DISCUSSION DRAFT

Elements of a Honolulu Strategy: a global platform for the prevention, reduction, and management of marine debris

DISCUSSION DRAFT

This document sets forth a broad variety of strategies and actions that might be taken at the global, regional, national, and local level to combat the issues of marine debris. Discussions during the course of the 5IMDC will be aimed at eliciting priority areas for actions and areas for concrete commitments that would most effectively address this issue. Following the conference, the paper will be modified to reflect the priorities and areas for action identified by the Conference Participants.

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Marine debris comprises any manufactured or processed solid material that finds its way into the marine and coastal environment irrespective of its size, including materials discarded into the sea or on beaches; brought indirectly to the sea by rivers, sewage, storm water, or winds; accidently lost or deliberately discarded at sea; or deliberately left by people on beaches and shores.

While some marine debris settles to the bottom of the sea where it can damage or contaminate critical benthic habitat, the remainder floats or is suspended in the water column. This debris has many impacts including detriments to wildlife and other marine biota, threats to navigational safety, and washing ashore on beaches, mudflats, and other coastal habitats. It is a global issue seriously affecting coastal lagoons, estuaries, ports and harbors, bays, seas, and the open ocean.

I. INTRODUCTION

Goals of the Honolulu Strategy

The overarching goal of the ***Honolulu Strategy*** is to prevent, reduce, and abate the ecological, human health, and economic impacts of marine debris worldwide. In this context, the Honolulu Strategy outlines a comprehensive platform aimed at halting and reversing the accumulation of man-made debris in the coastal and marine environment by 2030.

This overarching goal will be accomplished through the sustained pursuit of strategic activities and the coordinated implementation of recommended actions addressing the following themes:

a. Prevention, reduction, and management of land-based sources of marine debris

Human activities in both inland and coastal areas contribute to the accumulation of marine debris along beaches and into local waterways that carry these wastes to the ocean.

b. Prevention, reduction, and management of at-sea sources of marine debris

Human activities including maritime transportation, commercial and recreational fishing, solid waste management, and natural gas, petroleum, and mineral exploitation can contribute to the creation of marine debris.

c. Removal and processing of accumulated marine debris

Despite efforts to minimize land-based and at-sea sources of debris, an existing backlog of marine debris has accumulated and persists in the ocean and along waterways and coastal areas. Additionally, prevention efforts will not be immediately and completely successful, so the removal of marine debris must continue. Accumulated marine debris poses direct threats to marine resources and habitats, threatened and endangered species, human health and safety, and livelihoods.

The ***Honolulu Strategy*** provides a global platform that:

a. Facilitates the process of inclusion of marine debris management into an integrated solid waste management approach;

b. Facilitates the integration of a life cycle approach into production and consumption practices and policies to reduce waste while at the same time maximizing the economic performance of a product;

c. Promotes collaboration regarding ongoing marine debris research, monitoring and assessment to provide scientific validation for strategies and actions;

d. Promotes education, outreach and advocacy efforts for marine debris issues and solutions that will catalyze behavioral and regulatory changes and promote accountability;

e. Facilitates the sharing of information and lessons learned within the network, including good models for best management practices (e.g., waste management in the Rotterdam harbor); and

f. Ensures that research, monitoring, legislation, policy, and governance are woven throughout the entire structure of the global platform to comprehensively address marine debris.

The Honolulu Strategy is a platform document. It does not supplant or supersede the activities of national authorities, municipalities, industry, international organizations, or other stakeholders; rather it provides a focal point for improved collaboration and coordination among the multitude of stakeholders across the globe concerned with the prevention, reduction, and management of marine debris. Its successful implementation will require participation and support on multiple levels – global, regional, national, and local – involving the full spectrum of government and intergovernmental organizations, NGOs, business and industry groups, and civil society.

II. WHY WE NEED THE HONOLULU STRATEGY

Many countries have taken steps at the national and sub-national level to address the marine debris problem through various means, including:

- legislation and enforcement of regional and international agreements through national regulations;
- provision of appropriate reception facilities for ship-generated wastes (including abandoned, lost, or discarded fishing gear and nets);
- cooperative action within the fishing sector to prevent the abandonment and discarding of old fishing gear;
- improvements in solid waste management practices and product development; and
- education and public awareness programs using new social media tools to shift human use patterns and increase understanding of impacts on marine and human health.

Similarly, there are several multilateral legal instruments, codes, and programs that seek to prevent or limit marine debris. Examples include:

- *The International Convention for the Prevention of Marine Pollution from Ships* (MARPOL 73/78) and its *Annex V* (which prohibits the at-sea disposal of plastics and garbage from ships);
- *The 1972 Convention for the Prevention of Marine Pollution by Dumping of Wastes and other Matter and 1996 Protocol* (London Convention);
- *The 1992 Convention on the Trans-boundary Movements of Hazardous Wastes and Their Disposal* (Basel Convention).
- *The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities* (GPA);
- *The FAO Code of Conduct for Responsible Fisheries;* and
- The respective *Regional Seas Conventions, Protocols,* and *Action Plans.*

However, despite decades of effort and substantial investments, there is evidence that the problem of marine debris is persistent and continues to grow – especially as human populations and consumption of disposable consumer goods continue to increase. Most current solid waste management practices are inadequate in preventing or reducing marine debris and require changes to regulatory and enforcement

regimes as well as non-regulatory incentives. Better leadership and coordination of mandates and resources are required at both national and international levels to better address the global marine debris problem (NRC, 2008).

The persistence of the marine debris problem results from a lack of coordinated global, regional, national, and local strategies and from deficiencies in the implementation and enforcement of existing international, regional, and particularly national programs, regulations, and standards.

The Honolulu Strategy reflects the need to address a critical need to expand our global knowledge base on marine debris sources and impacts, increase collaborative efforts on national, regional, and international levels, and foster the introduction and implementation of key strategies and actions for solutions. The Strategy will become a platform for aligning national, corporate, or citizen-based actions as well as bilateral, multinational, and global collaborations for marine debris prevention, reduction, and management.

Ongoing international efforts

Concurrent with the development of the Honolulu Strategy, there are efforts underway on the revision of MARPOL Annex V by the International Maritime Organization (IMO) and its members. The preliminary revisions include significant changes to permitted discharges for most of the wastes generated from ship operations and fishing activities.

The United Nations Environment Programme (UNEP) Division of Technology Industry and Economics-International Environmental Technology Centre (DTIE-IETC) is developing the framework for the Global Partnership on Waste Management, which includes a thematic focus on marine debris.

The UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) Global Marine Litter Initiative and Regional Seas conventions provide an important regional framework to further activities proposed in the Strategy.

The European Commission is developing methods to assess the scope of the marine debris problem through the Marine Strategy Framework Directive (Galgani *et al.,* 2010), which includes an obligation for Member States to achieve ‘good environmental status’ for 11 descriptors by 2020, one of which is marine debris.

In the US, the 2006 Marine Debris Research, Prevention, and Reduction Act is up for reauthorization, which will clarify NOAA’s marine debris efforts to address more research issues and pursue international partnerships. These activities all provide a strong base of support for future marine debris efforts.

What is the status of marine debris?

Marine debris is a complex cultural and multi-sectoral problem that carries significant implications for the world’s marine and coastal environments and human activities. It results in tremendous environmental and economic costs around the globe. The problems caused by marine debris are multifaceted and are essentially rooted in poor or inadequate solid waste management practices; unsustainable product design and consumer choices; accidental loss or intentional discard of fishing gear or ship-generated debris; a lack of infrastructure; indiscriminate human activities; and the public’s poor understanding of the potential consequences of their actions. Quantifiable targets for the reduction of marine debris are needed and must be based on scientific assessments of impacts. The verification of the reduction will depend on a scientifically sound assessment of the time trends of debris present and discharged into the marine environment.

SCALE

Reliable information on the amount, spatial distribution, and seasonal variation of marine debris on a global scale is limited; however, there are several regional and national efforts to assess beach debris, floating debris, and seabed accumulations using a variety of protocols and activities. The use of differing methodologies to collect and measure marine debris does not permit valid global comparisons of the reported data or a systematic analysis of status and trends.

Informal marine debris counts have been produced in the annual International Coastal Cleanup (ICC) (www.oceanconservancy.org/ICC), a volunteer effort coordinated by the Ocean Conservancy, headquartered in Washington, DC, since 1986 (in the US) and 1989 (internationally) based on surveys conducted in over 100 countries. In 2009, approximately 6.8 million pounds of debris were collected in 104 countries participating in the annual ICC event. Another global effort is managed by Clean Up the World, headquartered in Australia, (http://activities.cleanuptheworld.org/), which promotes community cleanup projects in 130 countries since 1993. These activities provide a snapshot of the types of debris in a variety of areas and are successful education and outreach tools for engaging civil society and other stakeholders in the marine debris issue.

There are many examples of regional programs that measure the amount of marine debris found on beaches such as the *Coastwatch* Estonia, which in their 1999-2006 summary reported an average of 20 kg per 500 m of shoreline. To date, beaches in the OSPAR study report an average of 712 marine debris items per 100 m. In the Northwest Pacific Region marine debris monitoring activities were conducted in Japan, Russia, the Republic of Korea, and China as part of a regional Northwest Pacific Action Plan (NOWPAP) marine litter initiative. In 2009 an average of 9.1 kg per 100 m^2 was reported in Japan, 69.8 kg per 100 m^2 in China, 94.6 kg per 100 m^2 in Korea, and 31.5 kg per 100 m^2 in Russia (http://dinrac.nowpap.org/index.htm)., The National Marine Debris Monitoring Program assessed marine debris accumulations along the coastline of the US. In this five-year study (2001-2006) it was reported that an average of 95.4 $\pm$ 28.6 (SE) indicator items were removed during each survey. Survey tracks were 500 m in length, with no significant change in debris monitored (Sheavly, 2008).

