness 	
Strategy 1.3: Develop capacity and coordination mechanisms for marine debris removal	NOAA, USCG, DOBOR, Counties, NGOs
<ul style="list-style-type: none"> Assess existing mandates and capacities for marine debris removal 	
<ul style="list-style-type: none"> Prepare model guide on coordination for debris removal 	
<ul style="list-style-type: none"> Investigate additional cost-effective, safe, and less labor-intensive debris recovery methods 	
Goal 2 - Introduction of Solid Waste and Fishing Gear at Sea Decreased	
Strategy 2.1: Conduct education and outreach to ocean users on ocean dumping laws and proper waste management	NOAA, NGOs, WPFMC
<ul style="list-style-type: none"> Define target audience for education and outreach activities 	
<ul style="list-style-type: none"> Develop education and outreach materials and activities by target audience 	
<ul style="list-style-type: none"> Conduct education and outreach activities 	
Strategy 2.2: Provide low-cost and convenient disposal options for gear and solid waste	DOT, DOBOR, private harbors and ports
<ul style="list-style-type: none"> Evaluate cost and incentives for use of existing disposal facilities 	
<ul style="list-style-type: none"> Conduct feasibility study and economic analysis of disposal options 	
Strategy 2.3: Increase use of fishing materials and practices designed to reduce impacts	WPFMC
<ul style="list-style-type: none"> Identify fishing materials and practices causing greatest 	

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Activities	Possible Implementation & Support Partners
impacts	
<ul style="list-style-type: none"> • Work with suppliers to find alternative gear 	
<ul style="list-style-type: none"> • Work with fishermen to implement improved fishing practices 	
Strategy 2.4: Amend ocean dumping laws to prohibit disposal of solid waste resulting from vessel or platform operations at sea	NOAA, State Department, NGOs, WPFMC
<ul style="list-style-type: none"> • Advocate for amendment of ocean dumping laws • Prepare technical briefs to support amendment 	NOTE: The implementation of this strategy is largely outside the scope of the HI marine debris community.
Strategy 2.5: Build capacity to monitor and enforce ocean dumping	NOAA, USCG, DOT, DOBOR, private harbors and ports
<ul style="list-style-type: none"> • Conduct monitoring and enforcement capacity assessment 	
<ul style="list-style-type: none"> • Conduct workshop with agencies and other stakeholders to discuss monitoring and enforcement needs 	
<ul style="list-style-type: none"> • Prepare a capacity building plan 	
Goal 3 - Number of Abandoned and Derelict Vessels Decreased	
Strategy 3.1: Educate vessel owners on maintenance and maritime preparedness	NOAA, FEMA
<ul style="list-style-type: none"> • Review existing information and guidelines on storm preparedness and grounding avoidance for vessels 	
<ul style="list-style-type: none"> • Refine and update guidelines for storm preparedness and grounding avoidance 	
<ul style="list-style-type: none"> • Conduct training and outreach to vessel owners 	
Strategy 3.2: Develop capacity and coordination mechanisms for abandoned vessel removal	USCG, DLNR, DOBOR, private harbors and ports
<ul style="list-style-type: none"> • Refine communication protocols for abandoned, adrift, and grounded vessels 	
Strategy 3.3: Develop sustainable funding mechanisms and resources for vessel removal	NOAA, HDOT, DOBOR, private harbors and ports, insurance companies
<ul style="list-style-type: none"> • Conduct workshop to identify and recommend a range of sustainable financing mechanisms and barriers to implementation 	
<ul style="list-style-type: none"> • Conduct feasibility study on recommended range of sustainable financing mechanisms 	
Goal 4 - Land-based Debris in Waterways Reduced	
Strategy 4.1: Conduct education and outreach targeted to	EPA, DOH, CZM

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Activities	Possible Implementation & Support Partners
specific audiences	
<ul style="list-style-type: none"> Define target audience for education and outreach activities 	
<ul style="list-style-type: none"> Develop education and outreach materials and activities by target audience 	
<ul style="list-style-type: none"> Conduct education and outreach activities 	
Strategy 4.2: Improve effectiveness of stormwater permitting system	EPA, DOH
<ul style="list-style-type: none"> Conduct review of existing permitting system to identify gaps and barriers to debris prevention 	
<ul style="list-style-type: none"> Develop measures to streamline process and incorporate best practices for debris prevention 	
Strategy 4.3: Establish Total Maximum Daily Loads for trash for priority watersheds	EPA, DOH
<ul style="list-style-type: none"> Identify priority watersheds for TMDL study for trash 	
<ul style="list-style-type: none"> Conduct TMDL study for trash in priority watersheds 	
<ul style="list-style-type: none"> Develop implementation plan with stakeholders 	
<ul style="list-style-type: none"> Implement trash reduction and monitoring 	
Strategy 4.4: Build capacity to enforce water quality permits and laws	EPA, DOH
<ul style="list-style-type: none"> Conduct enforcement capacity assessment 	
<ul style="list-style-type: none"> Conduct enforcement workshop to identify opportunities to build capacity through partnerships 	
Strategy 4.5: Employ structural controls and BMPs to prevent land-based debris from entering the ocean	EPA, COE, DOT, Counties
<ul style="list-style-type: none"> Identify priority waterways for structural controls 	
<ul style="list-style-type: none"> Review effectiveness of existing best management practices to prevent land-based debris from entering the ocean 	
Strategy 4.6: Increase coordination and targeted cleanups in watersheds and beaches	NGOs, Community groups
<ul style="list-style-type: none"> Establish a web-based clearinghouse to advertise and coordinate volunteer cleanup efforts 	
<ul style="list-style-type: none"> Provide resources to volunteer groups for cleanup, reporting, and disposal 	
Strategy 4.7: Decrease use of potential debris items	DOH, State legislature, NGOs, private sector
<ul style="list-style-type: none"> Establish baseline of types and quantity of potential debris items imported 	
<ul style="list-style-type: none"> Conduct workshop with major buyers to raise awareness of the impacts of importing non-biodegradable items 	
Strategy 4.8: Improve solid waste management	DOH, State legislature, NGOs, private sector

6.0 PLAN IMPLEMENTATION AND MONITORING

The implementation and monitoring of outcomes of the HI-MDAP will be achieved through ongoing collaborative efforts and new partnerships needed to address specific strategies. The NOAA MDP has committed to support the adaptive management process from conceptualization and action plan preparation through implementation and monitoring (Figure 7). The HI-MDAP presents a conceptual model of the threats posed by marine debris (Figure 5 and 6). Threat reduction goals, intermediate results, and strategies were developed based on the conceptual model (Appendix B). This section presents activities to implement the plan and monitor progress.

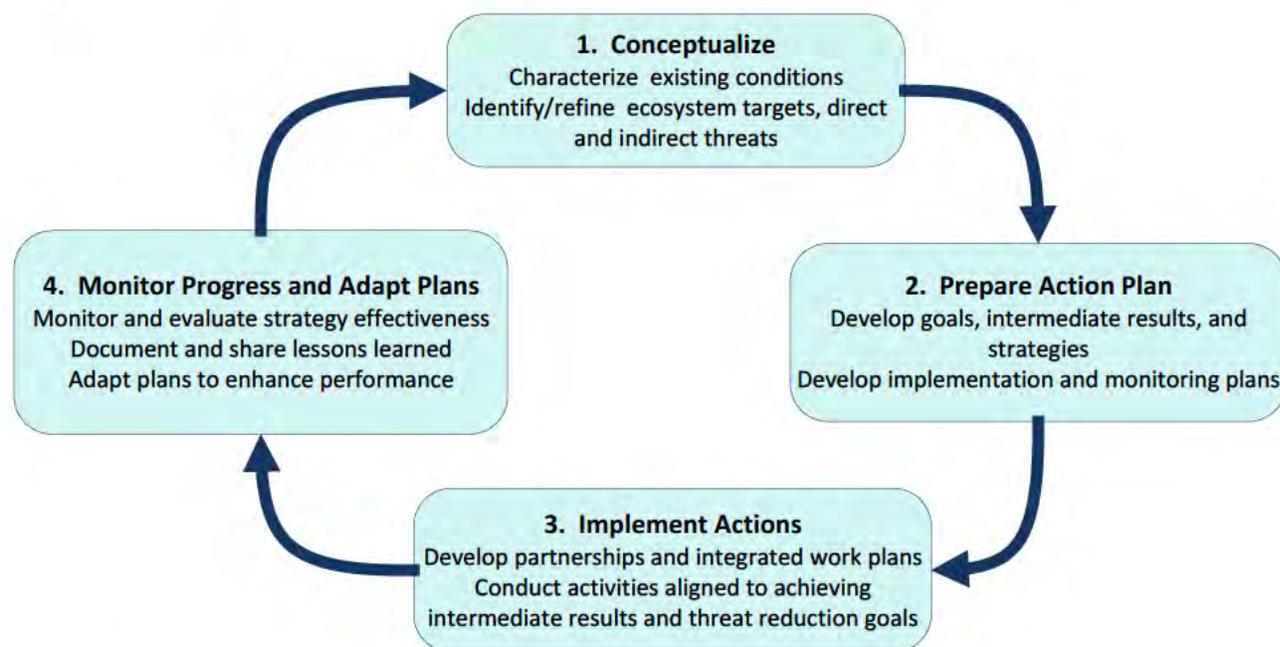


Figure 8. Adaptive management cycle (after CMP Open Standards project management cycle).

In order for organizations or agencies to participate in implementing the HI-MDAP, four steps must be accomplished:

1. Adopt and agree to the appropriate results chain, finding a fit under a strategy;
2. Develop a site-specific chain for your particular project (listing the resources that you bring to the table);
3. Adopt the metrics and agree to base metrics/indicators on what is in the results chain; and
4. Share your results using the results chain format

Plan implementation will build on ongoing efforts and partnerships and identify new collaborative efforts as needed. It is anticipated that multi-sectoral teams will be organized around results chains for specific threat reduction goals and strategies. The NOAA MDP and EPA will facilitate coordination and meetings to develop or refine the results chains,

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prepare integrated work plans, and monitor progress. Coordination tasks for plan implementation are listed in Table 3 from October 1, 2009, through September 30, 2011.

Table 2. Coordination tasks for plan implementation.

Tasks	FY10				FY11			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Establish results chain teams	■							
Review and refine results chains and performance indicators	■	■						
Develop integrated work plans and schedules	■	■						
Prepare performance monitoring plan with roles and responsibilities defined for data collection by results chain		■	■					
Identify funding gaps for plan implementation	■	■						
Conduct quarterly team meetings to review implementation	■	■	■	■	■	■	■	■
Conduct annual performance reporting workshop				■				■

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APPENDIX A. LIST OF ALL AGENCY/ORGANIZATION PARTNERS IN THE HAWAI‘I MARINE DEBRIS ACTION PLAN

1. Archinoetics
2. Beach Environmental Awareness Campaign Hawai‘i
3. Chris Woolaway and Associates, LLC
4. City and County of Honolulu, Department of Parks and Recreation
5. City and County of Honolulu, Department of Environmental Services
6. Community Work Day Program
7. County of Hawai‘i, Parks and Recreation, Aquatics
8. Covanta Energy
9. Enchanted Lake Residents Association
10. Environmental Science International, Inc.
11. Hanalei Bay Watershed Hui
12. Hawai‘i and Pacific Islands Ocean Observing System
13. Hawai‘i Institute of Marine Biology
14. Hawai‘i Longline Association
15. Hawai‘i Pacific University
16. Hawai‘i Wildlife Fund
17. Island Divers
18. Kaua'i Westside Watershed Council
19. Kako‘o ‘O‘iwi
20. Kini Beach
21. Kupu
22. Mālama Maunalua
23. Mālama Na 'Apapa
24. Matson Navigation
25. Maui Reef Fund
26. NOAA Fisheries Service, Recreational Fisheries
27. NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary
28. NOAA Marine Debris Program
29. NOAA Office of Law Enforcement
30. NOAA Office of National Marine Sanctuaries, Pacific Islands Region
31. NOAA Pacific Islands Fisheries Science Center
32. NOAA Pacific Islands Regional Office
33. NOAA Pacific Services Center
34. NOAA PIRO Observer Program
35. NOAA Restoration Center
36. Oceanic Institute
37. Oceanit
38. Oikonos - Ecosystem Knowledge
39. Pacific Ocean Producers Fishing and Marine
40. Papahānaumokuākea Marine National Monument
41. PlanSea

