MARINE WASTE AND DEBRIS

State of the Scotian Shelf Report

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CONTENTS

1 ISSUE IN BRIEF

LINKAGES

This theme paper also links to the following theme papers:

- Water and Sediment Quality
- Species at Risk

Marine waste or marine debris is any manufactured or processed solid material that enters the ocean environment either directly or indirectly (United Nations Environmental Programme 2011b; United States Environmental Protection Agency 2011; National Ocean and Atmospheric Administration 2011). Debris can range from plastic resin pellets to couchs (Vancouver Aquarium Marine Science Centre no date); Marine debris includes abandoned fishing gear (ghost gear), but excludes unexploded ordinances.

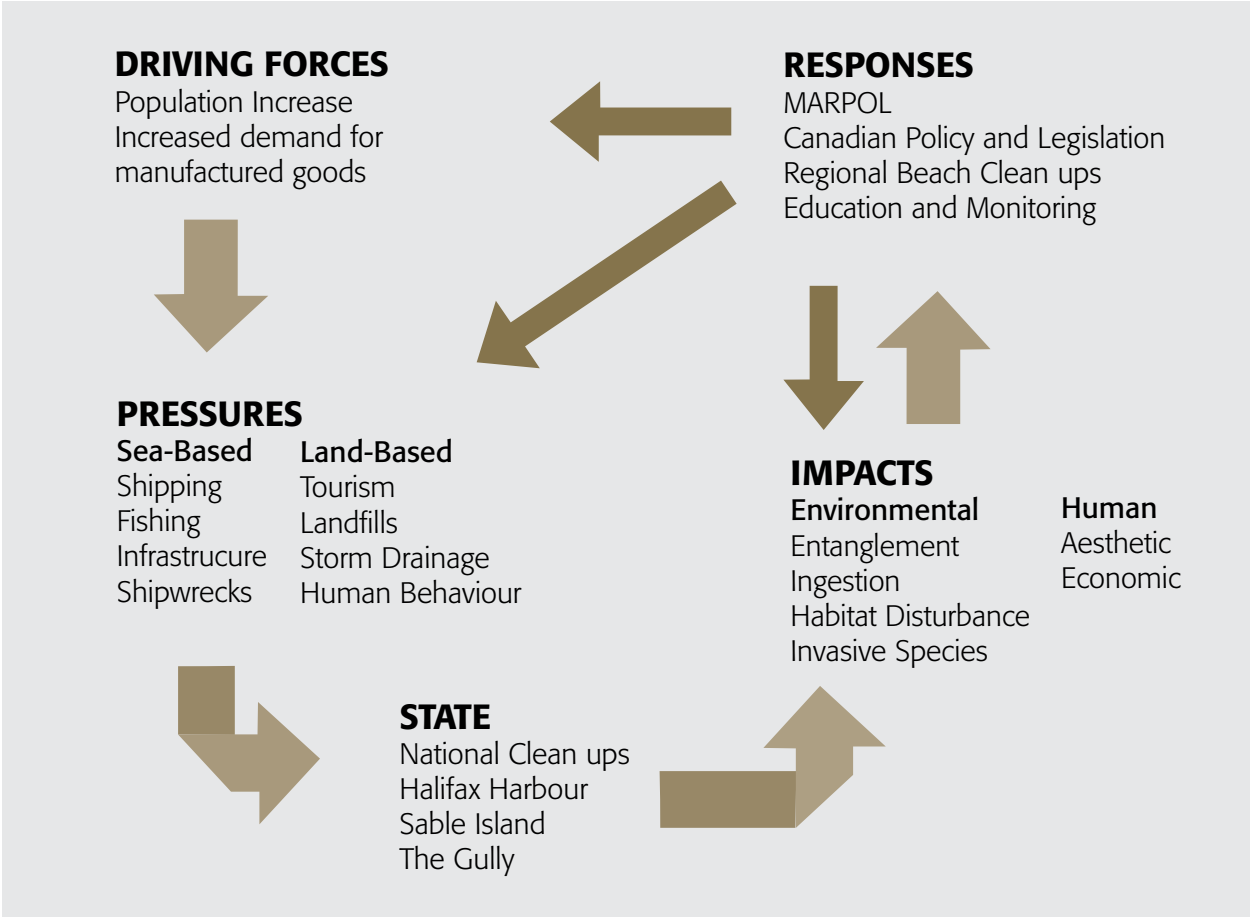

Figure 1: Driving forces, pressures, state, impacts and responses to marine waste on the Scotian Shelf.

Marine debris is becoming increasingly problematic on the Scotian Shelf. There is overwhelming evidence that plastic pollution is a threat to marine biodiversity, and particularly to marine biota, which is already at risk from various forms of anthropogenic disturbance (Derraik 2002). Sea life can become entangled in marine debris causing injury or death. Waste also causes socio-economic issues as it detracts from the beauty of beaches and other coastal areas.