Efforts to assess marine debris at sea have also been conducted. For example, vessel-based line transect surveys were conducted to study levels of marine debris pollution in the Ukrainian portion of the Kerch Strait and within the entire 12 nm-wide territorial waters of Ukraine in the Black Sea. Approximately 600,000 m^3 of litter was found on the seafloor of the North Sea (OSPAR, 1995). The density of floating plastic marine debris was estimated at 6.6 and 65.7 pieces per km^2 in the Ukrainian Black Sea and Kerch Strait, respectively (UNEP, 2009). Data were recently published from a 22-year period (1986-2008) of at-sea studies on plastic debris accumulations in the North Atlantic and Caribbean conducted by the Sea Education Association (SEA) - Woods Hole Oceanographic Institute. The highest concentrations (> 200,000 pieces per km^2) occurred in the convergence zones, but there was no significant increase in concentration during this 22-year period (Law *et al.*, 2010). An analysis of microplastics found in zooplankton samples in the North Pacific (So. California Coastal Current) reported no significant change in the proportion of the microplastics during a 25-year span (Gilfillan *et al.*, 2009).

IMPACTS

Wildlife entanglement and ingestion

Many forms of marine debris – especially abandoned, discarded, and lost fishing gear – pose serious threats to marine wildlife through entanglement. Derelict fishing gear continues to catch and kill ocean life in a process known as “ghost fishing.”

Entangling debris can hamper an animal’s mobility, inhibit growth and development, prevent it from eating, inflict cuts and wounds, or cause suffocation or drowning. Monofilament line, fishing nets, ropes and other gear, ring carriers, and packing strapping bands are some examples of the more harmful debris items that can cause animal entanglements. There are no accurate and comprehensive reports on global animal mortality rates. In the few entanglement reports that do exist on selected species, mortality estimates are likely to be radical underestimates because many animals may die and sink before they can be observed (Laist, 1998). According to the 1998 US Marine Mammal Commission’s (MMC) last published report, 136 marine species have been reported in entanglement incidents, including six of

seven species of sea turtles, 51 out of the world's 312 species of seabirds, and 32 species of marine mammals (MMC, 1998).

Many animals confuse debris for food and are unable to regurgitate these items once they have been swallowed. These ingested objects often become lodged in the animals' throats and digestive tracts. Debris that will not pass out of the stomach gives a false sense of fullness, causing some animals to stop eating and slowly starve to death. Of the 120 marine mammal species listed on the IUCN Red List (http://www.iucnredlist.org/), 54 (45%) were reported to have interacted (ingestion and/or entanglement) with marine debris (Cornish *et al.,* 2009). In studies of the Northern Fulmar, 96% of the beach-washed birds collected for Dutch marine litter monitoring in 2001 showed evidence of plastic ingestion (van Franeker and Meijboom, 2002). Studies from 2002-2006 with 304 dead fulmars showed an average of 31 plastic items in the stomachs with 95% of the birds being affected (van Franeker, 2006).

Habitat

Marine debris can lead to marine habitat alteration, degradation, or destruction, for example, coral reef abrasion from abandoned or lost fishing gear and smothering from plastic bags or sheeting. Such impacts on marine habitat and organisms can in turn lead to cascading ecological effects within communities of marine populations, such as altering trophic relationships, degrading the food web within an ecosystem, and altering the functional relationships between populations of marine organisms and the habitat they live in. For example, solid waste dumped into the sea may sink to the seafloor or be introduced through floods or storm activity and cover benthic habitat, in turn interfering with the natural foraging and home range behavior of marine animals.

Marine Protected Areas and World Heritage Sites

The proliferation of marine debris and the effects of entanglement and ingestion also pose a serious global management issue for marine protected areas. There are nearly 6,000 designated marine protected areas (MPAs) worldwide. Among these, 43 have received the highest internationally recognized status of conservation, i.e., UNESCO World Heritage Listing. Currently, 1.4 million square kilometers of ocean – about 0.4% of the world's oceans or an area about the size of the Gulf of Mexico – are protected under the World Heritage Convention, including 5 of the world's 10 largest MPAs. Overall, marine debris poses a threat to marine protected areas because it can directly affect the resources by destroying habitat and/or causing mortality in flora and fauna through ingestion or entanglement; provide a vector for alien species; pose a public health and safety risk to visitors; and present hazards to navigation for recreational, commercial, or public vessels. For protected areas that are also tourist attractions, marine debris poses an additional threat by making the site less attractive to visitors.

Alien species introduction

Marine debris may serve as transport for invasive species as it moves throughout the ocean. Drifting debris can harbor entire communities (including microbial communities) of encrusting and attached organisms and carry them great distances – potentially to areas where they may harm or compete with native species. Researchers have identified "hitch-hiking" benthic invertebrates such as mollusks, polychaete worms, and bryozoans living on floating mats of debris that are being transported by wind and surface currents all across the globe (Barnes, 2002). Overall, marine debris is estimated to have doubled the opportunities for marine organisms to travel at tropical latitudes and more than tripled it at high (>50°) latitudes (Allsopp *et al*., 2006). The introduction of invasive non-native species can have devastating environmental effects including loss of biodiversity, changes to habitat structure, and changes to ecosystem functions (Derraik, 2002 and Donnan, 2009).

Vessel damage and navigational hazard

Derelict fishing gear can cause serious damage to vessels of all sizes. Fishing nets, ropes, and other gear entangle vessel propellers and rudders resulting in costly repairs, loss of time, and danger to boaters and crews. Plastic bags clogging and blocking water intakes are a common cause of burned-out water pumps in recreational craft. Such incidents involve costly engine repairs and disablement. Vessels can

also directly strike floating or submerged marine debris, which may lead to human injury or severe damage to the vessel (NOAA, 2009).

Socio-economic impacts

The social impacts of marine debris are rooted in the ways it affects people's quality of life and include reduced recreational opportunities, loss of aesthetic value, and loss of non-use value (Cheshire *et al.,* 2009). Marine debris can also cause serious economic losses to various sectors and authorities. Among the most seriously affected are coastal communities (increased expenditures for beach cleaning, maintenance dredging, public health, waste disposal), tourism (loss of income, bad publicity), shipping (costs associated with fouled propellers, damaged engines, debris removal, and waste management in harbors), fishing (reduced and lost catch, damaged nets and other fishing gear, fouled propellers, contamination), and fish farming (UNEP, 2009 and Mouat *et al.,* 2010).

Human health and safety

Items such as broken glass, medical waste, rope, and fishing line pose immediate risks to human safety when encountered on beaches and underwater areas. Medical and sanitary wastes constitute a health hazard and can seriously injure people.

Discarded syringes, condoms, and tampon applicators can indicate more serious water quality concerns that affect human health. Medical and personal hygiene debris often enters the waste stream through direct sewage outflows or inadequate sewage treatment systems. These items can also indicate the presence of invisible pathogenic pollutants such as streptococci, fecal coliforms, and other bacterial contamination.

Marine debris-related damage to people also includes safety risks at sea (resulting in rescue services) due to fouling of propellers, accidents involving swimmers encountering submerged debris, and harm to human health (physical injuries, disease) from litter and debris (including medical waste) on beaches and in bathing waters.

EMERGING ISSUE

Microplastics

The primary types of micro-plastics are: (1) pre-production plastics (e.g., resin pellets, flakes, or powders) lost prior to processing; (2) small beads or particles produced as abrasives for shot blasting or for use in cosmetic products such as facial scrubs; and (3) fragments resulting from the deterioration and disintegration of larger plastic objects (mainly litter), which include various forms of food and beverage packaging, personal hygiene products, building materials, lost or discarded fishing and aquaculture gear, and others.

The environmental distribution and fate of microplastic in the marine environment represent a cause for concern. One aspect is the influence that microplastics may have on enhancing the transport and bioavailability of persistent, bio-accumulative, and toxic substances (PBT). Plastics have been shown to adsorb and concentrate organic contaminants from the marine environment. Mathematical models and experiments have demonstrated that plastic materials can transfer contaminants to organisms (Teuten *et al*., 2009). It is also known that plastic particles can accumulate persistent, bio-accumulating, and toxic contaminants such as PCBs, DDT, and PBDEs (GESAMP, 2010).

While it is widely accepted that microplastics (< 5mm) are a significant threat to the marine environment, their full environmental implications are not yet fully understood and require further research (Thompson *et al*., 2009).

III. A Platform for Action

The Honolulu Strategy is aimed at promoting sustained action to halt and reverse the incidence of debris in coastal and marine environment by 2030. As stated above, it is built around the following themes:

a. **Prevention, reduction, and management of land-based sources**
b. **Prevention, reduction, and management of at-sea sources**
c. **Removal and processing of accumulated marine debris in the open ocean (surface and sea floor) and along shorelines**

In the pages that follow, a roadmap in draft form for achieving the objectives and desired results for each theme is articulated in the form of Strategic Activities. Concurrent with this process, conceptual models and results-oriented chains have been prepared for the proposed activities (see Annex 1 for additional information). Listed under each Strategic Activity are specific recommendations for actions and collaboration that should be tailored to meet the requirements and priorities of respective stakeholders.

The Honolulu Strategy is a living strategy, which means that Strategic Activities can be added to or modified over time as our knowledge and understanding of the causes and effects of marine debris expands.

A. Strategies and actions for the prevention, reduction, and management of land- based sources of marine debris

The majority of solid wastes entering the world's oceans originate from land-based sources (UNEP, 2009; Coe and Rogers, 1997; GESAMP, 1991). The magnitude of the marine debris problem in a country is closely related to national waste minimization policies and the level of efficiency of solid waste management services provided by local and port authorities for municipal/industrial solid waste and wastes generated from commercial and recreational marine activities, respectively (UNEP, 2010). Marine debris is only one part of the broader problem of solid waste management, which is more generally linked to the protection and conservation of the marine and coastal environment as well as to sustainable development. Unfortunately, the prevention, reduction, and management of marine debris are rarely included in national solid waste management programs (UNEP, 2009).

Thematic Objective / Desired Result:

Reduced amounts of solid waste introduced into waterways and ocean from land-based sources.

A.1 Litter Prevention

Littering and illegal dumping (on land) of solid waste are significant land-based sources of marine debris. Litter is a form of pollution caused by the deliberate or careless mishandling or improper disposal of solid waste materials (KAB, 2009). Litter, consisting mainly of products such as bottles, cans, plastic and paper wrappings, newspapers, shopping bags, and cigarette packets - but also including items such as used car parts, rubble from construction sites, and old mattresses - accumulates in a variety of areas where it is either removed by the local authority or transported by wind and/or stormwater runoff into the drainage system. Once in the drainage system, litter is potentially able to travel via stormwater conduits, streams, rivers, lakes, and estuaries where it can become marine debris (Armitage and Rooseboom, 2000).