42. Reef Watch Waikiki
43. Sea Turtles International
44. Schnitzer Steel Hawai‘i Corporation
45. Sheavly Consultants
46. Sierra Club Hawai‘i Chapter
47. State of Hawai‘i, Department of Business, Economic Development, and Tourism, Coastal Zone Management Program
48. State of Hawai‘i, Department of Business, Economic Development, and Tourism
49. State of Hawai‘i, Department of Health, Clean Water Branch, Polluted Runoff Control Program
50. State of Hawai‘i, Department of Health, Environmental Health Administration
51. State of Hawai‘i, Department of Health, Environmental Planning Office
52. State of Hawai‘i, Department of Land and Natural Resources, Division of Aquatic Resources
53. State of Hawai‘i, Department of Land and Natural Resources, Division of Boating and Ocean Recreation
54. State of Hawai‘i, Department of Land and Natural Resources, Division of Conservation and Resources Enforcement
55. State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife
56. State of Hawai‘i, Department of Transportation, Harbors Division
57. State of Hawai‘i, Kahoolawe Island Reserve Commission
58. Surfrider Foundation
59. TetraTech EM, Inc.
60. The Nature Conservancy
61. TSphere Energy
62. United Fishing Agency
63. University of Hawai‘i Sea Grant College Program
64. University of Hawai‘i Marine Option Program
65. University of Hawai‘i, Center for Microbial Oceanography: Research and Education
66. U.S. Coast Guard
67. U.S. Environmental Protection Agency, Region 9, PICO Office
68. U.S. Fish and Wildlife Service
69. U.S. Navy Region Hawai‘i
70. USDA Natural Resources Conservation Service Pacific Islands
71. Western Pacific Regional Fisheries Management Council

APPENDIX B. PAST AND ONGOING ACTIONS TO ADDRESS THREATS FROM MARINE DEBRIS

Government agencies, nongovernmental organizations, academic institutions, and the private sector have been actively engaged in marine debris issues in Hawai'i for decades. Past and ongoing efforts of Hawai'i's marine debris community to address the threats posed by marine debris have included research and assessment, in-water debris removal and prevention, beach cleanup, land-based debris prevention, and education and outreach. This section provides a summary and highlights of these past and ongoing efforts. A list of some of these activities identified during planning workshops is provided in Table 1.

3.1 Research and Assessment

Research and assessment activities are critical to understanding the extent of and determining how best to address the threats of marine debris. Techniques are being developed to improve our understanding of the origin, movement, and accumulation hotspots of marine debris, as well the variety of threats and severity of impacts to the environment, human health, and economic interests. Past and ongoing marine debris research and assessment activities in the Hawaiian archipelago have covered a range of topics including identifying and quantifying sources of marine debris, conducting assessments of accumulation rates, testing new methods for at-sea detection, and characterizing direct impacts on wildlife and habitat as well as indirect impacts such as marine debris as vectors for alien species (Table 1).



Aerial surveys of the coastlines of seven of the main Hawaiian Islands were conducted from 2006-2008. Photo courtesy of NOAA PIFSC CRED.

National Priorities Recommended by the Interagency Marine Debris Coordinating Committee

- Research and technology development to assess next steps, address gaps, reduce or prevent material from entering marine system, and mitigate impacts.
 - Response to debris already in the environment through enforcement and cleanups.
 - Marine debris prevention through education and outreach, legislation/regulation/policy, and incentive programs.
 - Cross-theme efforts that foster coordination among federal agencies and other government and non-governmental partners to share information, coordinate efforts, and implement actions to prevent, reduce, or mitigate impacts of marine debris.
- (NOAA, 2008)

Surveys of marine debris accumulation areas have been conducted by NOAA PIFSC-CRED in

both the main Hawaiian Islands (shoreline) and the Northwestern Hawaiian Islands (in-water; Dameron et al., 2007). Between February and May of 2006, aerial surveys of the main Hawaiian Islands of Oahu, Kauai, Hawai‘i, Maui, Lanai, and Molokai revealed the presence of marine debris along the shores and nearshore reefs of all the islands. In total, over 700 debris sites were found, comprising an estimated 117 metric tons of marine debris. A second survey in 2008 located over 1,000 debris sites. For more information visit <http://www.pifsc.noaa.gov/cred/nwhiefforts.php> and <http://www.pifsc.noaa.gov/cred/mhefforts.php>.

Biologists in the NWHI have observed thousands of dead seabirds each year. Marine debris ingestion is thought to be one of several contributing factors to the deaths of these birds; however, the direct impact of debris ingestion on seabird mortality, especially on a population level, is unknown. Ongoing and past research projects to understand and address this critical issue focus on correlating seabird foraging patterns with plastic accumulation across the Pacific Ocean. Projects include determining the types of plastics found in adults and chicks in the NWHI (Tern, Midway, and Kure) and as well as using seabirds as an indicator of plastic marine debris in the North Pacific (Nevins et al., 2005).

One of the critical issues with marine debris is that most plastics do not biodegrade, they photo-degrade into smaller and smaller pieces, all of which are still plastic polymers. University of Hawai‘i oceanographers with the Center for Microbial Oceanography: Research and Education (C-MORE) have begun to investigate this issue, collecting numerous samples of small plastic from the open ocean of the North Pacific. They have conducted biochemical studies to understand the type and biomass of organisms associated with these small and microscopic plastic pieces. This information is critical in understanding how plastics affect the base of the marine food chain. For more information visit <http://cmore.soest.hawaii.edu/cruises/super/index.htm>.

The impact of marine debris as it reaches and becomes entangled in the shallow reef environment has been a concern in Hawai‘i since the 1980s, when annual net and line removal began along NWHI beaches (Henderson, 2001). Here the debris causes physical damage by scouring the reef, entangling and drowning endangered and other marine species, and can transport alien invasive species. Ongoing



Derelict fishing nets are known to damage coral reefs—the extent of damage is being studied at Midway Atoll. *Photo courtesy of NOAA PMNM.*

and past research in the NWHI includes investigations of the impacts of derelict net debris on coral reefs at Midway Atoll (http://marinedebris.noaa.gov/projects/nwhi_coral.html), derelict fishing gear as an alien species vector (http://marinedebris.noaa.gov/projects/nwhi_invasives.html) and ghost net identification to determine fishery and country of origin (<http://www.pifsc.noaa.gov/cred/netanalysis.php>). To improve and assess efforts in removing marine debris from the ocean environment, it is important to undertake new research as well as thorough analyses of data collected during marine debris removal, marine mammal disentanglement, and related efforts. Research into new techniques that can detect, track, and model derelict fishing gear in the open ocean are ongoing and may lead to its removal before this harmful debris reaches the shallow reef (<http://marinedebris.noaa.gov/projects/atsea.html>).

3.2 In-Water Debris Removal and Prevention



Once nets are carefully removed from the coral, lift bags are sometimes used to raise larger pieces of derelict fishing net to the ocean surface. *Photo courtesy of NOAA MDP.*

In-water removal of marine debris can be a dangerous activity. The size and weight of the debris and the high-energy environment of the nearshore reef requires specially trained personnel and sometimes large, expensive equipment. For this reason, most large-scale removal activities have been conducted through federal-state-industry partnerships. This includes the multi-agency effort launched in 1998 to aid NOAA in the removal and disposal of derelict fishing gear from the NWHI (Donohue, 2003). Between 1996 and 2009, nearly 700 metric tons of marine debris has been removed from the NWHI. The U.S. Coast Guard works with NOAA in removing in-water derelict nets and sometimes also collects land debris gathered by researchers, wildlife managers, and volunteers for transport back to O‘ahu. The net debris becomes

part of the Hawai‘i Nets to Energy Program, through which nets are chopped into small pieces suitable for combustion at Honolulu’s H-Power facility, creating electricity. While this effort has provided widespread benefit to the habitat and wildlife of Papahānaumokuākea Marine National Monument, work remains. An estimated 52 metric tons of marine debris accumulates annually on NWHI reefs (Dameron et al., 2007). Efforts to create and expand partnerships, including with the Department of Defense, commercial fisheries, and other industries, are ongoing and important to continue the momentum of these large-scale cleanup programs. For more information visit http://marinedebris.noaa.gov/projects/removal_nwhi.html.

While large-scale efforts are a critical aspect of in-water removal, small-scale and volunteer-supported efforts are also important in addressing this issue. Dive shops, non-profits, and spearfishing clubs organize and support underwater debris removal, such as recreational fishing gear entangled in

coral. Ongoing volunteer monitoring programs of nearshore reefs (e.g., Reef Check Hawai‘i) provide some information on the impact of marine debris and overall health of the reef. This information has been used in some areas, to prioritize removal areas (e.g., Island of Kaua‘i).

Programs such as the Pier 38 port reception bin continue to be excellent examples of successful partnerships with commercial fishermen, nonprofit organizations, and private businesses. The Pier 38 port reception bin on O‘ahu has been highly successful since its launch in 2006. It currently receives nets not only from Hawai‘i’s longline fishermen, but also community groups and the City and County of Honolulu. For more information visit



The Pier 38 port reception program is part of the Hawai‘iNets to Energy Program.
Photo courtesy of NOAA MDP.

<http://marinedebris.noaa.gov/projects/hiportrecep.html>.

3.3 Beach Cleanup

The presence of marine debris on popular beaches is perhaps the most well-known marine debris issue. The International Coastal Cleanup Day, held every September, has become an international phenomenon involving hundreds of thousands of people participating in cleanup activities on beaches and underwater. During the 2008 23rd annual International Coastal Cleanup, nearly 400,000 volunteers collected more than 6.8 million pounds of

Some of the Many Organizations and Groups Supporting Beach Cleanups in Hawai‘i

- B.E.A.C.H. - <http://www.b-e-a-c-h.org/>
- Chris Woolaway & Associates - <http://www.woolaway.com/>
- Girl Scouts and Boy Scouts of America - <http://www.girlscouts-hawaii.org/> and <http://www.scouting.org/>
- Hawai‘i Wildlife Fund - <http://wildhawaii.org/>
- Hui Malama O Ke Kai - http://www.kbac-hi.org/contractors/hui_malama.htm
- Kahoolawe Island Reserve Commission - <http://kahoolawe.hawaii.gov/>
- Malama Maunaloa - <http://malamamaunaloa.org/>
- Matson Navigation Company - <http://www.matson.com/>
- NOAA Marine Debris Program - <http://marinedebris.noaa.gov/>
- Save the Sea Turtles International - <http://www.seaturtlesinternational.com/>
- Sierra Club Hawai‘i Chapter - <http://www.hi.sierraclub.org/Chapter/Home.html>
- Surfriider Foundation - <http://surfriderkauai.ning.com/> and <http://www.surfrider.org/oahu/>
- The Nature Conservancy - <http://www.nature.org/wherework/northamerica/states/hawaii/>
- U.S. Environmental Protection Agency - <http://www.epa.gov/region09/>
- Waikiki Ohana Workforce
- WPFMC High School Summer Course
- ...and other community service groups and state and county agencies

trash in 104 countries and 42 U.S. states (Ocean Conservancy 2009). Known in Hawai‘i as “Get the Drift and Bag It,” the International Coastal Cleanup involves a large number of Hawai‘i-based organizations and community groups, who use it as an opportunity to generate support and awareness for local marine debris issues. For more information visit http://www.oceanconservancy.org/site/PageServer?pagename=icc_home.

For the most part, beach cleanups rely on volunteer time, small private donations, and the efforts of local environmental organizations. In Hawai‘i, supplemental funding for beach cleanups is available from NOAA, the state, and counties. Matson Navigation Company also has a program, called Ka Ipu ‘Aina (Container for the Land); the program provides a container, pays trucking expenses, and donates \$1,000 to each nonprofit organization that successfully completes a cleanup. For more information visit http://www.matson.com/corporate/about_us/container_for_the_land.html.



Volunteers helped to clean over 41 tons of debris from the southeast coast of the Big Island of Hawai‘i. *Photo courtesy NOAA MDP.*

Volunteer and community-based cleanup efforts occur on all of the inhabited islands. Some of the programs are specifically directed for school-age children through their schools or after-school clubs. Others are community-based, and often occur in areas where marine debris accumulates at higher rates than other parts of the islands (e.g., Waiohinu to Ka Lae coast, Island of Hawai‘i). Some are small-scale, removing a little trash each day, and others are large-scale, functioning to

conduct a comprehensive cleanup while providing an excellent opportunity for education and raising awareness. For example, regular beach cleanups occur along Waikiki beaches, where 30 to 140 volunteers assist in the effort. This highly visible, relatively large-scale effort promotes a shared sense of responsibility for the health and beauty of our beaches.

The Kaho‘olawe Island Reserve Commission also organizes marine debris cleanups, as massive amounts of debris accumulate along the island’s eastern and northeastern coastlines. Even though volunteers are utilized for the efforts and the program provides a great educational experience, these cleanups are logistically challenging and extremely expensive.