Marine debris – trash in our oceans – is a symptom of our throw-away society and our approach to how we use our natural resources. It affects every country and every ocean…

– Achim Steiner (UNEP 2011a)

Studies show that marine debris originates from sea-based sources like shipping and fishing industry dumping practices, and abandoned construction (Dufault & Whitehead 1994). Land waste is also a major contributor to marine debris (UNEP 2011b). Waste from landfills and beaches makes its way to coastal and ocean environments primarily through untreated waste and storm water overflows.

Debris on the coast of Sable Island. Photo courtesy of The Sable Island Green Horse Society

A lack of awareness among main stakeholders and the general public are major reasons that the marine litter problem appears to be increasing on the Scotian Shelf, and worldwide (UNEP 2011b). The North Atlantic contains high concentrations of plastic debris, comparable to those observed in the region of the Pacific known as the "Great Pacific Garbage Patch". This has been made evident, in part, by studies of marine debris on the Scotian Shelf from 1984-1986 (Lucas 1991). More recent evidence from the Sable Island area suggests that litter accumulation has not diminished (Lucas, personal communication, April 6, 2011).

This paper will explore the driving forces and pressures behind the persistent problem of marine waste, as well as the state and impacts of waste on the Scotian Shelf environment. It will also outline key international and regional responses to the problem. (**Figure 1**)

2 DRIVING FORCES AND PRESSURES

2.1 POPULATION GROWTH AND INCREASED DEMAND FOR MANUFACTURED GOODS

As coastal communities continue to grow, there will be increasing stress on natural resources, leading to environmental degradation. Ribic et al. (2010) identified several mechanisms through which human population can drive the proliferation of marine debris; population size is of particular significance. Increased marine and coastal debris is linked to population increases and proximity to

ports. The population of Nova Scotia remained relatively constant from 1996-2006 at roughly 900,000 (Statistics Canada 2010). The population of Halifax, however, has been steadily increasing over the same time period: from 340,000 to 369,000. It is likely that Halifax, as both a major port and as a city centre, contributes to higher levels of marine waste than smaller coastal communities on the Scotian Shelf. Ross et al. (1994) offer insight on the level of marine waste around Halifax in a 1989 study.

Human behaviour is increasingly consumptive and generates waste. Worldwide demand for manufactured plastic products is expected to continue growing faster than the economy as a whole (Industry Canada 2011). In Canada, the packaging and plastics industry is considered a high growth industry. Twenty nine percent of plastic products produced in Canada are considered 'packaging', which contribute to solid waste totals soon after use (Industry Canada 2011). Two percent of these are manufactured in Nova Scotia.

Plastics are the main source of marine debris worldwide; between 60% and 80% of litter collected (Derraik 2002). Most commonly, items constructed of plastic occur on the Scotian Shelf and Atlantic coastal waters, and can account for up to ninety two percent of marine debris (Lucas 1992; Dufault & Whitehead 1994; Clean Nova Scotia Foundation 2010). Most of the plastic is millimetres in size and consists of polyethylene or polypropylene, materials that float in seawater (UNEP 2011b). The identifiable plastics include: grocery bags, nylon rope, potato chip bags, Styrofoam, bottles, cans, and cigarette filters (US EPA 2011).

Canada produces the most municipal waste per capita with some estimates at 791 kg per person (The Conference Board of Canada 2011). This figure has been steadily rising since the 1980s. In Nova Scotia, per capita waste estimates were 429 kg in 2008. Though much of Nova Scotia's waste is diverted through recycling and composting programs, three of the top five marine debris items collected during national marine debris monitoring were items that potentially could have been recycled: plastic bottles, plastic bags, and cans (US EPA 2011).

It has been estimated that over 13,000 pieces of plastic litter are floating on every square kilometre of ocean surface

– UNEP 2011b

2.2 LAND BASED SOURCES OF MARINE DEBRIS

Debris enters the aquatic environment via sewage outflows and storm water drains during periods of intense rainfall and flooding. Litter is improperly disposed of down drains and toilets or stormwater carries litter and other debris through municipal water systems and over land to be discharged into marine environments (Ribic et al. 2010; US EPA 2011). Other extreme natural events are capable of carrying objects or directing objects into the ocean as well (NOAA 2011).

As population increases, there will be more pressure on the environment from human consumption. Increasing consumptive populations contribute to land-based debris, which becomes marine debris through improper waste management regimes and extreme weather. Irresponsible beachgoers leave behind waste and debris which gets swept into the ocean or remains to litter the shoreline (US EPA 2011).