Street litter may also be washed, blown, or discharged into nearby waterways through rain, flood events, snowmelt, and wind. Inappropriate or illegal dumping of domestic and industrial rubbish, public littering, and inadequately covered household trash containers and garbage cans contribute to the creation of marine debris from households.

Research has identified seven major sources of litter: motorists, pedestrians, improperly containerized commercial refuse putouts (dumpsters), improperly containerized household refuse, loading and unloading docks and work areas, uncovered or unsecured loads on vehicles, and construction and demolition sites (KAB, 2009). Other sources are associated with recreational beach activities and events (e.g., beach goers, waterside entertainment and athletics venues, festivals).

A.1.1 Promote activities to reduce the amount of waste than can be littered by individuals

A.1.1.1 Promote the "4Rs" of reduction, reuse, recycling, and recovery in local waste management programming, including the use of reusable products to help reduce the creation of "potential" marine debris (See A.4.1.2 for related industry strategy)

A.1.1.2 Develop local recycling programs that will divert paper, glass, plastic, and metal materials from the waste stream

A.1.1.3 Develop electronic recycling programs to recover metals and other materials

A.1.1.4 Develop policy incentives for industry buy-back of waste materials and the use of fees for the use of select products that are likely to become marine debris

A.1.2 Establish adequate waste management processes and equipment to better manage solid wastes and help prevent littering

A.1.2.1 Provide adequate waste and recycling receptacles in public areas

A.1.2.2 Provide adequate collection and removal of solid wastes at key collection points

A.1.3 Increase public awareness of proper waste disposal and reduction

A.1.3.1 Encourage the public to use less, reuse, and take preventive measures related to single-use products

A.1.3.2 Conduct public awareness programs involving multiple sectors of user groups on litter prevention and proper waste disposal options

A.1.3.3 Produce necessary educational materials and training to help modify the public's perception of littering and its impacts – litter-free events, litter-free public outdoor areas, litter-free parks, schools, businesses, etc.

A.1.4 Establish and enforce stringent anti-littering laws with the public

A.1.4.1 Enact or change public policies regarding littering, including appropriate penalties

A.1.4.2 Enforce existing laws and regulations regarding littering

A.1.4.3 Utilize economic instruments such as fines for littering and impose heavier fees or taxes on excessive waste disposal

A.2 Solid Waste Management

Marine debris is a part of a broader problem of solid waste management, which affects all coastal and upland communities and is closely linked to the protection and conservation of the marine and coastal environment and sustainable development (UN-HABITAT, 2010). Traditionally, municipalities are responsible for providing solid waste management services, which include organizing and managing the public sanitation system and providing the infrastructure for the collection, transportation, treatment, and disposal of waste. However, in some countries, the capacity and resources to manage solid waste services can be limited. Relatively few national solid waste programs include specific activities related to marine debris management.

In many countries landfills and dumps are inadequately constructed or not maintained due to a lack of equipment and financial resources. The roads leading to dumps and those on dumps themselves are

often primitive, becoming impassable in the wet season. Wastes are dumped in water bodies of all kinds, especially by settlements that do not have municipal waste collection, such as informal houses or fishermen shacks near the coast. In a few cases, sea disposal is carried out by the municipal authorities. Additional solid waste reaches the sea after being dumped illegally near or in rivers and canals (UNEP-IETC, 2005).

The majority of solid wastes entering the oceans have been identified originating from these vectors: (1) street litter that is washed, blown, or discharged into nearby waterways by rain/flood events, snowmelt, and wind; (2) inappropriate or illegal dumping of domestic and industrial rubbish, public littering; (3) inadequately covered trash containers and garbage container vehicles (improperly secured or covered loads); (4) poorly managed waste dumps; (5) manufacturing sites, plastic processing, and transport; (6) sewage treatment and combined sewer overflows; (7) people using the sea for recreation and shore fishing; and (8) shore-based solid waste disposal and processing facilities (UNEP, 2009).

A.2.1 Enact legislation and policies at the regional, national, and local level that will support solid waste management practices

A.2.1.1 Develop and implement legislation and policies that support municipal solid waste management programs and infrastructure at national and local levels

A.2.1.2 Promote the ratification and legislative implementation of MARPOL Annex V at the national level, as the facilities that are needed for port reception of ship-born wastes are a component of the general solid waste management for the surrounding community

A.2.1.3 Provide training opportunities for judicial officials/magistrates/enforcement officers, park rangers, and others on the importance of marine debris prevention practices

A.2.2 Build enforcement capacity to encourage compliance with solid waste disposal regulations and standards

A.2.2.1 Engage waste management professionals to collaborate with law enforcement and regulatory authorities to encourage and increase public compliance with existing laws and regulations regarding solid waste management

A.2.2.2 Establish technically adequate collection and cleanup systems and disposal sites as part of an integrated solid waste management program

A.2.3 Promote twinning and benchmarking of BMPs in Solid Waste Management, including South-South cooperation

A.2.3.1 Establish model twinning projects between mentor countries and partner countries to share information and work to develop initiatives for integrated solid waste management programs that include marine debris issues

A.2.3.2 TBD

A.2.4 Increase public awareness on proper solid waste disposal and reduction

A.2.4.1 Conduct education and outreach campaigns on the negative impacts of improper solid waste disposal

A.2.4.2 Promote BMPs to encourage proper disposal of municipal solid waste and/or reduce the volume of waste generated

A.2.4.3 Expand existing public awareness and education programs for solid waste management to include marine debris issues and address public perceptions about littering

A.3 Municipal (Urban) Waste Management

Municipal or urban solid waste includes refuse from households, non-hazardous solid waste from industrial, commercial, and institutional establishments (including hospitals), street vendor market waste, yard waste, and street sweepings. Solid waste is commonly referred to as 'trash' or 'garbage' and consists of everyday items such as product packaging, containers and bottles, food scraps, newspapers, grass clippings, furniture, clothing, appliances, paint, and batteries. The solid wastes that create marine debris are generally composed of non-biodegradable and non-compostable biodegradable materials.

A.3.1 Implement best management practices (BMPs) for municipal solid waste disposal

A.3.1.1 Develop and promote BMPs by waste managers to improve waste management technical capacity and infrastructure

A.3.1.2 Promote and implement BMPs for the capture of trash in municipal stormwater systems, including the installation and maintenance of full trash-capture devices

A.3.1.3 Develop and implement plans to improve public waste management services

A.3.1.4 Develop and implement plans to implement a "4R" approach of reduction, reuse, recycling, and recovery as part of an integrated waste management approach

A.3.1.5 Develop and implement a "waste-to-energy" initiative that includes BMPs to control air pollution to reduce overall solid waste disposal and increase recovery of materials

A.3.2 Increase recycling efforts and the use of alternative materials

A.3.2.1 Develop and implement an education campaign to increase recycling efforts

A.3.2.2 Develop an infrastructure for establishing full-scale material recycling that includes glass, paper, plastics, and metals

A.3.2.3 Develop and implement an education campaign to support sustainable material use choices and new innovations to reduce litter

A.3.2.4 Develop model framework legislation for the implementation of "Extended Producer Responsibility" for packaging

A.3.2.5 Educate the public on the concept of "cradle to cradle" and life cycle analysis of products and the consequences of their choices

A.3.3 Use tools and analyses to support the adoption and use of sustainable material choices for packaging and single-use products

A.3.3.1 Support production and implementation of approaches based on life cycle information to show comprehensive environmental impacts of alternative materials and products.

A.4 Industrial Solid Waste Management

Land-based marine debris can come from industrial and manufacturing facilities as well as construction and demolition sites. Industrial wastes can include waste from coal or ore mines, electroplating works, oil refineries, paper industries, plastics industries, textiles industries, and others. Industrial waste contains inorganic or organic pollutants. Facilities can generate marine debris if their production, equipment, trash disposal, and waste streams are improperly managed.

Many forms of solid waste can be generated during the construction, renovation, and demolition of buildings, roads, and bridges. Similar to industrial materials, construction and demolition materials can become marine debris if appropriate disposal practices are not followed or if equipment or supplies are left unsecured.

A.4.1 Apply market-based approaches to promote waste minimization, recycling, and the use of reusable and alternative material products

A.4.1.1 Develop partnerships between producers, manufacturers, and retailers to offer cost-effective, convenient goods to consumers who can substitute single-use (disposable) products with products produced of alternative materials

A.4.1.2 Develop approaches for end-of-life materials management (e.g., energy recovery, extended producer responsibility/cradle-to-cradle methodology) for packaging materials, sharps (needles, lancets), medical wastes (blood /IV infusion bags), electronics (computers, cell phones), and other products

A.4.2 Seek incentives to implement self-imposed private sector standards and codes that meet or exceed established BMPs

A.4.2.1 Establish proper solid waste disposal collection services that exceed current BMPs in commercial areas and government facilities

A.4.3 Promote programs that enhance product stewardship to prevent materials from entering the environment and becoming marine debris, including waste stream and site-based cleanup efforts in commercial spaces

A.4.3.1 Expand and encourage participation in Operation Clean Sweep, a plastics industry containment program to prevent the pellets from getting into waterways that eventually lead to the ocean (http://www.opcleansweep.com/overview/environment.asp)

B. Strategies and actions for the prevention, reduction, and management of at-sea sources of marine debris

At-sea sources of marine debris include merchant shipping, ferries and cruise liners, fishing vessels, public vessels, private vessels, offshore oil and gas platforms and drilling rigs, and aquaculture installations (IMDCC, 2008). These various sectors can produce a broad assortment of marine debris in the form of solid wastes, cargo, fishing gear, and a host of other products depending upon the function of these vessels and platforms.

Thematic Objective / Desired Result

Reduced amount of solid waste, lost cargo, derelict fishing gear, and abandoned vessels introduced at sea

B.1 Shipping, Boating, and Transport

Despite international agreements prohibiting the disposal of plastics at sea, as well as other items certain distances from shore, these continue to be accidentally released or deliberately discarded by vessels, particularly on long journeys. Large vessels also produce a waste stream of galley wastes (food and beverage packaging and containers) and operational wastes (e.g., light bulbs, batteries, rope, hard hats, gloves) that become marine debris if illegally dumped overboard. Another concern from the shipping sector is the frequent loss of containers from cargo ships with up to 10,000 reported lost worldwide each year (Podsada, 2001).

Cruise line crew and recreational boat owners and operators may accidentally or deliberately discharge solid waste and other manufactured items into the marine environment. Such debris could include galley wastes, operational wastes, and recreational fishing gear (Sheavly, 2005). Military vessels are also a potential source of marine debris through general ship activities and military operations that might result in the discharge of ammunition, ordnance, and other wastes.