NOAA conducted aerial surveys of seven of the main Hawaiian Islands in 2006 and 2008. Following the 2006 survey, NOAA personnel removed 34 metric tons of debris from O‘ahu and Lana‘i beaches. Following the 2008 aerial surveys, 6 metric tons of debris was removed from O‘ahu shores over 10 days. Information from these surveys will be published in a booklet to promote community removal efforts. For more information visit <http://www.pifsc.noaa.gov/cred/mhefforts.php> or http://marinedebris.noaa.gov/projects/main_hawaiian.html.

In 2007, the National Marine Debris Monitoring Program published the results of a five-year study on the characteristics of marine debris on beaches (Sheavly 2007). For sites in Hawai‘i, ocean-based debris comprised the majority of debris (42.8%) over the five-year study period. Land-based items made up 22.4% of the items, and the remainder was general items that could not be tied specifically to either ocean or land activities. The dominant indicator items collected in the Hawaiian Islands were ocean-based, specifically fishing line (3,573; 11.8%), rope (2,907; 9.6%) and nets (1,735; 5.8%). Dominant land-based indicator items were metal beverage cans (3,628; 12.0%) and straws (2,317; 7.7%). General-source debris items that exhibited higher numbers were small plastic bags (3,146; 10.4%) and plastic beverage bottles (2,914; 9.7%). For more information and to download the report visit http://www.oceanconservancy.org/site/PageServer?pagename=mdm_debris.

3.4 Land-Based Debris Prevention

Land-based debris is washed off the land through storm drains, rivers, and streams; blown by winds; or intentionally dumped on the shore. Land-based sources of debris are a major threat to marine wildlife and ocean health. Birds, sea turtles, and marine mammals can ingest debris such as disposable lighters, convenience food packaging, and plastic bags, restricting their ability to eat and breathe.

In Hawai‘i, recent efforts have been initiated to limit the amount of plastic entering the environment. Maui County has banned the use of plastic shopping bags, effective in 2011, and Hawai‘i County has considered a ban. In 2008, the State Legislature considered banning the distribution of plastic shopping bags by retail stores and supermarkets (SB 584), but the measure did not pass. Most recently, in January 2009, retail outlets on Marine Corps Base Hawai‘i voluntarily eliminated the use of plastic bags and the U.S. Coast Guard quickly followed suit.



Overflowing trash bins are one of the many land-based sources of marine debris.



Photo courtesy of City and County of Honolulu, Dept. of Environmental Service.

Because many of Oahu’s streams have been channelized, discarded litter from miles inland quickly finds its way to the ocean after a rainstorm. The “Adopt-A-Stream” program is sponsored by the City and County of Honolulu’s Department of Environmental Services, Storm Water Quality Branch; it trains and supports Hawaii’s residents to remove debris, collect data on debris and water quality, and increase stewardship among the greater community. For more information visit

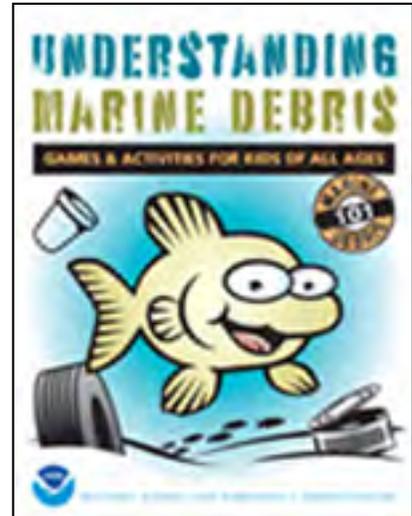
<http://www.cleanwaterhonolulu.com/storm/hero/adopt.html>.

The State Department of Health’s Clean Water Branch Polluted Runoff Control Program administers grant money it receives from the U.S. Environmental Protection Agency (EPA) through Section 319(h) of the Federal Clean Water Act. Projects, which include watershed planning and protection or remediation strategies, are ongoing at Kalihi Stream, Waimanalo Stream, and other impaired streams across the state. In addition, the Clean Water Branch responds to complaints of illegal dumping and littering on state and private lands, while the City and County of Honolulu’s Department of Environmental Services handles county jurisdiction. These programs are directly aimed at reducing the amount of trash in Hawaii’s streams as well as increasing public awareness and stewardship. For more information visit

<http://hawaii.gov/health/environmental/water/cleanwater/index.html> and <http://www.envhonolulu.org/>.

3.5 Outreach and Education

Increasing public awareness of the sources and impacts of marine debris is an essential component of reducing impacts to marine ecosystems. Most people are not aware that a large percentage of marine debris comes from land-based sources, and that much of this debris comes from careless disposal of garbage. The public is also unaware that much of the derelict fishing gear is caused by bad weather, gear failure, and improper disposal. Education and outreach about the causes and impacts of marine debris is focused on changing individual behavior, leading to a reduction of debris in the ocean.



Activity books on marine debris help in educating children on the subject.

Educational curriculum and outreach products are focused on reaching specific audiences, including school children, the fishing industry, and recreational ocean users, among others. The NOAA Marine Debris Program maintains a comprehensive list of such resources and materials from Hawai‘i and across the nation. For more information visit <http://marinedebris.noaa.gov/outreach/otherres.html>.

Traveling and permanent displays combine Native Hawaiian principles, interactive elements, and informational videos to engage and enlighten a wide segment of the public at various locations around the state such as the Mokupāpapa Discovery Center in downtown Hilo. For more information visit <http://marinedebris.noaa.gov/projects/mokupapapa.html>.

Several programs incorporate marine debris removal and education as part of their activities. A marine debris program with daytime field activities and evening lectures has been developed for eco-tourists visiting Midway Atoll National Wildlife Refuge (http://www.oceansociety.org/nhexp_midway_atoll). Established programs, including the Junior Lifeguard program and the Hawai‘i Youth Conservation Corps are partnering with marine debris education and outreach professionals to incorporate marine debris issues into their programs. These

are often combined with beach or stream cleanup activities, providing hands-on experience with this widespread issue.

A major focus of education and outreach is the development of classroom curriculum and field experiments for K-12 age students.

Project Niu provides K-12 students and teachers with hands-on, project-based experiences with satellite technologies used

to remotely monitor the ocean. Students deploy sensor-laden drifters that allow them to follow their tracks and the information they gather online. This develops a firsthand understanding of ocean currents and marine debris while forming personal connections to the environment. For more information visit <http://www.projectniu.org/home/frontpage>.



The Center for Microbial Oceanography: Research and Education (C-MORE) at the University of Hawai‘i has developed marine debris science kits, which are distributed to teachers for use in marine debris lessons. When the lesson is completed, the kits are returned for use by other teachers. For more information visit

http://cmore.soest.hawaii.edu/education/teachers/science_kits/marine_debris_kit.htm.

Additionally, the Northwestern Hawaiian Islands Multi-Agency Education Project provides marine debris lesson plans for grades 3-6 as well as a module on marine debris for grades 4-12. For more information visit

http://www.hawaiiatolls.org/teachers/lesson_marine_debris.php and <http://www.hawaiiatolls.org/research/NWHIED2005/resources/MarineDebrisModule.php>.

A number of documentary films and feature stories on television, the radio, and in the print media have been created to reach the widest possible audience. Some videos have been placed on YouTube, while a high-profile video of a 12-day transect from California to Hawai‘i that focused on marine debris in the open ocean was screened at the San Francisco Film Festival.

Outside of the classroom, art is being used to help spread the word about marine debris. Artists like Susan Scott and Pam Longobardi use the colors and texture of marine debris to create beautiful works of art that carry important conservation messages. For more information visit <http://www.susanscott.net/OceanWatch2009/feb-28-09.html> and <http://www.driftwebs.com/>.



A pair of Laysan albatross are created using bits of plastic debris and cigarette lighters. *Artwork by Susan Scott.*

Table B-1. Past and ongoing marine debris activities identified by workshop participants.

Activities	Lead Organization
RESEARCH AND ASSESSMENT	
Research on impacts to living marine resources, including entanglement, ingestion, habitat degradation, and ghostfishing	NOAA, FWS
Research on at-sea detection, tracking technology, and movement of marine debris (remote sensing, oceanographic modeling, detachable tracking buoys/sensors, etc.)	NOAA PIFSC-CRED
Information-gathering on economic impacts of marine debris (e.g., NOAA Observer Program)	NOAA PIRO
Research on accumulation of marine debris, especially in “hot spot” areas	NOAA PIFSC-CRED
Assessment of impacts of marine debris on alien species introduction in shallow reef environments	NOAA PIFSC-CRED
Ghost net identification	UH Sea Grant
S.U.P.E.R. cruise for at-sea plastic research	UH SOEST, C-MORE
Data collection on marine debris in the NWHI	NOAA, FWS
Analysis of albatross boluses and tracking of foraging trips	Oikonos, HPU
North Pacific seabird and marine debris cruise	Sea Education Association, HPU
Assessments of ingested plastic by seabirds using ultrasound: a nondestructive approach	HPU
Monitoring of the amount and type of marine debris (largely plastics) ingested by N. Pacific seabirds.	Oikonos, MLML
Using satellite-tagged sensor suite for open ocean monitoring of oceanographic data and ocean current tracking	Archinoetics, ATI
OUTREACH AND EDUCATION	
Hawaiian cultural display on marine debris	NOAA PSC
Marine debris educational display at Mokupapapa Discovery Center	NOAA PMNM
Booths at community events to make people aware of debris washing ashore in NWHI and how they	NOAA PMNM

Activities	Lead Organization
can reduce its impact	
Informational video about marine debris	Bishop Museum
Marine Debris Awareness Month (lectures, events, school visits, art projects, film showing)	B.E.A.C.H.
Project Niu: Using science and technology to educate students and the general public about the impact of their own actions on the oceans and watershed while helping them form personal relationships with the environment	Archinoetics
Integration of marine debris issues in the Junior Lifeguard program of O‘ahu	NOAA Fisheries
Development of outreach material to document location of marine debris around MHI	NOAA PIFSC CRED
Production of engaging high-profile education video distributed broadly	C-MORE
Development of portable MD science lessons for grade school teachers to implement in their classrooms	NOAA , C-MORE
Media exposure of MD issues	NOAA MDP, PIFSC-CRED
Public outreach – Education for school groups	B.E.A.C.H., City and County of Honolulu, C-MORE, NOAA, WPFMC, and many more
Participation of Hawai‘i Youth Conservation Corps in marine debris cleanup	KUPU, DLNR, Pono Pacific
Marine debris eradication, Maui Nui	American Reef Coalition
Ecotourism marine debris education and on-site volunteerism used to collect marine debris	Ocean Society
Printing and distribution of education and outreach materials at regional and international events	Numerous agencies and organizations
IN-WATER REMOVAL AND PREVENTION	
Identification/Survey of Kaua‘i high-impact reef area and prioritization of marine debris removal	Malama Na Apapapa, Limahuli Gardens
Nets to Energy Program and Partnership	NWHI Multi-Agency Marine Debris Coordination Group

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Activities	Lead Organization
USCG opportunistic transport of marine debris from the NWHI	USCG
Derelict fishing net hotline (discontinued)	UH Sea Grant
Marine debris bounty program with recreational fishermen in Kane‘ohe Bay, O‘ahu (discontinued)	UH Sea Grant
Underwater volunteer debris removal activities	Island Divers Hawai‘i (O‘ahu), Maui Reef Fund, Hawai‘i Wildlife Fund
Collaborative partnerships and projects with fishing industry, U.S. Department of Defense, and others involved in in-water debris removal and prevention	NOAA, USCG
Disposal sites for nets at harbors, boat ramps - pilot project at Pier 38	NOAA, WPFMC
LAND-BASED DEBRIS PREVENTION	
Stream and canal debris removal programs (e.g., Adopt a Stream)	City and County of Honolulu, Department of Environmental Services
Stream cleanups as part of 319(h) projects at Kalihi and Waimanalo Streams	City and County of Honolulu, Department of Environmental Services
Enforcement regarding litter and illegal dumping.	DOH-CWB, City and County of Honolulu
BEACH CLEANUP	
Regular volunteer beach cleanups	Many organizations
Community-based beach cleanups	Hawai‘i Wildlife Fund
Waikiki beach cleanup	Waikiki Improvement Association, Waikiki Ohana Workforce
Ka Ipu ‘Aina Program, providing communities with containers for beach cleanups	Matson Shipping Company
Windward – Makapu‘u – Mokule‘ia Beach cleanup at various city parks	City and County of Honolulu
Afterschool program for upper elementary students conducts small cleanups	Hui Malama O Ke Kai

Activities	Lead Organization
Kaho‘olawe marine debris cleanup	Kaho‘olawe Island Reserve Commission
Main Hawaiian Islands aerial survey and removal	NOAA PIFSC CRED

APPENDIX C. RESULTS CHAINS

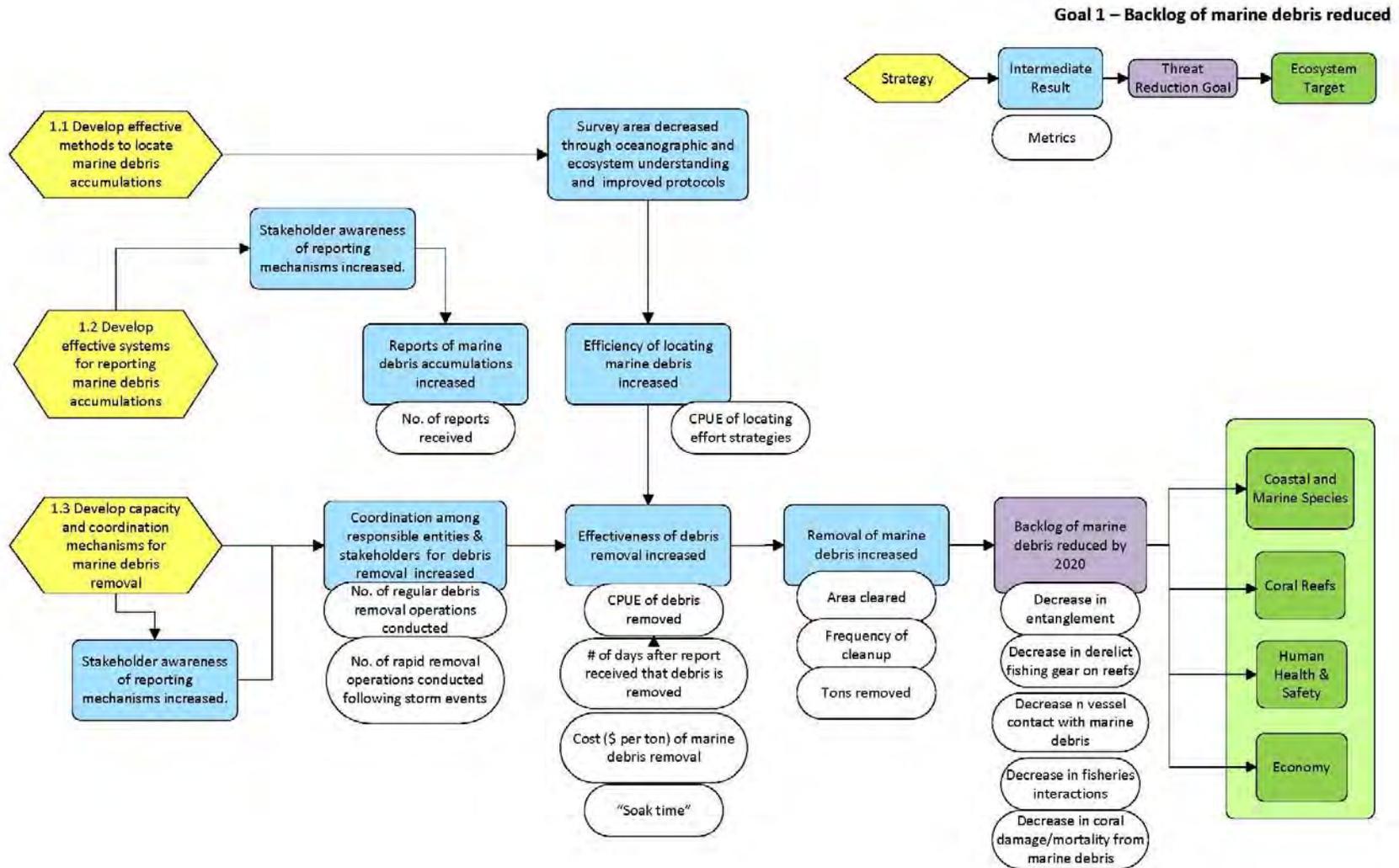


Figure C-1. Results chains for threat reduction goal 1 – Backlog of marine debris reduced

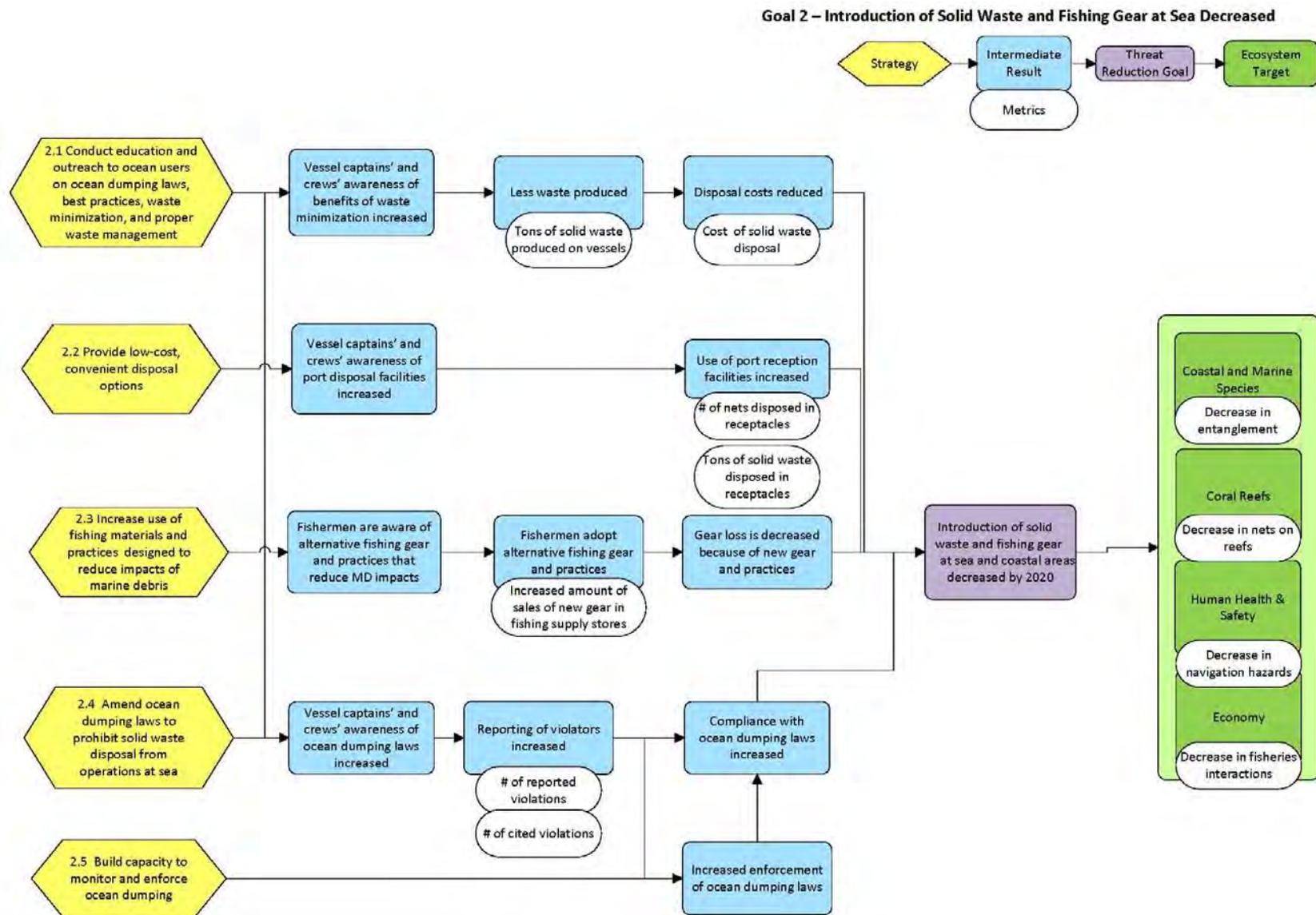


Figure C-2. Results chains for threat reduction goal 2 – Introduction of solid waste and fishing gear at sea decreased

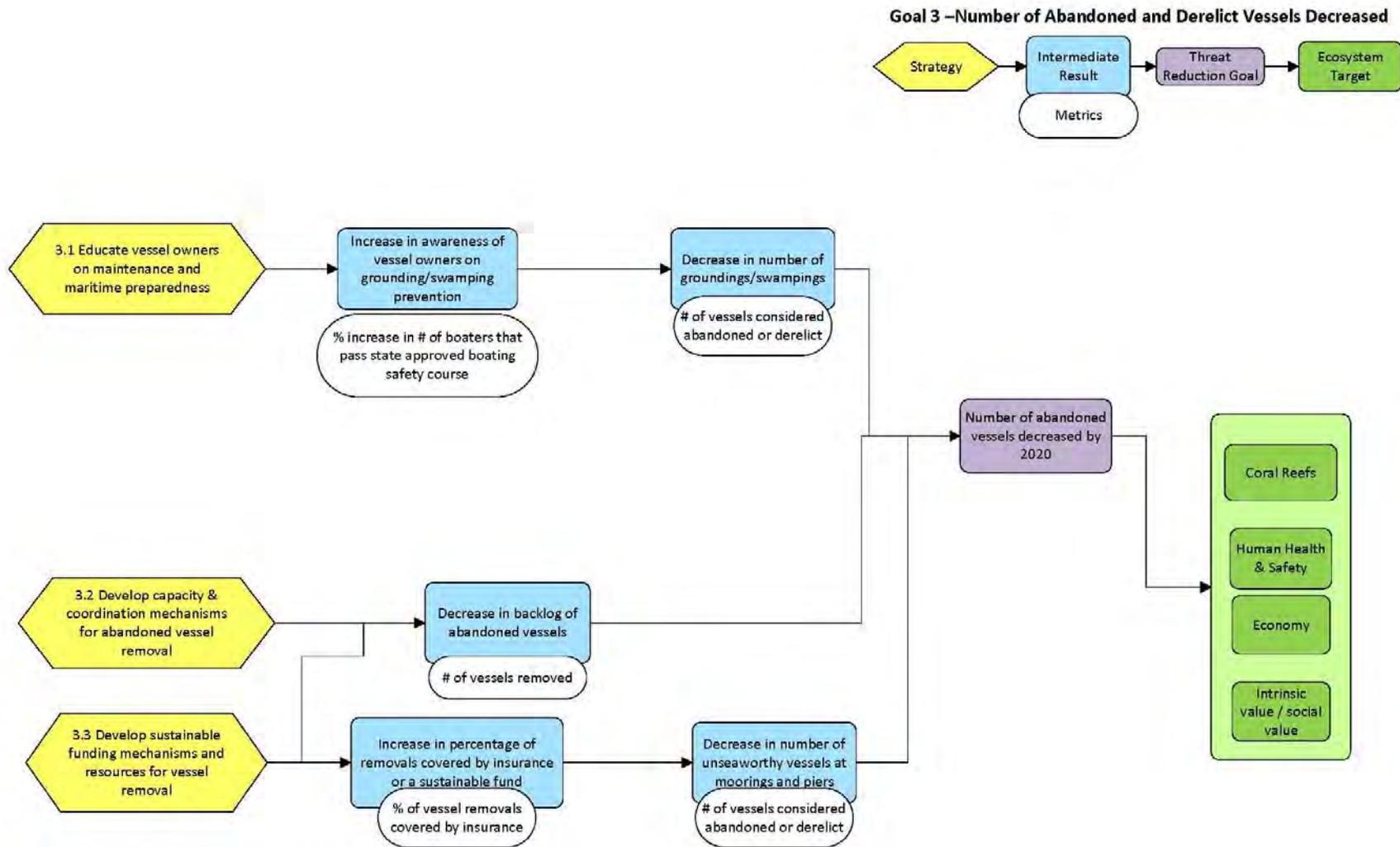


Figure C-3. Results chains for threat reduction goal 3 – Number of abandoned and derelict vessels decreased