B.1.1 Enact legislation and implement policies at the regional and national level that will lead to the prevention, reduction, and management of marine debris from maritime activities, including controls for their implementation

B.1.1.1 Develop legislation and policies to implement MARPOL 73/78, particularly Annex V

B.1.1.2 Develop legislation and polices to implement the London Dumping Convention/Protocol

B.1.1.3 Facilitate exchanges at the regional and country level related to experience and expertise in implementing MARPOL 73/78 and the London Dumping Convention/Protocol

B.1.2 Improve compliance and enforcement with existing laws

B.1.2.1 Build national capacity to actively monitor and enforce compliance dumping and discharge prohibitions.

B.1.3 Increase awareness with shipping, boating, and maritime transport stakeholders and users in proper solid waste management practices and procedures at sea

B.1.3.1 Conduct education and outreach programs to engage ocean-users (ship officers and crew, boaters) on ocean dumping laws

B.1.3.2 Conduct training programs on best management practices/technologies for waste prevention, reduction, and management at sea and introduce these programs at nautical colleges

B.1.3.3 Develop and promote best management practices by users to minimize accidental loss of cargo, equipment, solid waste, or vessels at sea

B.1.3.4 Expand onboard waste minimization procedures to include reuse and recycling

B.1.3.5 Implement a policy goal of zero discharge of MARPOL Annex V solid waste products

B.1.3.6 Provide cruise ship passengers outreach materials on the ecological and conservation issues associated with their transport

B.1.4 Apply market-based tools to support positive incentives for better waste management practices at sea

B.1.4.1 Develop programs for economical in-port disposal options of ship-borne wastes to minimize incidence of illegal, ocean dumping

B.1.4.2 Develop port reception facilities for Annex V wastes and determine indirect financing of in-port disposal

B.2 Commercial and Recreational Fishing

Nets, ropes, fishing lines, crab and lobster pot, and other fishing debris are among the most visible elements of marine debris. Fishing gear loss of nets, long lines, traps and pots, floats, weights, and monofilament fishing line can be accidental or intentional. Other persistent solid wastes (galley and operational) can also be produced by fishing crews and recreational fishers; those wastes can become marine debris if allowed to enter the environment. Design flaws in gear, unanticipated operational considerations (weather, vessel distress, etc.), and gear conflicts lead to accidental loss. Intentional dumping or abandonment of fishing gear can be the result of inadequate shoreline disposal options, illegal, unreported, or unregulated (IUU) fishing, or vandalism.

B.2.1. Enact legislation and policies at the regional, national, and local level that will lead to the prevention, reduction, and management of marine debris from fisheries operations:

B.2.1.1 Develop legislation and policies to implement MARPOL 73/78 through close cooperation with relevant international organizations, Regional Fisheries Management Organizations,

Regional Seas Organizations, national governments, the fishing industry, ports, and environmental NGOs

B.2.1.2 Provide adequate, accessible, and affordable reception facilities for waste fishing gear in ports, marinas, and small-scale harbors

B.2.1.3 Implement marine spatial planning to prevent conflict between fishing activities and existing ferry or shipping lanes

B.2.2 Improve compliance and enforcement with existing laws

B.2.2.1 Build national capacity to actively monitor and enforce MARPOL Annex V requirements for minimizing fishing gear loss

B.2.3 Increase awareness on the part of commercial and recreational fishers of regulations and proper solid waste management practices and procedures at sea

B.2.3.1 Implement education and outreach programming on: (a) fishing gear dumping laws and penalties, (b) at-sea BMPs for fishing gear deployment, handling, and maintenance, (c) new technologies, including fishing gear that minimizes accidental loss and gear disposal in port, and (d) waste minimization practices to reduce gear loss and/or replacement rate

B.2.3.2 Conduct seminars and workshops on abandoned, lost, and derelict fishing gear (ALDFG) problems and solutions directed at fishers, the fishing industry, and port users and operators at local, national, regional, and international levels

B.2.3.3 Develop “Fishing for Litter” campaigns to collect debris found at sea as part of fishing activities, with disposal in port/on land http://www.kimointernational.org/FishingforLitter.aspx

B.2.3.4 Engage ocean users in programming on fishing gear handling and maintenance best practices and the application of new gear technologies that reduce the probability of accidental gear loss at sea

B.2.4 Redesign and promote the use of alternative fishing gear technologies that minimize risk of accidental loss at sea

B.2.4.1 Research the development of improved gear technologies and efficiency of different measures to reduce and recover ALDFG

B.2.4.2 Employ the use of technologies that reduce ghost fishing of nets and traps such as escape mechanisms, rot cords, weak ropes, acoustic beacons, biodegradable and oxy-degradable materials, and sound-reflecting substances

B.2.4.3 Research, design, test, and promote the use of new alternative fishing gear and technologies that reduce the probability of accidental at-sea gear loss

B.2.4.4 Develop and promote materials and BMPs for alternative gear to minimize accidental loss

B.2.5 Promote the use of low-cost, convenient options for disposal as an ocean dumping alternative

B.2.5.1 Provide low-cost, convenient reception facilities for damaged and discarded fishing gear in ports and marinas

B.2.6 Implement private sector standards and codes

B.2.6.1 Develop and promote the application of BMPs for fishing gear deployment, handling, and maintenance in order to minimize or reduce the probability of accidental gear loss at sea

B.2.6.2 Develop a compendium of environmentally safe fishing gear that will be accessible to the public

B.2.6.3 Engage ocean users through training and outreach on fishing gear handling and maintenance BMPs and the application of new gear technologies that reduce the probability of accidental gear loss

B.2.6.4 Require fishing nets to have electronic gear marking and transponders attached for location and identification if lost at sea

B.2.6.5 Implement a compulsory detection system for lost fishing gear

B. 3 Aquaculture Installations and Oil/Gas Infrastructure

The growth of coastal and offshore aquaculture operations in Asia, Latin America, and Europe suggests that materials used in aquaculture are likely to become a more prominent component of derelict fishing gear and marine debris (NRC, 2008). The type of material lost in aquaculture activities depends upon the type of culture system, construction quality, vulnerability to damage, and fishery management practices. Fish cage components that could potentially end up as marine debris include nets, rope/ties, and cage structures (wood, metal). In seaweed systems, the major losses would be lines or floating raft structures (foamed plastic elements), and in mollusk farming activities, the debris could include poles, bags, lines, concrete and rope, and other devices.

Oil and gas platforms and drilling rigs are another ocean-based source of marine debris. This can be the result of improper disposal of wastes or equipment, or loss during heavy weather. These facilities have regulations, policies, and programs in place to reduce, eliminate, and control potential debris resulting from general operations; however, severe storms and other natural events can significantly damage these platforms, introducing waste into the sea (IMDCC, 2008).

B.3.1 Enact legislation and policies at the regional and national level that will lead to the prevention, reduction, and management of marine debris from aquaculture and other offshore infrastructures

B.3.1.1 Develop legislation and policies to implement MARPOL 73/78 through close cooperation with relevant UN agencies (FAO, IMO and UNEP), Regional Seas Organizations, national governments, the aquaculture industry, ports, petroleum and mineral extraction industry, and environmental NGOs

B.3.2 Improve compliance and enforcement with existing laws

B.3.2.1 Build national capacity to actively monitor and enforce MARPOL Annex V requirements for minimizing aquaculture gear loss and other solid waste materials

B.3.2.2 Actively monitor and enforce MARPOL Annex V requirements for minimizing equipment and gear loss of aquaculture and extractive operations

B.3.2.3 Adopt international protocols for monitoring equipment loss/breakage in aquaculture production

B.3.2.4 Develop a compendium of environmentally safe aquaculture gear

B.3.3 Increase ocean user and public awareness

B.3.3.1 Conduct education and outreach programs related to MARPOL Annex V regulations and best practices/technologies for the prevention, reduction, and management of aquaculture-related debris and other solid wastes that engage aquaculturists

B.3.3.2 Develop and promote the application of BMPs for aquaculture operations and practices, including aquaculture equipment and gear deployment, handling, and maintenance, in order to minimize or reduce the probability of accidental aquaculture equipment and gear loss at sea

B.3.3.3 Conduct research into the modification of aquaculture gear in order to prevent loss resulting in marine debris

B.3.3.4 Promote good practices for the environmental management of aquaculture

B.3.4 Improve waste management programs used on petroleum and mineral extraction facilities

B.3.4.1 Review existing regulations and waste management programs to reduce potential introduction of solid waste materials into the sea

C. Strategies and actions for the removal and processing of accumulated marine debris

Over time, introduced marine debris may accumulate and persist. The process of marine debris accumulation is influenced through a number of mechanisms, including: (a) physical oceanographic processes, such as waves, currents, and eddies; (b) lunar and tidal cycles; (c) extreme natural events such as floods, severe storms, or tsunamis that can introduce large amounts of debris in a short time; and (d) human actions such as dumping large volumes of trash and debris in one event. Accumulations and aggregations of marine debris primarily occur along the shoreline, floating at sea (pelagic), or settled onto the sea floor (benthic deposits).

Thematic Objective / Desired Result:

Accelerated removal of marine debris from coastal shorelines, benthic habitats, and the open ocean

C.1 Shoreline Areas

Several vectors can deposit marine debris onto shorelines and beaches. Wave action and currents can bring the various types of debris floating offshore onto the beach during regular tidal cycles, with higher deposition during certain stages of the lunar cycle or as a result of a storm event (e.g. tidal surges, Nor'easters, tsunamis, cyclones, and hurricanes). The movement of this debris up onto the beachfront can be very damaging to submerged habitats of coral reefs, sea grass beds, and other communities. Once on the beach, this debris can be harmful to wildlife that live and forage in this area as a source of entanglement and an improper food source if accidentally eaten.

Human activities on beaches provide another vector for the deposition of marine debris. Coastal communities have tourism activities associated with beach access and use by local residents and visitors. The behaviors of beach visitors can result in the production of solid wastes that can become marine debris when those materials enter the water. Examples include the handling of packaging remnants from picnicking (e.g., food wrappers/containers, beverage bottles and caps) or fishing supplies (e.g., line, bait containers), athletic events such as volleyball, smoking, and other activities. Another human activity that can result in marine debris is illegal dumping of solid wastes onto beach areas.

C.1.1 Develop solid waste management programs that include plans for addressing the accumulation of trash and litter on beach areas and adjacent zones following a significant storm event

C.1.1.1 Develop a plan for removal activities before the next tide or storm in the community

C.1.1.2 Develop a plan to routinely clean/clear drains, ditches, culverts, gullies, streams, and other stormwater pathways to help prevent flooding

C.1.2 Develop solid waste removal programs for recreational beach and underwater areas

C.1.2.1 Ensure placement of adequate trash, cigarette, and recycling receptacles for visitors to use as they leave the beach and coastal areas

C.1.2.2 Provide recycling opportunities for beach visitors as part of the municipal solid waste management program

C.1.2.3 Analyze the patterns of solid waste creation based on activities that occur in a public beach area in order to focus enforcement, solid waste and recycling receptacle placement, and outreach activities

C.1.3 Develop education programs to help prevent beach and underwater sites from becoming littered or a dump site

C.1.3.1 Conduct tourism campaigns working with staff and patrons of waterfront hotels and restaurants

C.1.3.2 Conduct public education campaigns using tools for reaching beachgoers

C.1.3.3 Train beach wardens on BMPs for patrol of beach areas and to work with the public on handling trash and litter

C.1.3.4 Support beach and underwater cleanup events within the public and private sectors (e.g., International Coastal Cleanup, Clean Up the World, and other public beach cleanup efforts)

C.1.3 5 Create and promote adopt-a-beach or adopt-a-dive site programs.

C.1.3.6 Promote beach stewardship programs such as “Blue Flag” (http://www.blueflag.org/) and others

C.1.3.7 Promote the use of reusable bags and containers as an educational tactic to reduce the use of disposable products

C.1.4 Build the capacity to enforce solid waste management regulations with the public

C.1.4.1 Enforce existing laws

C.1.5 Enact or strengthen laws and regulations to address solid waste management and littering

C.1.5.1 Prepare new ordinances as needed

C.2 Pelagic Areas

Marine debris is found in open ocean areas, far from land and in areas that may rarely be visited by a passing ship. Wind and currents in the open water of the world’s ocean concentrate accumulations of floating marine debris in many forms including derelict fishing gear, with nets and floats entangled into huge masses and with sections that float at the sea surface and others that hang down into the water column. The forces that bring together these aggregations of lost and abandoned fishing gear bring to the same areas other debris that consists of beverage bottles, crates, shoes, toys, clothing, and an assortment of products that reads like a laundry list of everything we use on land or on the water. In addition to what is visible are microplastic bits and other materials that were at one time part of larger products that have been broken down over time by physical and chemical processes while being transported around in the ocean. This debris is not evenly distributed throughout the world’s oceans, but is usually found in areas where wind and currents cause the water to converge.

The impacts of marine debris in the open, pelagic areas are considerable. Floating debris can pose a serious navigational hazard to all forms of maritime traffic. Wildlife that traverses or enters these areas may encounter entanglement (marine mammals, fish, and birds) or ingestion (Fulmars and other sea birds) hazards.

One of the questions being posed is whether debris that is currently in the ocean can be effectively removed. Removal of floating debris at sea is a huge challenge and is being explored by several groups such as *Project Kaisei* that voyaged to the North Pacific Gyre to assess the status of marine debris in this region from plankton tows and also tested techniques for the bulk removal of debris. There are research groups that have been assessing the status of marine debris at sea since the 1970’s with recent resurgence in research by SEA from Woods Hole Oceanographic Institute (22 year study in the Atlantic,

Caribbean, and North Pacific), Scripps Institute of Oceanography (*SEAPLEX*), and many other scientific groups. Several NGOs have also conducted cruises to explore the gyres and have increased public awareness of the presence of marine debris in the open ocean (e.g., Algalita Marine Research Foundation, 5 Gyres).

C.2.1 Assess the amount of marine debris at sea for comparison and prioritization of efforts in debris removal and processing

C.2.1.1 Develop standardized methods for assessing the amount of marine debris in open ocean areas which can be used for the assessment of time series trends

C.2.1.2 Develop models on the transport and distribution of marine debris for use in targeting removal efforts

C.2.1.3 Develop a public innovation process to drive technology development in the remote detection and tracking of derelict fishing gear in open ocean environments, including aerial and satellite photography

C.2.1.4 Develop standardized methods for collecting and assessing microplastics found in open ocean areas

C.2.1.5 Encourage and implement “Fishing for Litter” initiatives

C.2.2 Use new methods to improve the removal process of observed marine debris accumulations at sea

C.2.2.1 Research best disposal or recovery options for debris collected at sea

C.2.2.2 Develop removal capacity from ships of opportunity (e.g., the commercial fishing community) for retrieval of large aggregations of marine debris (e.g., derelict fishing gear)

C.2.3 Use information gathered from at-sea collections to promote better waste management on land and at sea

C.2.3.1 Establish collaborations of NGOs and industry groups to assess the types of debris found at sea and develop or increase programs to address those specific sources

C.3 Benthic Deposits

A significant proportion of debris that enters the sea eventually sinks and accumulates on the seabed in nearshore and deepwater habitats (termed as benthic litter; UNEP 2005). Benthic litter is rarely seen by the general public and therefore draws little attention or public reaction (Galgani *et al.,* 2000). Nevertheless, this litter continues to pose numerous problems. It is a potential navigation hazard, an impediment to trawl fishers (OSPAR, 2006), and can lead to entrapment or smothering of marine biota (NOWPAP, 2007).

C.3.1 Remove marine debris accumulations on the sea floor

C.3.1.1 Develop techniques for identification of accumulation areas on the seafloor

C.3.1.2 Research best recovery options for debris collected at sea

C.3.1.3 Develop removal capacity from “ships of opportunity” (e.g., the commercial fishing community) for retrieval of large aggregations of marine debris (e.g., derelict fishing gear)

C.3.1.4 Develop and promote the use of best practice guidelines for the removal of the marine debris on the seafloor

C.3.1.5 Develop BMP guidelines for the removal of the marine debris on the seafloor

D. Cross-cutting components

D.1 Understanding the marine debris challenge

In order to develop and implement realistic and efficient marine debris management programs it is important to have information and data on the amounts, distribution, and impacts of marine debris. There are quite a number of relevant projects around the world but still not enough to cover all aspects of the problem.

The problem of marine debris was recognized in 2005 by the UN General Assembly (UNGA), which in its Resolution A/60/L.22 calls for national, regional, and global actions to address the problem of marine debris. This resolution notes the lack of information and data on marine debris, encourages States to develop partnerships with industry and civil society, urges States to integrate the issue of marine debris within national strategies dealing with waste management, encourages the development of appropriate economic incentives to address this issue, and encourages States to cooperate regionally and sub-regionally to develop and implement joint prevention and recovery programs for marine debris. A number of regions and countries have taken some steps to address the marine debris issue but despite all these efforts there are indications that the marine debris problem keeps growing (Cheshire *et al*., 2009).

As recognized in the UNGA Resolution, one of the significant barriers to addressing marine debris is the absence of adequate science-based monitoring and assessment programs that will provide useful information from which the most critical impacts of debris, on national, regional, and global scales can be determined. Changes in accumulation rates and composition, trends over time, and the effectiveness of management systems are also hard to assess without good monitoring methodologies. Although monitoring of marine debris is currently carried out within a number of countries around the world, the methods of survey and monitoring used tend to be very different, preventing comparisons and harmonization of data across regions or time-scales (Cheshire *et al*., 2009).

D.1.1 Research/monitoring gaps needed to assess the global, regional and local impacts of marine debris

D.1.1.1 Research the impacts of marine debris on wildlife and habitats

D.1.1.2 Monitor the trends in the amount and composition of debris ingested by marine wildlife

D.1.1.3 Research trends, fates, and impacts of marine debris, particularly micro-plastics

D.1.1.4 Research the long-term implications of micro-plastics, particularly with regard to the impact on marine organisms and human health and accumulation along food chains

D.1.1.5 Implement regular, long-term collection, collation, and dissemination of information on derelict fishing gear, and national inventories of net types and other fishing gear, as appropriate

D.1.2 Regional and global assessments on the status of marine debris

D.1.2.1 Develop standardized monitoring methodologies for shoreline, pelagic, and benthic marine debris assessments

D.1.2.2 Develop and implement regional and national marine debris monitoring programs, based on internationally accepted methodologies to facilitate comparisons

D.1.2.3 Develop mapping strategies for pelagic and benthic marine debris to assess their global distribution and relative abundance of different types of debris

D.1.2.4 Conduct regional assessment studies on the status of marine debris in Regional Seas areas that did not prepare such studies to date (Arctic, Northeast Pacific, ROPME Region, Pacific, and West/Central Africa)

D.2 Understanding the Economic Impacts and Opportunities

The marine environment is tremendously important economically to communities throughout the world and supports a diverse range of activities including fishing, commercial shipping, and tourism. Marine debris can cause a broad spectrum of economic impacts that both reduce the economic benefits derived from marine and coastal activities and/or increase the costs associated with them (Committee on the Effectiveness of International and National Measures to Prevent Marine Debris and Its Impacts *et al.,* 2008).

Evaluating environmental damage of marine debris in economic terms is extremely challenging and has generally not been addressed by research. Establishing what the long-term effects of marine debris will be on the environment is highly complex and difficult to translate into economic damages, and research is urgently required to investigate what the costs, both environmental and economic, of taking no further action to reduce marine litter would be.

In 2000, KIMO International presented the results of a two-year project to investigate the economic and social impacts of marine litter on coastal communities (Mouat *et al.*, 2009). The report, titled "Economic Impacts of Marine Litter" finds that the cost of litter on coastal communities and marine industries has risen significantly in the last 10 years. In some instances the report shows that costs have risen as much as 83%, taking into account inflation, placing a totally unnecessary burden on those who live by or make their living from the sea. The report has highlighted a problem that not only ruins beaches and maims unsuspecting wildlife but costs governments and industry millions of Euros each year. Very few studies to date have explored the economic impact of marine litter.