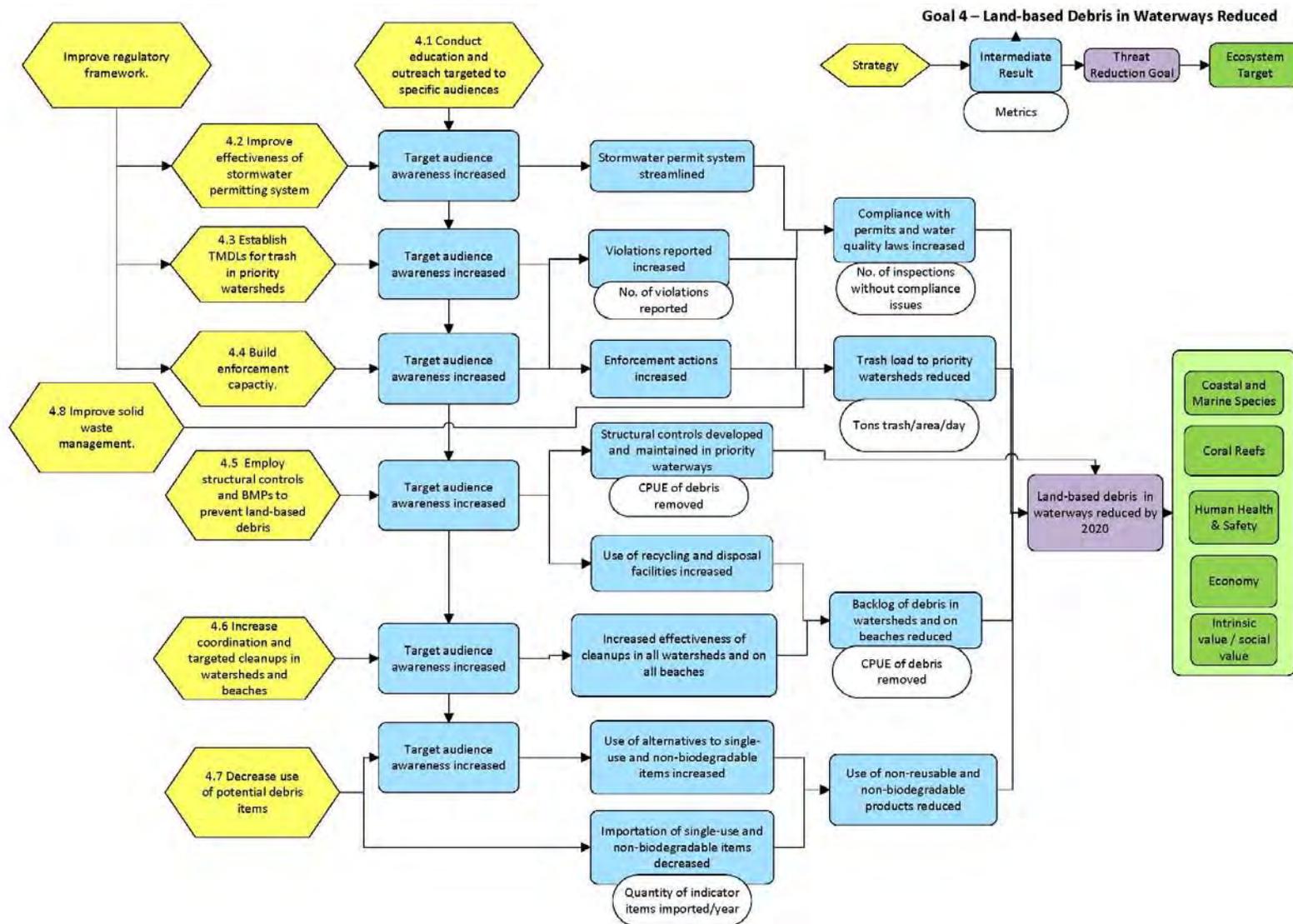


Figure C-4. Results chains for threat reduction goal 4 – Land-based debris in waterways reduced

APPENDIX D. DESCRIPTION OF NEW ACTIONS

The new actions listed here were created within the focus-area workshops, before the goals and strategies were finalized. For that reason, there is not a one-to-one correspondence between the priority activities listed in Table 1 and the new actions listed here. The actions in this section are numbered according to those focus areas:

RA – research and assessment

IW – in-water debris removal and prevention

BC – beach cleanup

LB – land-based debris prevention

OE – outreach and education

The actions are grouped according to goal and strategy, with crosscutting actions listed at the end. One goal (3 – Number of abandoned and derelict vessels is decreased) and several strategies were developed entirely after the focus-area workshops were completed and so do not yet have action write-ups. One of the tasks for the results chain teams will be reconciling the actions listed here with the results framework.

Goal 1 – Backlog of Marine Debris at Sea Reduced

Strategy 1.1: Develop effective methods to locate marine debris accumulations

Action RA2. Standardize survey methodology, data collection, and design for in-water sampling or sonar surveys	
Description: Develop or adapt, test, and disseminate marine debris survey methodologies and design across the state and in line with the rest of the nation so that data are comparable. Offer recommendations on data parameters to facilitate data sharing and comparison. Potential methods may vary with type of debris (nets vs. metal debris)	
Debris Type: Ocean-based	Location: MHI initially
Duration: 2 years	Funding Status: unfunded
Estimated Cost: \$150,000, exclusive of vessel costs	Funding Sources: NOAA MDP
Lead Organization: NOAA	Partner Organizations: Universities, AMRF, USCG, fishermen
Significance of Expected Outcomes: Assessing and monitoring amounts of marine debris in various environments will allow prioritization of removal and prevention activities. Using standardized protocols will allow comparison with other regions and a robust time series.	

Action RA3. Standardize survey methodology, data collection, and design for remotely sensed detection of derelict fishing gear	
Description: Use results of “Characterize net debris” to work with engineers to select a sensor, determine operational conditions to select platform and sensor package. Develop or adapt, test, and disseminate survey methodologies and design across the state and in line with the rest of the nation so that data are comparable. Offer recommendations on data parameters to facilitate data sharing and comparison. Potential methods may vary with goals for survey (removal or census of debris).	
Debris Type: DFG	Location:
Duration: multiple years	Funding Status:
Estimated Cost: \$100s of thousands, at least	Funding Sources:
Lead Organization: NOAA	Partner Organizations: NASA, military, military

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	contractors
Significance of Expected Outcomes: Being able to detect debris at sea will allow completion of a census to get a baseline of open-ocean debris and determine what fraction makes it to Hawaii’s shores and reefs each year. If an economical, robust, simple system is developed, it could possible used in conjunction with open-water removal operations, which could prevent damage to nearshore resources.	

Action RA12. Characterize net debris	
Description: Gather samples of DFG of interest for at-sea detection; define the physical properties necessary for direct detection (e.g., size, color, surface area, reflectance, buoyancy); research fouling (and defouling) rates; empirically determine the relationship between DFG movement and oceanic forcing mechanisms (wind, currents, wave action).	
Debris Type: DFG (nets, lines, floats)	Location: NWHI, MHI
Duration: 1 year	Funding Status: partially funded (collection)
Estimated Cost: \$100K	Funding Sources: NOAA, NASA
Lead Organization: PIFSC	Partner Organizations: NASA, LM
Significance of Expected Outcomes: Information from this project will help with selecting sensors for at-sea detection and help make oceanographic models more applicable for modeling debris movement.	

Strategy 1.2: Develop effective systems for reporting marine debris accumulations

Action RA5. Increase mapping efforts utilizing GPS tracking, tagging, etc.	
Description: GPS tracking for debris locations – marking debris locations with a GPS recorder and then uploading the data to a website; tagging debris with GPS, flag, ID tag, etc. and then upload to a website that would map debris, track debris, and potentially removing debris through response. Liability of response issue; Have dive community involved and buy-in; FAD issue. Map in-water areas highly impacted by marine debris – include local knowledge with technology (e.g., GPS); continuation of mapping – long-term project (trends over time). - NOAA Fisheries ecosystem assessment information. - Mainly coordination of existing – inter-agency, etc.	
Debris Type: Ocean-based	Location: MHI
Duration: 16-18 months	Funding Status: Unfunded
Estimated Cost: startup \$100K – sustainable source of funding for long-term continuation of mapping	Funding Sources: Grant, government
Lead Organization: NOAA or ATI	Partner Organizations: Fishing industry, recreational fishermen, tow boat companies, divers (recreational and business), tracking device manufacturers (e.g., ATI), NOAA
Significance of Expected Outcomes: Increase awareness, prioritization, standardizations, cooperation	

Strategy 1.3: Develop capacity and coordination mechanisms for marine debris removal

Action RA6. Increase research on impacts including indicators and potential impact areas	
Description: 1. Determine species that can serve as indicators of ecosystem/human impacts 2. Survey these species every few years, tapping into existing research opportunities (e.g., lancetfish). 3. Increase research on potential impacts – e.g., tires, metal – toxicity?	
Debris Type: Land-based/Ocean-based	Location: Statewide
Duration: Long-term research (3-5 years min; 10 years)	Funding Status: Unfunded

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scientifically valid)	
Estimated Cost: \$200,000+	Funding Sources: Federal
Lead Organization: Universities/Academia	Partner Organizations: Government, industry, etc.
Significance of Expected Outcomes: Awareness of resources impacted; Show how removal and prevention efforts are working (or not); Better understanding of impacts; increased awareness of impacts; prioritization of research through best use of indicator items.	

Action RA7. Assess distribution and accumulation rates of derelict fishing gear in high-priority areas	
Description: Determine high-priority areas (sensitive species or habitats?); map baseline distribution of debris; undertake monitoring at an appropriate frequency; analyze data to determine accumulation rates. Publish findings.	
Debris Type: DFG	Location: TBD
Duration: multiple years, ongoing	Funding Status: partially funded (NWHI, MHI helicopter surveys, Midway beach)
Estimated Cost: \$100s of K, unless well integrated into other projects in same locations	Funding Sources: NOAA, DOI, Dow
Lead Organization: NOAA	Partner Organizations: DOI
Significance of Expected Outcomes: Understanding the scope of the problem can guide removal efforts and help in developing outreach messages, but can also aid in understanding oceanographic forcings on debris movement, which might ultimately lead to at-sea detection and removal.	

Action RA8. Assess distribution and accumulation rates of post-consumer plastic debris in high-priority areas	
Description: Determine high-priority areas (sensitive species or habitats?); map baseline distribution of debris; undertake monitoring at an appropriate frequency; analyze data to determine accumulation rates. Publish findings.	
Debris Type: Land/Ocean-based (non-DFG plastics)	Location: TBD
Duration: multiple years, ongoing	Funding Status: partially funded (Midway beach monitoring project)
Estimated Cost: \$100s of K, unless performed by motivated, well-trained volunteers or integrated into other projects in same locations	Funding Sources: EPA?
Lead Organization:	Partner Organizations: Ocean Conservancy, NOAA, Counties, HTA, NGOs
Significance of Expected Outcomes: Understanding the scope of the problem can guide prevention and removal efforts and help in developing outreach messages.	

Action RA9. Sample surface and subsurface waters for microplastic distribution in nearshore and convergence zone	
Description: Work with oceanographers to pinpoint subtropical convergence zone, develop or use approved protocol for sampling (start with plankton trawls), sample at various times of the year and day and across multiple ENSO cycles. Analyze and publish data.	
Debris Type: Land-based/Ocean-based	Location: nearshore and north of Oahu
Duration: multiple years, ongoing	Funding Status: unfunded
Estimated Cost: \$100s of K, unless well integrated into other projects in same locations	Funding Sources: NOAA
Lead Organization: NOAA	Partner Organizations: EPA, universities, fishermen?
Significance of Expected Outcomes:	

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Action RA14. Calculate cost of debris removal efforts for various projects, locations, and/or types of debris	
Description: Collect and analyze budget data to determine the cost of removal activities in accordance with current techniques utilized, with note made of the impact/benefit to natural resources of the activities. These data will be combined with economic data, when available, on impacts (both biological and economic) to determine return on investment of removal activities. As feasible, prevention activities will be similarly analyzed. Output: report with costs (\$ per ton, for instance) and precision for various removal activities.	
Debris Type: Land-based/Ocean-based	Location: Statewide
Duration: 3 months	Funding Status: Unfunded
Estimated Cost: \$10,000 (contract?)	Funding Sources: NOAA, State
Lead Organization: Consultant (contract with funding source)	Partner Organizations: All involved in marine debris activities in HI
Significance of Expected Outcomes: Having this information is a first step toward performing cost-benefit analysis to support management decisions.	

Action RA17. Create an online site or guidebook that will house newly standardized survey methodologies and SOPs	
Description: Edit and publish survey methodologies developed for beach monitoring, beach cleanups, in-water surveys, reef removal, open-water removal, etc. Forms and data management guidelines would be part of this collection. Publishing can be at the MDP website or a Hawaii-specific website. Additionally, a printed version may be appropriate in a small run.	
Debris Type: Ocean-based/Land-based	Location: nationwide
Duration: 6 months	Funding Status: unfunded
Estimated Cost: \$30,000	Funding Sources: NOAA, EPA
Lead Organization: NOAA	Partner Organizations: FWS, universities, OC, EPA
Significance of Expected Outcomes:	

Action IW1. Compile current knowledge, methods/techniques, information, and resources/expertise for in-water debris removal.	
Description: Given their more than ten years of experience, NOAA’s Coral Reef Ecosystem Division marine debris group has gathered significant knowledge, developed methods and techniques, and kept records on removing marine debris in water. This information should be captured and shared. Existing documents and video footage should be made into informational products, a guidebook, etc. Perform cost-benefit analysis (for reefs/seals) for various methods and protocols (this may be a separate action).	
Ideas include:	
<ul style="list-style-type: none"> • Using high entanglement risk zone data (e.g., Hawaiian monk seal/NWHI) • Link debris removal priorities with ecosystem management and living marine resources. 	
Debris Type: DFG	Location: Statewide
Duration: 12 months	Funding Status: Unfunded
Estimated Cost: \$15,000 or so (depending on if full-time staff support is needed)	Funding Sources: NOAA (PMNM? MDP?)
Lead Organization: NOAA PIFSC Coral Reef Ecosystem Division	Partner Organizations: NOAA PMNM, USCG
Significance of Expected Outcomes: By sharing information on techniques for removing debris in-water, research can be designed to improve the efficiency and safety and decreasing the environmental impacts of removal. In addition, it’s possible that these techniques can be adapted by those in other regions of the country or world.	

Action IW2. Create a standard operating procedure or workplan for high risk/priority marine debris response in water.
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Description: There is a need for a response plan for high risk/high priority marine debris situations, such as a derelict fishing net floating in waters offshore known to be frequented by endangered Hawaiian monk seals. This would include a comprehensive list of agency jurisdictions, resources, limitations, and contact information.	
Debris Type: Primarily Ocean-based, possibly Land-based	Location: MHI
Duration: 12-24 months	Funding Status: Unfunded
Estimated Cost: \$40,000 if done on contract	Funding Sources:
Lead Organization: NOAA or DLNR	Partner Organizations: NOAA, ACOE?, City/County Facilities and Maintenance, City/County Parks and Recreation, State Parks and Recreation, DLNR, NGOs, businesses
Significance of Expected Outcomes: Primarily this plan would help in protecting sensitive species and habitat from damage caused by in-water marine debris. It would also help prevent human health and safety issues (at-sea), along with navigational safety issues from high-risk marine debris. This plan would increase and strengthen the partnership and coordination/cooperation among various government agencies, NGOs, and businesses. The public calling in to report a high risk debris item will be happy knowing that they have done something to help the environment – awareness and a sense of responsibility will also be increased.	

Action IW3. Increase information and data sharing for marine debris survey and removal in Hawaii.

Description: Work with groups that undertake MD surveys and removal to determine how they currently archive, analyze, and share their data. Hold focus meetings with potential data users to determine their needs for shared information. If needed, develop a GIS-based online database/data ‘hub’ with metadata, forms, survey sheets, methodology, etc. Qualified individuals can enter their data, and anyone can access data from the site. Data such as location, time, and broad categories will have standardized minimum criteria. Other data, such as photographs and descriptive text, may be entered as well. Will also include contact information. Data quality ratings, such as Amateur, Researcher, etc. will be employed. Examples of similar databases include the Avian Knowledge Network, E-Bird, Clean Islands Council (sensitive habitat). Management responsibilities must be with a single organization. Partner with databases that already exist.	
Debris Type: Land-based/Ocean-based	Location: Statewide
Duration: Set-up and background Info. collection, existing databases: 12 month Ongoing	Funding Status: Unfunded
Estimated Cost: \$100,000	Funding Sources: Partners, NGO, Government
Lead Organization: Partner with existing database.	Partner Organizations: Government, users, Clean Islands Council (database on sensitive areas), USGS (has database), etc.
Significance of Expected Outcomes: Increase collaboration amongst partners and including shared information and data; Standardization of data collected; Share existing information – not reinvent the wheel; Capacity-building; Increase awareness and outreach; promote international collaboration.	

Goal 2 - Introduction of Solid Waste and Fishing Gear at Sea and Coastal Areas Decreased

Strategy 2.1: Conduct education and outreach to ocean users on ocean dumping laws and proper waste management

Action RA11. Research aspects of fishermen's behavior that lead to loss

Description: Work with fishermen (gillnetters, pot fishermen, possibly longliners) to survey what they perceive to

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be the source of derelict gear, what motivates them to dispose of gear at sea, and what they believe it would take to change their own or others’ behaviors that contribute to gear loss.	
Debris Type: DFG	Location: MHI, mostly Oahu
Duration: 2 years, including OMB review of survey	Funding Status: unfunded
Estimated Cost: \$60K	Funding Sources: NOAA, DLNR
Lead Organization: NOAA? DLNR?	Partner Organizations: HLA, WPFMC
Significance of Expected Outcomes: While it seems unlikely that simply interviewing fishermen about their illegal activities would yield useful information, there may be interesting outcomes in terms of what groups they feel are most likely to create derelict gear and why. This could lead to development of outreach campaigns or incentives.	

Strategy 2.2: Provide low-cost and convenient disposal options for gear and solid waste

Action RA13. Compile information on legal and logistical aspects of establishing an incentive program in Hawaii	
Description: Gather information on various types of incentive programs. Develop set of potential incentive types. Outline legal and logistical obstacles for each potential incentive program and path to overcome them, within the Hawaii legal and logistical framework. Conduct survey of ocean users (fishing industry, dive tourism industry, shipping industry) to determine interest in incentives for debris removal. Assess costs and ability of waste management system to absorb additional waste generated through incentive system.	
Debris Type: Ocean-based	Location: MHI
Duration: 1 year	Funding Status: Unfunded
Estimated Cost: \$25,000	Funding Sources: NOAA, USCG, industry, State
Lead Organization: Consulting firm, contracted to funder	Partner Organizations: Fishermen, boaters, ocean-users, private, industry, etc.
Significance of Expected Outcomes: Analysis of existing and proposed incentive programs would be an important step in assessing the feasibility, costs, and likely effectiveness of implementing such a program in Hawaii to aid in the prevention and removal of marine debris. If implemented, such an incentive program would engage ocean-users, industry, and others that might not be involved in marine debris activities without an incentive.	

Action IW5. Conduct feasibility studies of known ports/harbors across the state where nets are brought or collect and work to establish port reception programs at areas with a high likelihood for success	
Description: Pier 38 net recycling site is a success and bringing in tons of nets. However, for boaters that don’t use Pier 38, there is no convenient place to dispose responsibly of nets collected at sea. Survey potential sites for likelihood that boaters and community members using that harbor or boat ramp would retrieve nets and use a port reception facility. Survey for likelihood and level of use. Aspects of receptacle maintenance, and oversight would also need to be found for each potential site. Work with partners who are currently involved in Hawaii’s Nets to Energy program. Are the potential sites feasible? Would an expansion of this program adversely affect them? Willingness to continue services though program is expanding? Ability to handle additional debris? Work with harbor master (DOT Harbors Division) to get permission and permits for receptacle placement. Purchase the receptacles and implement project at sites where there would be a high likelihood for success. Outreach to target audiences and general public.	
Debris Type: Ocean-based (derelict fishing gear)	Location: MHI
Duration: 18-24 months	Funding Status: Unfunded
Estimated Cost: \$150K (receptacles + feasibility study)	Funding Sources: NOAA MDP?
Lead Organization:	Partner Organizations: Harbor and boat ramp management agency, fishing assn. County and States
Significance of Expected Outcomes: By removing the inconvenience or expense of disposing of DFG collected on the water, more boaters will be encouraged to remove debris; thus preventing harmful interactions with active fishing gear, boats, divers, marine wildlife, and habitat.	

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Action LB1. Replicate monofilament recovery and recycling project (e.g., U.S. southeast region) in Hawai‘i	
Description: Use NOAA Southeast region model (e.g., Florida and 12 NGOs) to create monofilament recycling project. Create a network of physical recycling sites (such as PVC tubes or 55-gallon drums). Targeted on recreational users and focusing on hot spots such as parks or boat ramps. Determine hot spots by working with those knowledgeable about recreational fishing. Enlist partners to maintain and take ownership of individual bins (e.g., service organizations like Boy Scouts). Work with BoatUS to get bins, or build them locally. Explore recycling versus waste-to-energy options for disposal.	
Debris Type: Derelict fishing gear (Ocean-based and Land-based)	Location: MHI
Duration: 1 year	Funding Status: Unfunded
Estimated Cost: very low	Funding Sources: NOAA MDP or through BoatUS
Lead Organization:	Partner Organizations: BoatUS, service organizations, UHSG, NOAA MPD and Fisheries
Significance of Expected Outcomes: While responsible fisherfolk can dispose of monofilament in garbage cans, establishing monofilament recovery and recycling bins at fishing areas and boat ramps will educate fishers about the impacts of monofilament and help keep monofilament out of the marine environment.	

Strategy 2.3: Increase use of fishing materials and practices designed to reduce impacts of marine debris

Action RA10. Research aspects of fishing gear that lead to loss	
Description: Work with fishermen (gillnetters, pot fishermen, recreational line fishermen, possibly longliners) to survey what they lose and why.	
Debris Type: DFG	Location: MHI
Duration: 2 years, including OMB review of survey	Funding Status: unfunded
Estimated Cost: \$60K	Funding Sources: NOAA, WPFMC, DLNR
Lead Organization: NOAA	Partner Organizations: WPFMC, DLNR, fishing clubs
Significance of Expected Outcomes: While it seems unlikely that simply interviewing fishermen is going to yield much—if they had great ideas on why they lose gear, wouldn’t they have fixed the issue?—there may be interesting outcomes in terms of what causes loss – bad weather, snagging on obstacles, interference with other fishing gear, etc. This could lead to development of gear modifications or best practices.	

Action IW4. Modify fishing gear to prevent loss, minimize ghostfishing impact	
Description: Using results of research on gear loss, modify gear components (cables, floats, hawsers, etc.) to prevent gear loss. Incorporate new technology (biodegradable, acoustic pingers that allow relocation, satellite tags, etc.) that make lost gear less lethal over time to minimize the impact of ghost nets.	
Debris Type: Ocean-based	Location: Worldwide
Duration: Ongoing	Funding Status: Unfunded
Estimated Cost: > \$200,000	Funding Sources: Government
Lead Organization: NOAA	Partner Organizations: Fishing groups, international fisheries, FMCs
Significance of Expected Outcomes: Reduce in-water debris and ghost fishing mortality and habitat destruction	

Strategy 2.4: Amend ocean dumping laws to prohibit disposal of solid waste resulting from operations at sea
 [No action write-ups yet]

Strategy 2.5: Build capacity to monitor and enforce ocean dumping laws
 [No action write-ups yet]

Goal 3 - Number of Abandoned and Derelict Vessels Decreased

[No action write-ups yet]

Strategy 3.1: Educate vessel owners on maintenance and maritime preparedness
Strategy 3.2: Develop capacity and coordination mechanisms for abandoned vessel removal
Strategy 3.3: Develop sustainable funding mechanisms and resources for vessel removal

Goal 4 - Land-based Debris in Waterways Reduced

Strategy 4.1: Conduct education and outreach targeted to specific audiences

Action LB6. Create and execute an anti-litter campaign that includes interpretive enforcement and a thorough, research-based outreach campaign as well as aids in the improvement of existing enforcement and systems	
<p>Description: Research study component: Gather information on existing mechanisms to enforce litter and dumping laws and reporting system. What works? What doesn't? Why? Examine personal property issues with littering; that is, if someone litters or dumps on private property, whose responsibility/right is it to clean it up? Will require working closely with Counties' Dept. of Environmental Services, law enforcement personnel, EPA, AG's Office, and Hawaii Environmental Enforcement Meeting (HEEM). Enforcement: Work with appropriate enforcement agencies to facilitate an increase enforcement of anti-litter and anti-dumping laws (uncovered trucks, littering, dumping) and perhaps require beach cleanups by littering offenders. Combine with outreach campaign that lets the public know that these laws are being enforced – interpretive enforcement. Additionally, based on study results, work with these agencies to improve the functionality and effectiveness of the public reporting system for land-based pollution sightings and illegal dumping. This may involve letting folks know about the existing systems (e.g., Environmental Concerns hotline, EPA webpage "Badge," opala.org online dumping reporting system) rather than creating a new system. Outreach campaign: Create and execute an outreach campaign (PR mainly) based upon the research study results and aimed at changing the behavior of offenders. Also include information on increased enforcement.</p>	
Debris Type: Land-based (all types)	Location: Oahu, to start – targeted areas already identified by HEEM.
Duration: 18-24 months	Funding Status: Partial state and federal funding, but insufficiently funded.
Estimated Cost: \$100K (coordinator/project manager, PR)	Funding Sources: County and State Govt., Federal funds. Fines
Lead Organization: State?	Partner Organizations: EPA, environmental watchdog NGOs (like EnviroWatch, WAA), DOH, HEEM agencies, HPD
<p>Significance of Expected Outcomes: In spite of existing laws, littering and dumping continue to occur. Increased enforcement will send a message to potential violators that there are consequences to their actions. In addition, having a functional and effective reporting system will encourage non-violators to take a stake in the environment. Fines recovered can support continued enforcement. The end result will be less land-based debris making it into the marine environment.</p>	

Action OE1. Create, share, and train partners in the use of outreach resources, including "soundbite science," key messages, and a media strategy	
<p>Description: Misinformation and half-truths abound in the field of marine debris. The goal of this action is to ensure that Hawaii's public outreach and media strategy is based on the best available science regarding marine debris. Build from the facts and talking points developed by the NOAA Marine Debris Program to incorporate other</p>	

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agencies’ and organizations’ findings. Periodically update the list, and share these talking points with one another. Share media, outreach planning, and related trainings with all marine debris-related outreach personnel, as allowed. Conduct periodic trainings or information sessions for staff of agencies and organizations to update them on the state of the knowledge.	
Debris Type: Land-based, Ocean-based	Location: Main Hawaiian Islands
Duration: 2009-ongoing	Funding Status: unfunded
Estimated Cost: \$25K per year, on average	Funding Sources: NOAA, EPA
Lead Organization: NOAA Marine Debris Program	Partner Organizations: NOAA PSC
Significance of expected outcomes: By basing outreach products and interviews with media on the best available science, we will build a strong message. A facts-based approach will also be more welcome in classroom settings.	