Some of the examples of the economic impact of marine debris are:

- ***Debris removal costs.*** Estimates suggest that the total cost of marine debris removal to all UK local authorities is approximately £14 million per year (Environment Agency, 2004 cited in OSPAR, 2009). Cleansing of the Swedish Skagerrak coast in 2006 was estimated to cost 15 million SEK (about €1.5 million) (OSPAR, 2009). The total cost reported by local authorities in Denmark, Sweden, UK, and Norway for beach clean-ups was £2,913,795 (US$4.42 million) (Hall, 2000). Research in Poland found that the cost of removing marine debris from the shoreline of two ports amounted to €570,000 (Naturvårdsverket, 2009). An estimated cost to effectively remove litter from South Africa's wastewater streams is about R2 billion (US$279 million) per year (Lane, 2007).

- ***Losses to tourism.*** Research from Sweden suggests that marine debris inhibits tourism there between 1-5% resulting in a loss of £15 million in revenue (Ten Brink et al 2009). In extreme cases, marine debris can also lead to the closure of beaches, as was the case in New Jersey and New York in 1988. This was estimated to cost the regional economy between $379 million and $3.6 billion in lost tourist and other revenue (Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts *et al*., 2008).

- ***Losses to fisheries.*** Research focusing on the Shetland fishing fleet found that marine debris could cost a vessel up to £30,000 a year (Hall 2000). A separate study looking at the Scottish Clyde fishery reported that losses of up to $21,000 in lost fishing gear and $38,000 in lost fishing time were experienced by a single trap fisher in 2002 (Watson and Bryson, 2003 cited in Macfadyen *et al.,* 2009). Ghost fishing in the tangle and gillnet fisheries is equivalent to less than 5% of EU commercial landings (Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts *et al.*, 2008), while the ghost catch of monkfish in the Cantabrian Sea equates to approximately 1.46% of landings (Brown *et al*., 2005). In the US, an estimated $250 million worth of marketable lobster is lost to ghost fishing annually (Allsopp *et al*., 2006), and 4-10 million blue crabs are trapped in ghost fishing gear each year in Louisiana (Macfadyen *et al.,* 2009). Estimates put the cost of marine litter for the UK fishing industry at over €33 million a year (Ten Brink *et al*., 2009).

- ***Losses to aquaculture.*** Marine debris can result in economic losses to aquaculture producers (UNEP, 2009) as a result of damage to vessels and equipment, removal of debris, and staff downtime. Entangled propellers and blocked intake pipes present the most common problems for aquaculture operators and can result in costly repairs and lost time.

- ***Costs to shipping.*** Shipping faces increased costs from marine debris resulting from vessel damage and downtime (Ten Brink *et al*., 2009), debris removal and management in harbors and marinas (UNEP, 2009), and emergency rescue operations to vessels stricken by marine debris (Macfadyen *et al.,* 2009). For harbors in the UK, the removal of debris could cost up to £15,000 a year with manual clearance of the harbor required up to four times per week. Anecdotal evidence received from marinas suggested that some marinas had to be manually cleaned on a daily basis at a cost of up to £10,000 a year (Hall, 2000). Research in 1998 found that 230 rescues were undertaken to vessels with fouled propellers in UK waters at a cost of £2,200 to £5,800 per incident, depending on the type of lifeboat required. This amounted to an overall cost of between £506,000 and £1,334,000 for that year (Hall, 2000). In 2005, the US Coast Guard made 269 rescues to incidents involving marine litter resulting in 15 deaths, 116 injuries, and US$3 million in property damage (Moore, 2008).

- ***Costs to power stations.*** The effects of marine debris on power stations can include blockage of cooling water intake screens, increased removal of debris from screens, and additional maintenance costs. Anecdotal evidence suggests that marine debris can cost companies up to £50,000 to remove with additional costs for pump maintenance (Hall, 2000).

D.2.1 The economic status of impacts of marine debris on key sectors

D.2.1.1 Assess the costs within the fishing sector due to abandoned, lost, and discarded fishing gear

D.2.1.2 Assess the costs of debris collection and removal on beaches in resort areas

D.2.1.3 Assess the direct economic impacts of marine debris due to the loss of services and goods provided by affected ecosystems

D.2.1.4 Solicit reports on funds spent in coastal regions municipal and harbor authorities on cleaning up marine debris to highlight the true costs to society due to marine debris

D.2.2 Effectiveness of market-based instruments, as they pertain to marine debris and the costs and benefits of various marine debris abatement programs

D.2.2.1 Assess traditional approaches such as the “polluter pays principle” and others to determine if these affect the amount of marine debris produced

D.2.3 Funding sources to support regional efforts for addressing marine debris issues of prevention and removal

D.2.3.1 Encourage that UNEP Regional programmes for marine debris be incorporated into national budgets

IV. Taking the Honolulu Strategy Forward

Participants at the 5th International Marine Debris Conference will have the opportunity to provide feedback and suggestions for the Honolulu Strategy.

With that feedback, the Conference Committee will prepare another iteration of the Honolulu Strategy that contains additional information and plans for the next steps.

One such feature will be “Supporting Statements” from organizations, agencies, and individuals related to the goals of the Honolulu Strategy. In Annex 2, there is a sampling of statements from groups that were involved in the planning and preparations for the Conference.

Annex 1

Introduction

The Honolulu Strategy was developed through an iterative process working with marine debris researchers, resource managers, and other practitioners from around the globe to develop a framework for action. The 5th International Marine Debris Conference served as a catalyst for developing the Strategy. The Strategy adopts a results-oriented framework designed to support actions that lead to measurable results.

Results Chains as a Planning Tool

Results chains (Conservation Measures Partnership, 2007) were used as a tool to inform the development of a framework for the Honolulu Strategy. Results chains show how a particular action will lead to some desired result (Figure 1). They are depicted as a chain of causal statements that link short-, medium-, and long-term results in an "if…then" fashion. For planning purposes, a results chain represents a set of assumptions about how strategies will contribute to reducing important threats, leading to the conservation of ecosystem targets (FOS, 2009).

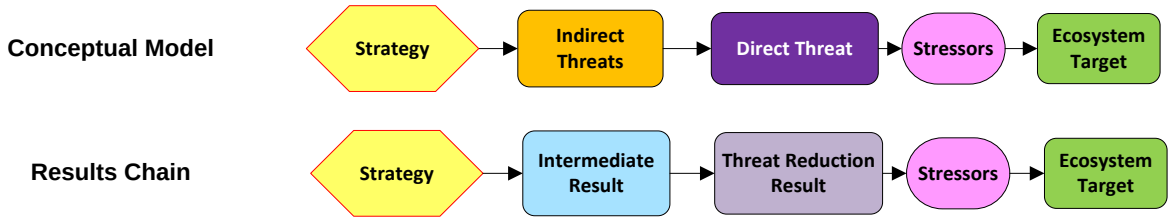

Figure 1. Schematic Diagram of Conceptual Model and Results Chain

Results chains are 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. Key features of a conceptual model include:

- A simplified understanding of the situation at a project site
- Provides a framework for strategic planning
- Illustrates assumed linkages between factors
- Reflects the group's collective understanding
- Reflects the most relevant factors
- Is based on sound information

Conceptual models show the state of the world before a particular action takes place, while a results chain shows the state of the world resulting 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.

Marine Debris Results Chains for the Honolulu Strategy

Results chains for marine debris were developed to show the relationship between strategies, intermediate results, and threat reduction results (Figure 2). Draft conceptual models, illustrating the relationship between the issue of marine debris (direct threat) and the problems that act as root causes (indirect threats) are presented here for both land-based (Figure 3) and at-sea (Figure 5) sources of marine debris. Similarly, a set of draft results chains that show the relationship between strategies and

expected results are presented that address the threat of marine debris from land-based (Figure 4) and at-sea (Figure 6) sources.

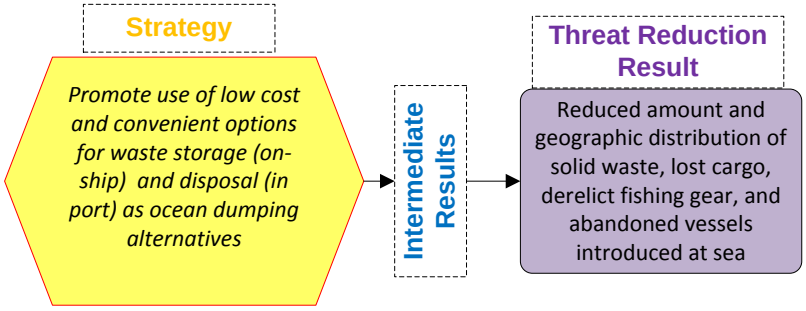

Figure 2. Example of Strategy-Threat Reduction Result Pair used in Honolulu Strategy

Two threat reduction results (purple boxes in Figure 4 and 6) were identified in the marine debris results chains for the Honolulu Strategy:

1. Reduced amount and geographic distribution of litter and solid waste introduced into the sea from land- based sources
2. Reduced amount and geographic distribution of solid waste, lost cargo, derelict fishing gear, and abandoned vessels introduced at sea

Nine categories of strategies (yellow hexagons in Figure 4 and 6) were identified to achieve the intermediate and threat reduction results developed for the Honolulu Strategy. These categories are summarized below based on Salfsky et al.,2008 as:

- *Site/Area Management:* includes actions to manage protected areas and other resources for conservation.
- *Habitat and Natural Process Restoration:* includes actions to enhance degraded or restore missing habitats and ecosystem functions; dealing with pollution
- *Awareness and Communication:* includes actions to raise environmental awareness and provide information through various media or through civil disobedience.
- *Legislation:* includes actions related to making, implementing, changing, influencing, or providing input into formal government sector legislation or policies at all levels: international, national, state/provincial, local, and tribal.
- *Policies and Regulations:* includes actions related to making, implementing, changing, influencing, or providing input into policies and regulations that affect implementation of the laws at all levels: international, national, state/provincial, local, and tribal.
- *Private Sector Standards and Codes:* includes actions related to setting, implementing, changing, influencing, or providing input into voluntary standards and professional codes that govern private sector practice.
- *Compliance and Enforcement:* includes actions related to monitoring and enforcing compliance with laws, policies, and regulations, and standards and codes at all levels.
- *Substitution:* includes actions related to promoting alternative products and services that substitute for environmental damaging ones.
- *Market Forces:* includes actions that use market mechanisms, such as incentives, to change behaviors and attitudes.