Action OE6. Develop signage on impacts of marine debris at public shorelines, marinas, piers, boat ramps, beach parks, storm drains, etc.	
Description: Littering on public beaches and marine facilities is a land based source of marine debris. Ocean recreational users leave behind plastic bottles, fishing line, beach toys, cigarette butts, and a variety of non-biodegradable trash that is washed into the marine environment with changing tides. Increased public awareness of the ecological, economic, and social impacts of littering on public beaches and marine facilities is needed through the development of a consistent and concise message that can be posted in high use areas.	
Debris Type: Land-based, Ocean-based	Location: State-wide, specific locations
Duration:	Funding Status: unfunded
Estimated Cost: ?	Funding Sources:
Lead Organization: ?	Partner Organizations:
Significance of expected outcomes: Reduced sources of marine debris from public recreational and marine facilities through increased awareness of ecological impacts	

Action OE7. Conduct social marketing campaign to keep Waikiki free of debris	
Description: Work with hotels, recreational tour operators, etc. based in or operating out of Waikiki; need compelling visuals (e.g., Susan Middleton photos); target images and messages on debris types tied to tourist activities (may need research), See also OE04; Steps: bring together industry and agency personnel to find opportunities and willingness to implement tools and strategies; identify champion industry partners; map out strategies, develop tools and strategies working with industry; Integrate MD messages into hotel daycare activities	
Debris Type: Land-based; food/beverage and recreational items	Location: Waikiki
Duration: ongoing	Funding Status: partially funded
Estimated Cost: \$40,000	Funding Sources: industry for matching funds
Lead Organization: UH Sea Grant (in with Center of Excellence in Sustainable Tourism)	Partner Organizations: Waikiki Improvement Association; HTA; restaurant and hotel association; Chamber of Commerce; businesses based in or operating out of Waikiki (including recreation operators)
Significance of Expected Outcomes: The fact that Waikiki is flagship destination for tourism industry and gateway to Oahu makes it the ideal place to get messages to tourists. While message is received in Waikiki, impact is island-wide. Reduce amount of land-sourced debris.	

Strategy 4.2: Improve effectiveness of stormwater permitting system
[No action write-ups yet]

Strategy 4.3: Establish Total Maximum Daily Load for trash for priority watersheds

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Action RA4. Conduct research to quantify inputs to marine environment from streams and beaches	
Description: Within high-priority watersheds, install in streams or canals booms or catchments that can withstand floodwaters; remove at regular intervals and weigh debris. Do mark and recapture litter surveys of items on land to see if/how quickly they make it into the streams. Do mark and recapture litter surveys on high-priority beaches not subject to cleanups to see how long litter items stay on the beach (assumption is that ones that disappear are entering the ocean).	
Debris Type: Land-based	Location: Oahu to start
Duration: 2-3 years	Funding Status: Unfunded
Estimated Cost: \$150,000 (mostly for installation and maintenance of debris catchment structures)	Funding Sources: EPA
Lead Organization: USEPA or City and County	Partner Organizations: USEPA, City and County, NGO
Significance of Expected Outcomes: Results of this action can direct efforts toward (or away from) land-based debris prevention efforts.	

Strategy 4.4: Build capacity to enforce water quality permits and laws

Action LB3. Examine and define legal/institutional framework for State of Hawaii	
Description: Access, jurisdiction, and enforcement are important topics in addressing land-based debris. <ul style="list-style-type: none"> • Access: ownership and access of nearshore waters, stream and instream access • Jurisdiction: who (landowner, agency) is responsible for public areas (upper watershed canals...) • Enforcement: who is responsible for enforcing illegal dumping and trash in specific areas; on private property, streambanks, nearshore waters... 	
Debris Type: Land-based	Location: MHI
Duration: 6-8 months	Funding Status: Unfunded
Estimated Cost: Could be a law student externship	Funding Sources: Law school, hosting agency
Lead Organization: USEPA, State AG Office	Partner Organizations: Federal, state, county agencies
Significance of Expected Outcomes: Information will provide governments and communities info needed to decrease trash and dumping by knowing, by area, jurisdiction for possible enforcement. Reduce repeat dumping by education or enforcement. Also, watershed and other organizations doing stream cleanup could utilize the information for permissible access/liability issues.	

Strategy 4.5: Employ structural controls and BMPs to prevent land-based debris from entering the ocean

Action LB2. Review permitted municipal stormwater facilities to ensure implementation of management measures to prevent and reduce marine debris, such as maintenance of storm drains and use of BMPs such as storm drain filters	
Description: Review municipal storm water permits for implementation of management measures that prevent and reduce marine debris. This would include maintenance of storm drains, storm drain filters, litter catchments, etc. (NPDES permits, EPA permits regulated by DOH)	
Debris Type: Land-based	Location: MHI
Duration: Ongoing	Funding Status: Unfunded
Estimated Cost: \$	Funding Sources: Funded by permittee
Lead Organization:	Partner Organizations: County, State, EPA
Significance of Expected Outcomes: As part of the MS4 management plan the permittee will implement BMP's to capture, remove and recycle land-based pollution before it reaches canals and nearshore waters. This would lead	

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to an overall reduction of land-based debris entering the marine environment, as well as raise awareness of marine debris in the permittee.

Strategy 4.6: Increase coordination and targeted cleanups in watersheds and on beaches

Action RA1. Standardize beach debris monitoring methodology, including data parameters used in data collection	
Description: Develop or adapt, test, and disseminate marine debris survey methodologies and design across the state and in line with the rest of the nation so that data are comparable. Offer recommendations on data parameters to facilitate data sharing and comparison. Potential methods may vary with objectives: three possibilities are precise quantification of amount or accumulation of debris, education, and awareness-raising.	
Debris Type: Land and Ocean-based	Location: Statewide
Duration: 2-3 years	Funding Status: Unfunded
Estimated Cost: \$100K	Funding Sources: NOAA, EPA, State, Industry
Lead Organization: University researcher, NOAA, or EPA	Partner Organizations: All MD partners in the state
Significance of Expected Outcomes: Standardized data collection has been a recommendation of every international marine debris conference. With significant quantities of beach debris and numerous monitoring activities underway or completed, Hawaii could lead the nation. If data collection were standardized in methodology, implementation, and dissemination of data, more information would be comparable. This would lead to an increased breadth of information and data available for a particular research interest, and better understanding of the overall results. This may lead to more comprehensive management decisions, activities, and practices to address marine debris.	
Action BC1. Create a standard operating procedure or workplan for emergency cleanups	
Description: It is known that there is an increase in the amount of marine debris that will wash ashore during high storm events and natural disasters. To date, Hawaii has no marine debris response plan to address this type of debris. Ideas include: 1. Have a trained “weather crew” for beach cleanups during weather events.	
Debris Type: Land-based and Ocean based	Location: MHI
Duration: 1 year	Funding Status: Unfunded
Estimated Cost: \$100,000	Funding Sources: State
Lead Organization:	Partner Organizations: City/County Facilities and Maintenance City/County Parks and Recreation State Parks and Recreation NGOs NOAA MDP and PIFSC
Significance of Expected Outcomes: Hawaii would be better prepared for recovery after a natural disaster and in emergency situations. Additionally, Hawaii would be able to respond more quickly and possibly prevent additional damage from deposited debris.	
Action BC2. Create a standard operating procedure or workplan for high risk/priority marine debris response	
Description: There is a need for a response plan for high risk/high priority marine debris situations, such as a derelict fishing net floating in waters offshore known to be frequented by endangered Hawaiian monk seals. This would include a comprehensive list of agency jurisdictions, resources, limitations, and contact information.	
Debris Type: primarily Ocean-based, possibly Land-based	Location: MHI
Duration: 1-2 years	Funding Status: Unfunded
Estimated Cost: \$	Funding Sources:
Lead Organization: NOAA or DLNR	Partner Organizations: NOAA, ACOE?

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	City/County Facilities and Maintenance City/County Parks and Recreation State Parks and Recreation DLNR NGOs, businesses
<p>Significance of Expected Outcomes: Primarily this plan would help in protecting sensitive species and habitat from damage caused by marine debris. It would also help prevent human health and safety issues, along with navigational safety issues from high-risk marine debris. This plan would increase and strengthen the partnership and coordination/cooperation among various government agencies, NGOs, and businesses. The public calling in to report a high risk debris item will be happy knowing that they have done something to help the environment – awareness and a sense of responsibility will also be increased.</p>	

<p>Action BC3. Support and increase participation for International Coastal Cleanup (ICC) Day in Hawaii (Get the Drift and Bag It!)</p>	
<p>Description: Include media for event sponsors, provide incentives for volunteers, and increase dive club participation. Increase visibility and participation of International Coastal Cleanup Day (“Get the Drift and Bag It”) and sponsorship. Increase collaboration between partners and with ICC coordinators.</p>	
Debris Type: Land-based and Ocean-based	Location: MHI
Duration: 1 year	Funding Status: Unfunded
Estimated Cost: \$25,000 (media, materials)	Funding Sources:
Lead Organization: Ocean Conservancy, C. Woolaway and Associates	Partner Organizations: Fed, State, City, NGOs, industry, businesses, etc.
<p>Significance of Expected Outcomes: Awareness of marine debris would increase through increase in visibility of ICC.</p>	

<p>Action BC4. Increase communication and collaboration amongst volunteer programs addressing marine debris through the use of a centralized information portal (e.g., website (see OE4))</p>	
<p>Description: There are several successful programs across the state that help address marine debris. Many of them are not known by the general public, and thus when new volunteers want to help out and participate, many do not know where to go. If we increase communication and collaboration between these groups, as well as assist in getting the collective word out, the outreach and scope of many of our existing programs (e.g., Adopt-A-Stream, Beach, Highway, etc. programs), including participation in preventing marine debris in the MHI would also increase. This could be done by 1) identifying all of the groups and programs involved in volunteer beach cleanups, 2) creating a comprehensive contact list, 3) including a calendar of events or contact list on a centralized marine debris in Hawaii website.</p>	
Debris Type: Land-based and Ocean-based	Location: MHI
Duration: 1 year	Funding Status: Unfunded
Estimated Cost: \$25K (provide some resources (e.g., garbage bags, gloves) to groups + internship stipend for college student to do the research and legwork)	Funding Sources:
Lead Organization: State Parks and Recreation County Parks and Recreation	Partner Organizations: County Environmental Services, EPA
<p>Significance of Expected Outcomes: This would establish long-term relationships with various community groups or members of the public to volunteer and help our environment. It would also aid the public who are interested in volunteering their time to help remove marine debris. This would hopefully lead to greater participation, a more unified appearance for our state, and increased awareness of marine debris in Hawaii.</p>	

<p>Action BC5. Make information on threats to ecosystem management/NOAA trust resources available to beach cleanup coordinators and educate them on the importance of targeting cleanups to areas of greatest impact</p>	
<p>Description: First step shelter in Kaka‘ako and homeless groups participate in beach clean-up efforts.</p>	

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Debris Type: Land-based	Location: MHI
Duration: indefinite	Funding Status: Unfunded but low cost (bags)
Estimated Cost: ?	Funding Sources: County, State, NGO
Lead Organization: Shelters in conjunction with County Parks	Partner Organizations: Parks
Significance of Expected Outcomes: Education, reduce Land-based debris	

Strategy 4.7: Decrease use of potential debris items

Action LB5. Work to create and pass legislation to establish incentive for non-use of plastic bags and disincentives for continued use through policy reforms based on a thorough review of successful legislation in other states	
Description: Work with NGOs and supportive legislators to craft legislation that would result in the decreased use of plastic bags statewide.	
Legislation ideas for decreasing use of plastic bags, especially “t-shirt” bags (thin plastic bags), include the following:	
<ul style="list-style-type: none"> • Discount for taking own bags or bringing in plastic bags. • Plastics surcharge for thin plastic bags. • Ban thin plastic bags. • Establish incentive for use of re-usable bags. 	
Debris Type: Land-based, thin plastic bags	Location: MHI
Duration: 24-48 months	Funding Status: Unfunded
Estimated Cost: \$150K (campaign coordinator + PR)	Funding Sources:
Lead Organization: NGO (e.g., Sierra Club Hawaii Chapter)	Partner Organizations: NGOs, Community groups
Significance of Expected Outcomes: By decreasing the number of thin plastic bags in the system, we will see fewer making it into the ocean.	

Strategy 4.8: Improve solid waste management

Action LB7. Work with communities and governmental agencies to help ensure ample or more appropriate receptacles at access sites (e.g., beaches), including recycling receptacles through purchase and placement of receptacles and corresponding media/outreach campaign and that includes community-based cleanups	
Description: Sometimes people litter because garbage cans are overflowing and they put their trash beside the receptacle. Or an overflowing receptacle looks trashy, so people may feel it’s OK to litter. This project would require working with city and county parks, neighborhood boards, hotels to ensure sufficient receptacles exist on beaches, at boat launches, other areas that could be a source of litter and marine debris. In addition, could use public awareness art on the trash cans. Similar to “cows in Chicago” or “artistic painting for fishing boats in Maine.” Or simply put an anti-littering message (instead of individually painted cans). Adopt-a-Can program?	
<ol style="list-style-type: none"> 1. Community-based cleanups + associated outreach to groups, schools, etc. 2. Placement of new receptacles 3. Media/outreach 	
Debris Type: Land-based, especially food and beverage-related, recreational goods (toys, snorkels, etc) smoking materials	Location: MHI, starting on Oahu
Duration: Ongoing	Funding Status: Unfunded
Estimated Cost: Staff time and cost of receptacles, assuming counties can pick up full containers with the needed frequency	Funding Sources: Counties, hotels, HTA, State
Lead Organization: Community groups	Partner Organizations: NGOs, Community groups,

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	neighborhood boards, State, Federal, County government
Significance of Expected Outcomes: With responsible disposal options available and convenient, people will be less likely to litter. As a result, there will be less marine debris.	

Crosscutting Actions

Action RA15. Increase networking of marine debris researchers through conferences and workshops	
Description: Hold symposia at local scientific conferences; host international marine debris conference; hold research workshops to discover data, brainstorm research ideas, learn about funding opportunities.	
Debris Type: Ocean-based/Land-based	Location: Statewide and beyond
Duration: Ongoing, with big push for 2009-2010	Funding Status: Unfunded
Estimated Cost: \$20,000 to \$500,000 (for large conferences)	Funding Sources: NOAA, DOI, USEPA
Lead Organization: NOAA MDP	Partner Organizations: UH, HPU, other universities, UH SG, USFWS, USEPA
Significance of Expected Outcomes: By reducing duplicative research and sharing information, limited funding sources can be directed to the most-needed areas.	

Action RA16. Synthesize and analyze findings and data that already exist for Hawaii	
Description: Hire or find someone to discover data and share with marine debris researchers. Collect marine debris data collected by agencies (e.g., NOAA monk seal and humpback whale entanglement, sea turtle ingestion and entanglement, accumulation rates; FWS seabird ingestion, shoreline accumulation; State seabird, turtle, and marine mammal data; City and County land-based debris removal from canals and streams) and other organizations. Undertake analysis or share findings with researchers who could analyze data.	
Debris Type: Ocean-based/Land-based	Location: NWHI, MHI
Duration: 1-1.5 year	Funding Status: unfunded
Estimated Cost: \$70K	Funding Sources: NOAA
Lead Organization: Consultant? NOAA? Could be a variety of efforts within agencies.	Partner Organizations: various NOAA offices, FWS, State DLNR/DOH, Ocean Conservancy, EPA, CCH Stormwater program
Significance of Expected Outcomes: Aside from the benefits of the findings of analysis, this activity will save significant resources by preventing duplicative efforts to gather data. Tremendous time and cost savings could be attained by using data already collected through non-MD programs.	

Action LB4. Create and update on a regular basis database(s) for implementation and coordination of HI-MDAP efforts	
Description: Create database(s) that consolidate and have in one place: <ul style="list-style-type: none"> • Scientific studies (completed and ongoing) data, names of investigators • Watershed organizations and other informal watershed groups • Other community groups database – NGOs, schools, scouts, churches, etc. • Other strategic plans/projects – focus on identifying targeted (mutually beneficial/potential success) areas and gaps 	
Debris Type: Land-based	Location: MHI
Duration: Ongoing	Funding Status: Unfunded
Estimated Cost: \$30,000 for part-time coordinator, database entry	Funding Sources: Federal, state funding
Lead Organization:	Partner Organizations: Watershed group
Significance of Expected Outcomes: Higher level of success if concentrated in targeted areas to leverage funds and other work for success. Potential for using info for “gap analysis” to target missing projects.	

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Action OE2. Undertake baseline surveys on attitudes of different user groups on marine debris (recreational fishers, commercial fishers, boaters, tourists, beachgoers, etc.)	
Description: In order to measure the effectiveness of outreach, a baseline level of value and attitudes must be understood. Steps: Develop survey, test survey, administer survey, evaluate results.	
Debris Type: Land-based and Ocean-based	Location: Main Hawaiian Islands
Duration: 2010	Funding Status: unfunded
Estimated Cost: \$40K	Funding Sources: Grants?
Lead Organization:	Partner Organizations:
Significance of expected outcomes: Better outreach can be designed if we understand the attitudes and values of the various audiences.	

Action OE3. Compile and maintain a list of both outreach and educational opportunities for marine debris information to be shared. Again, include both typical and novel opportunities	
Description: Each year there are numerous opportunities for outreach, however a comprehensive list of these events and opportunities does not exist with any entity. Instead, each organization participates in events that it has either worked in the past, or finds out about opportunistically during the year. A comprehensive list and calendar of this sort would not only be helpful for outreach related to marine debris, but for any organization involved in marine conservation. This product should be available to all on a centralized “hub” that everyone is able to access and add to.	
Debris Type: Land-based and Ocean-based	Location: Main Hawaiian Islands
Duration: 2009-	Funding Status: unfunded
Estimated Cost: \$0	Funding Sources: --
Lead Organization: Coral Reef Outreach Network?, OCEANIA NMEA Chapter?	Partner Organizations: Marine conservation organizations involved in outreach
Significance of expected outcomes: A comprehensive list and calendar of outreach opportunities could help increase outreach not only on marine debris, by allowing for more strategic participation in events, but also a more cohesive, collaborative, and thorough approach to outreach involving the entire marine conservation community. This comprehensive approach would help all entities strategize their participation to maximize the effectiveness of outreach efforts. Overall, by working together and collaborating on participation in outreach opportunities, we will be more effective in raising awareness of the problem of marine debris and the importance of our oceans and hopefully promote a conservation and stewardship ethic in a greater number of people than are currently being reached.	

Action OE4. Maintain a “hub” (e.g., webpage) for accurate informational resources and key messaging on marine debris (e.g., NOAA MDP Educational Resources webpage)	
Description: The NOAA Marine Debris Program, like several other organization sites, maintains a webpage that lists educational resources available on marine debris from other organizations. Through communication and collaboration with various partners this site could be updated and maintained as the main site for anyone looking for information on marine debris in Hawaii and the nation. NOAA Marine Debris Program webpage: http://marinedebris.noaa.gov/marinedebris101/resources_edu.html . Marine debris has been a “hot topic” in the media and with the public for a while, however much of the information being circulated is of questionable origin. Many organizations and agencies within Hawaii are working on activities to address marine debris in the state, and have good, factual information on marine debris. There needs to be a cohesive and accurate set of key/core marine debris messages distributed by organizations across Hawaii for the most effective outreach. This collaboration could be conducted through regular communication between the core group of participants with regular (e.g., quarterly) meetings.	
Debris Type: Land-based debris and Ocean-based	Location: Statewide
Duration: 2009-	Funding Status: funded
Estimated Cost: \$?	Funding Sources: NOAA MDP
Lead Organization: NOAA Marine Debris Program	Partner Organizations: Organizations involved in marine debris

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Significance of expected outcomes: Collaboration among partners to build a comprehensive site that contains all known resources available on marine debris would be an immense help to educators, teachers, students, and interested public. Having such a site would also help to highlight the great work that has been done by other organizations and serve as a portal to their respective websites. Overall, a site like this would help in raising awareness of the problem of marine debris and the importance of our oceans and hopefully promote a conservation and stewardship ethic.

Action OE5. Incorporate marine debris message into existing venues, projects, partnerships (e.g., Mokupapapa Discovery Center, Disney/Little Mermaid)

Description: Collaborate with partners to find ways that marine debris can be incorporated into existing venues (e.g., Bishop Museum), projects, and partnerships. Marine debris impacts such a wide array of areas within the umbrella of marine conservation that it is typically a natural fit into any messaging. This could be done through increased and ongoing communication with partners, and perhaps as a part of regular meetings.

Debris Type: Land-based and Ocean-based	Location: Statewide
Duration: 2009-	Funding Status: unfunded
Estimated Cost: \$0	Funding Sources: --
Lead Organization: ?	Partner Organizations: Organizations involved in marine debris

Significance of expected outcomes: Leveraging existing opportunities and venues would increase the number of people reached, as well as overall, be an effective outreach tool. Key messages on marine debris incorporated into other projects and venues may help to increase their effectiveness, as well as create a more well-rounded marine conservation message. Overall, it would help in raising awareness of the problem of marine debris and the importance of our oceans and hopefully promote a conservation and stewardship ethic.

Action OE8. Provide assistance for legal research and compilation of information into one place to assist in marine debris–related activities

Description: Assistance in legal information related to all aspects of marine debris activities (e.g., photo release, liability, insurance, etc.). Start with a small “test-pool” of teachers to utilize this new tool. Student survey of knowledge and awareness. Survey principals on how often they reject teacher requests for beach cleanup field trips due to liability.

Debris Type: Land-based	Location: Main Hawaiian Islands
Duration: 6 mos. – 1 yr.	Funding Status: unfunded
Estimated Cost: \$5	Funding Sources: In kind, grants
Lead Organization: ?	Partner Organizations: Kamehameha Schools, UH Law School, DOE, govt. agencies, Kokua Foundation, HASTA,

Significance of Expected Outcomes: Facilitate teachers/educators to safely conduct marine debris activities with minimal worry of legal aspects or ramifications. Increase in awareness of students about marine debris due to an increase in opportunity for them to have hands-on interaction and experience in marine debris.

Action OE9. Creation of a toolbox of interdisciplinary marine debris resources and materials

Description: Creation of a toolbox of interdisciplinary marine debris activities suited for or specific to the issue in Hawaii. To do this, a comprehensive search would need to be done of resources and materials available, including existing curriculum and activities. To ensure the best possible information is disseminated through this toolbox, a review team should be formed to ensure that all materials and resources contain good, factual, accurate information on marine debris. This toolkit should be produced on a DVD and available via a website (e.g., NOAA Marine Debris Program) and made available to formal and non-formal educators through connections with partners (e.g., OCEANIA, HSTA, etc.)

Debris Type: Land-based, Ocean-based	Location: Statewide
Duration: ?	Funding Status: unfunded

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Estimated Cost: \$30K	Funding Sources: ?
Lead Organization: ?	Partner Organizations: Barb Mayer, C-MORE, State, County, Feds
Significance of Expected Outcomes: This would assist formal and non-formal educators in providing a “one stop shop” toolkit for teaching marine debris. Having this product would greatly facilitate education and outreach on marine debris thereby leading to increased awareness.	