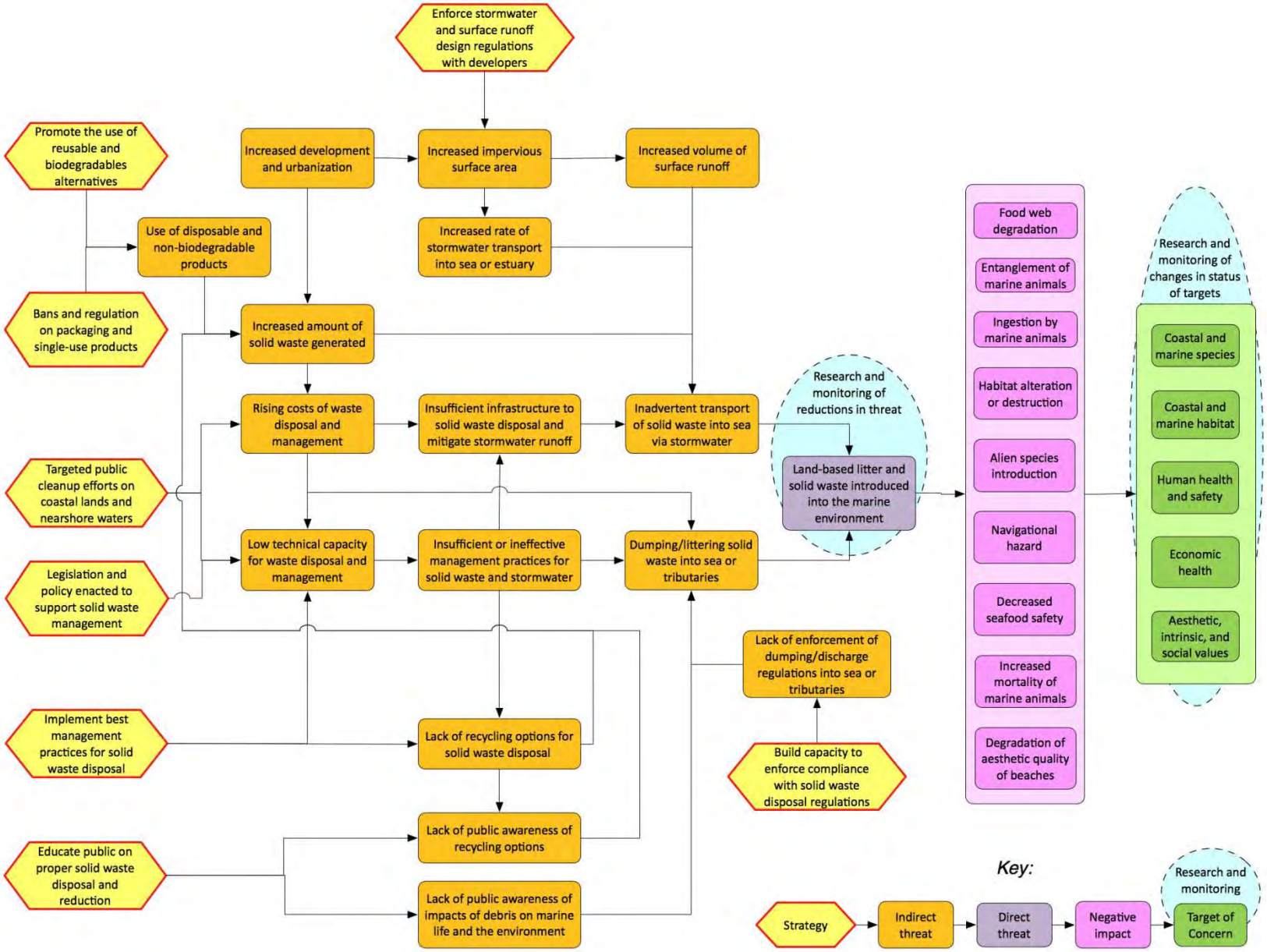

Figure 3. Conceptual model for land-based sources of marine debris

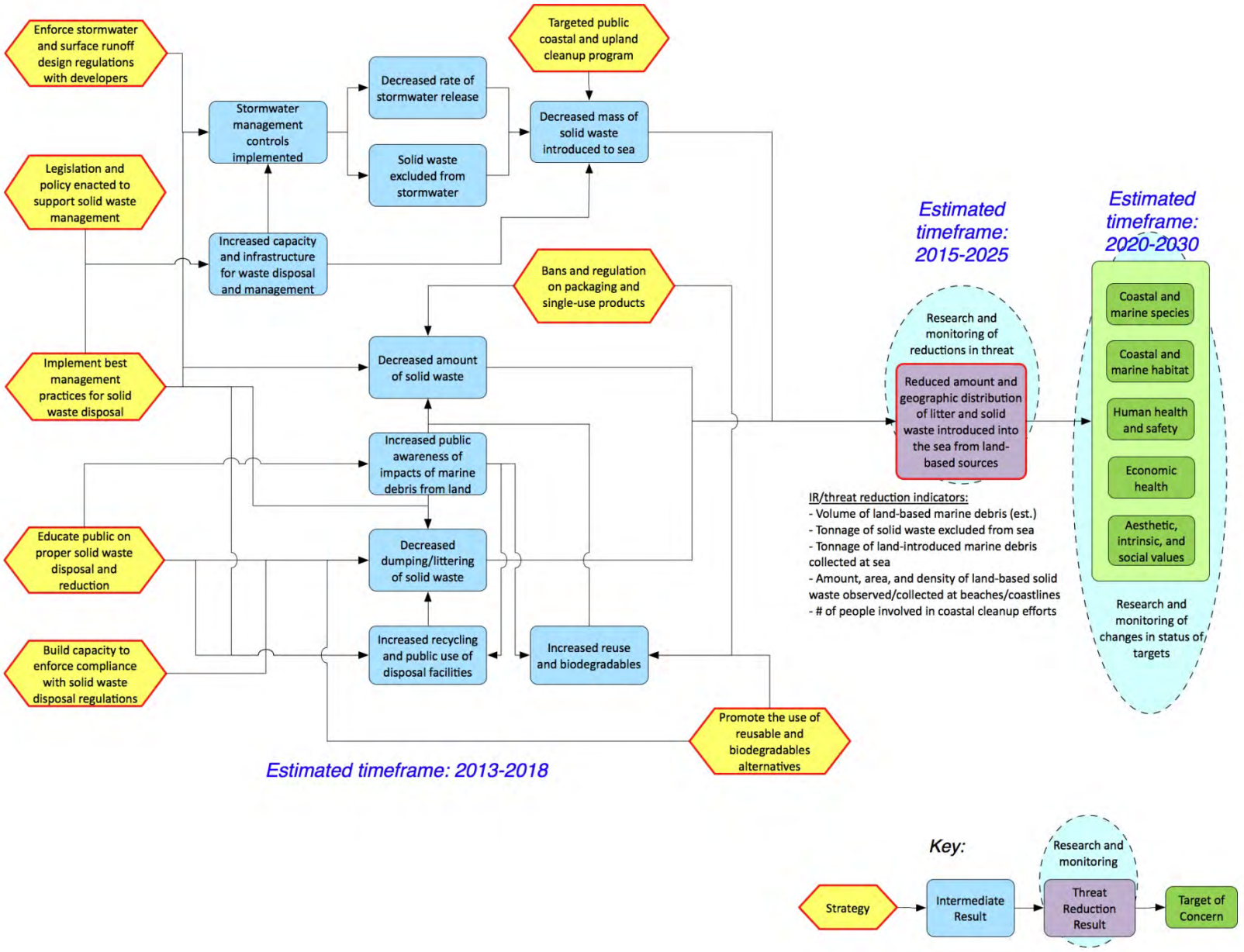

Figure 4. Results chain for land-based sources of marine debris

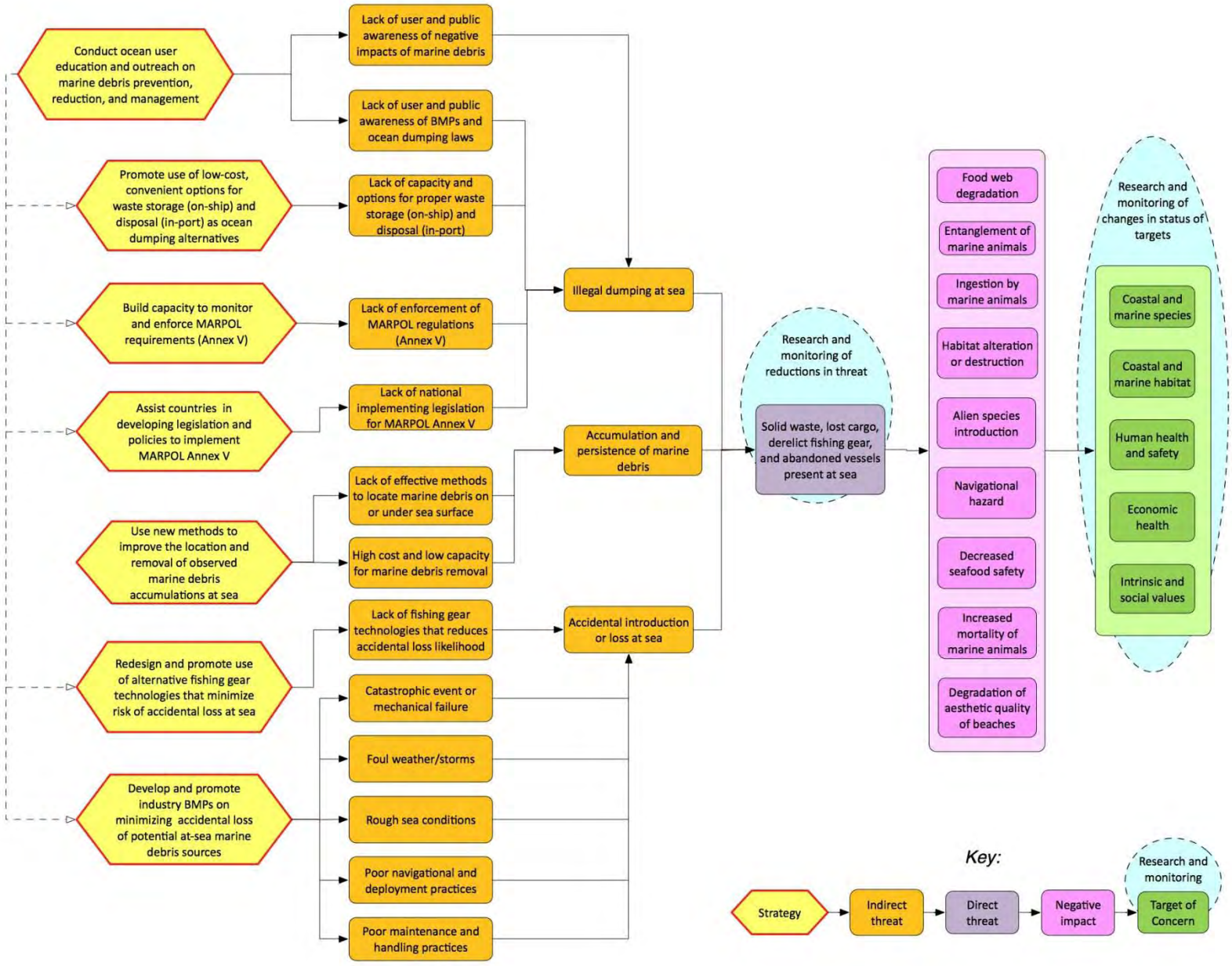

Figure 5. Conceptual model for at-sea sources of marine debris

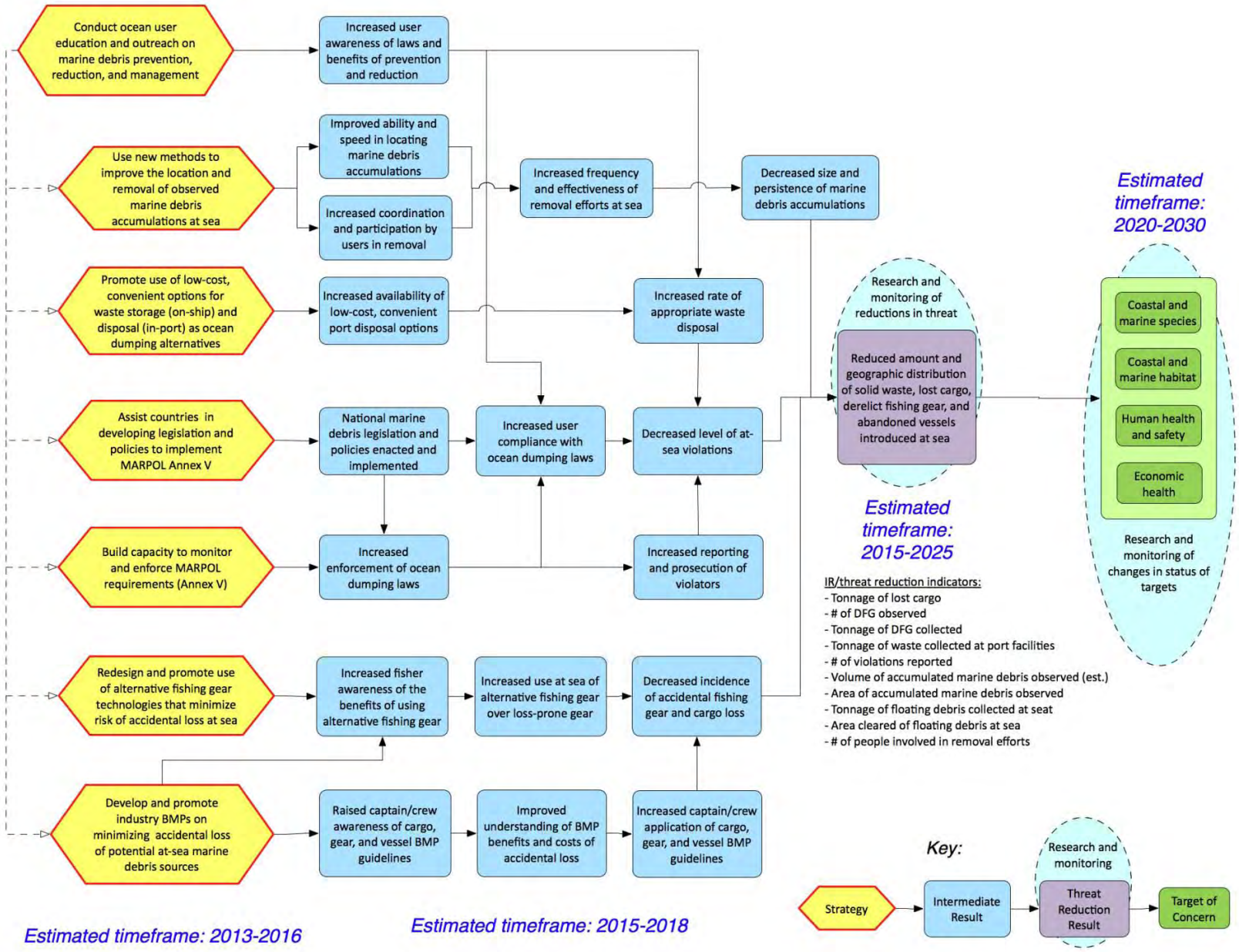

Figure 6. Results chain for at-sea sources of marine debris

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ANNEX 2 – Support for the Honolulu Strategy

The Honolulu Strategy's success will only be as effective as the commitments made by the broad spectrum of partners and stakeholders currently working on marine debris issues and those who are new to this campaign. The following are statements of support for the Honolulu Strategy from various organizations, regional groups and individuals that were involved in the planning and preparations for the 5IMDC. Other statements of support can be added followingt the Conference:

- *As part of the European Union's Marine Strategy Framework Directive (Directive 2008/56/EC), the **Marine Strategy Framework Directive Technical Subgroup on Marine Litter** will be developing a toolbox with applicable monitoring/quantification methods and a roadmap for the further MSFD Descriptor 10 implementation to harmonize monitoring approaches, produce common guidelines to assess good environmental status (GES) on regional and European scales, prepare recommendations for the evaluation of GES, give scientific support for the definition of objectives and organize data management and coordination. "Descriptor 10" aims at achieving that "properties and quantities of marine litter do not cause harm to the coastal and marine environment." This will support the Honolulu Strategy as part of a more worldwide process to achieve reduction of marine litter at sea.*

- ***EPA's Marine Debris Prevention Program** is supporting the Honolulu Strategy by exploring and applying educational, pollution prevention, and regulatory tools to help with the marine debris problem. As a regulatory agency, EPA is equipped to address the various stressors and activities that lead to marine debris (e.g., solid waste, wastewater, storm water, vessels). EPA uses a comprehensive, multi-office approach to prevent, control, and remove marine debris from the environment.*

- *As producers of products that find their way into the marine environment, plastic makers are working with government officials, scientists, retailers, litter prevention groups and consumers to devise solutions to prevent marine debris. Over the years plastic makers and recyclers have invested billions of dollars to develop and help support a nationwide infrastructure to recycle plastics, and we continue to develop new, innovative programs to collect additional plastic products. The plastic industries of the **American Chemistry Council** also support a growing number of education and research programs around the country to encourage people to Reduce, Reuse, Recycle and Recover.*

- *In support of the implementation of the Honolulu Strategy, the **California Coastal Commission** (CCC) staff will participate in the development of the West Coast Governors' Agreement on Ocean Health Marine Debris Alliance. In addition, the CCC will continue to administer the year-round Adopt-A-Beach Program and annual California Coastal Cleanup Day Program (a part of the International Coastal Cleanup) to remove deposited marine debris from California's beaches and shorelines. To expand the reach of its cleanup efforts, the CCC will encourage inland communities within California to take part in the annual Coastal Cleanup Day and spread the message about the need for reductions in marine debris to all citizens within the state. The CCC will also grow the year-round Adopt-A-Beach Program within coastal communities in California in order to reduce the burden of marine debris California contributes to the world's oceans. Finally, the CCC will seek to reduce the amount of materials produced and used during its cleanup events in order to further implement a model program that allows for debris removal without creating debris in the process.*

- *For 25 years, **Ocean Conservancy** has been ridding the ocean of trash as the founder and leader of the International Coastal Cleanup – the world's largest volunteer effort to both clean up and catalog the garbage in our ocean and waterways. Building upon this legacy, Ocean Conservancy commits to an ultimate goal of trash free seas. By partnering with innovative allies, and nesting our work in sound scientific research, we aim to reinvent products, reduce the flow of trash, and continue to remove trash and debris. We pledge to bring in a greater number of*

volunteers and partners worldwide so that through the International Coastal Cleanup we can expand efforts to remove trash in the ocean. And we commit to preventing more trash from reaching the ocean in the first place. We commit to partnering with industry and other allies to reinvent consumer products that are less harmful to the environment and we vow to seek out ways to change bad habits and champion policy initiatives that reduce the amount of single-use materials and manufactured debris that are improperly discarded.

- *Over the last 18 years,* ***Project AWARE Foundation*** *has partnered with scuba divers in more than 100 countries to remove and prevent marine debris underwater. Scuba divers are uniquely positioned to tackle this global ocean issue, to take action every day and prevent debris from entering the ocean. Since working towards marine debris solutions is a core focus area for Project AWARE, we are committed to the goals of the Honolulu Strategy. Now, Project AWARE's marine debris program has evolved with a comprehensive, tiered approach. On a local level, AWARE works with dive leaders around the world to lead a comprehensive underwater debris assessment program, provide a global view of debris underwater and identify marine debris "hot spots." AWARE also supports work with local communities and governments to prevent, reduce, and manage marine debris including underwater debris removal projects and integrated solid waste management practices. In addition, we are committed to sharing data and working with organizational partners such as Ocean Conservancy's International Coastal Cleanup while also assisting in the development of waste management policies and frameworks at national, regional and international levels*

- ***The West Coast Governors' Agreement on Ocean Health*** *comprising the states of Washington, Oregon, and California, highlighted marine debris as one of its priority actions in its 2008 work plan. A team formed to address this topic has been developing a West Coast Marine Debris Strategy that will seek unified, regional goals in marine debris reductions. Working from this Strategy, the West Coast Governors' Agreement commits to developing a tri-state Marine Debris Alliance in order to work towards marine debris reductions along the west coast of the United States in a coordinated, comprehensive fashion. By partnering with academia, nongovernmental organizations, the private sector, and federal, state, local and tribal governments, the Marine Debris Alliance will seek specific reductions in derelict fishing gear and marine debris originating from land-based sources. The West Coast Governors' Agreement commits to enhancing coordination towards the goal of a debris-free ocean. The West Coast Governors' Agreement further commits to expanding the reach of the Marine Debris Alliance, either by spreading to other states or countries or by sharing information on the development and implementation of its West Coast Marine Debris Strategy.*