Table 1: Canada's Dirty Dozen List (2009)

2009 RANK	ITEM	NUMBER OF ITEMS COLLECTED
1	Cigarettes/Cigarette Filters	367,010
2	Food Wrappers/Containers	116,138
3	Bags (Plastic)	74,276
4	Caps, Lids	63,471
5	Cups, Plates, Forks, Knives, Spoons	40,799
6	Beverage Cans	38,702
7	Beverage Bottles (plastic) 2 litres or less	37,618
8	Bags (paper)	30,019
9	Straws, Stirrers	29,925
10	Beverage Bottles (glass)	29,361
11	Tobacco Packaging/Wrappers	19,906
12	Cigar Tips	17,328

2.3 SEA BASED SOURCES OF MARINE DEBRIS

Sea-based sources of marine debris include: recreational and commercial fishing, routine disposal of garbage at sea by shipping vessels, and construction projects.

Debris from the fishing industry includes: fishing nets, lines, lures, rope, bait boxes, and light sticks. It is estimated that 52 metric tonnes of abandoned fishing gear accumulates annually (UNEP 2011b).

Recreational boats, military vessels, cargo ships, cruise ships, ferries, and charter boats can be sources of galley waste, garbage, plastic bags, and other materials. All of these materials can accidentally fall, blow, or wash off the vessels into the water and become marine debris. In some cases, waste and debris is deliberately thrown overboard; routine disposal of garbage at sea as been reported for fishing and merchant fleets, and Canadian military and government research vessels (Lucas 1992). In one study, only 1% of selected vessels reported all garbage taken to shore (Lucas 1992).

3 STATUS AND TRENDS

Little quantitative information is available about marine debris either regionally or internationally (Ribic et al. 2010; UNEP 2011b). Although there are no recent or certain statistics on how much litter is released into ocean and coastal environments worldwide, in 1997, the US Academy of Sciences estimated the total input of marine litter into the oceans at approximately 6.4 million tonnes per year (UNEP 2011b). Environment Canada (2010) reports that each year in Canada, between two and four million tonnes of material are disposed of at sea. About 90 percent of that quantity is not considered waste, but dredged sediment from estuarine or marine sources or excavated native till from land based sources.

Some estimates reveal that roughly 8 million debris items enter the oceans every day, about 5 million of which are thrown overboard or lost from ships
– UNEP, 2011b

On the Scotian Shelf, marine debris has been sporadically tracked since the 1980s. Generally, data on marine waste and debris are collected by survey monitoring. Surveys are undertaken visually, by passengers on vessels, or physically by collecting waste and debris either in the ocean or on coastal beaches. Waste collected during surveys gives us a general impression of the condition of the surrounding waters.

Many areas including the Gully, Sable Island, Halifax Harbour and numerous coastal beaches have been surveyed over time to record marine debris and waste. The following sections describe results and trends identified through the research, moving from the coast to the offshore, which contribute to our understanding of the marine waste issue on the Scotian Shelf.

3.1 SHORELINE CLEANUPS

On the Atlantic coast, a substantial amount of debris is directly deposited by visiting beach areas (not simply washed ashore). In 2009, participants of the Canadian Shoreline Cleanup removed litter from 2,457 km of shoreline nation-wide (**Table 2**) . Clean up results indicate that the amount of waste

Table 2: Canadian Shoreline Cleanup Results for 2009 (National)

YEAR	REGISTERED SITES	DISTANCE CLEANED (KM)	GARBAGE BAGS	WEIGHT (KG)*	WEIGHT (KG) PER KM
2009	1,568	2,457	15,930	160,914	65
2008	1,531	2,152	13,202	135,467	63
2007	1,240	1,772	13,473	87,489	49
2006	965	1,640	8,867	84,735	52
2005	812	1,477	10,383	78,356	53
2004	658	1,147	9,319	64,988	57
2003	477	771	5,438	49,859	57
Totals	**5,683**	**8,958**	**60,682**	**500,894**	

collected during national shorline cleanups (kg/km^2) has increased over time.

Items recovered during the Canadian Shoreline Cleanup were classified by activity: recreational, ocean-related, smoking, dumping and medical/hygiene (**Table 3**).

Provincial marine debris data is highly variable. **Table 2** gives some perspective on the state of the coastal debris issue in the Atlantic Provinces. According to this table, in Nova Scotia 64% of debris collected was attributed to smoking-related activities. However, preliminary data via beach sweeps conducted by Clean Nova Scotia's 'Ship to Shore' program suggest that smoking-related activities make between two and five percent of waste collected on shorelines, whereas, ocean/waterway activties can contribute up to 95%. Variations could be attributed to the location of the clean up, access to the site, the time of year, or other factors, such as data collection methods.

A survey of the Atlantic coast also identified large quantities of fishing-related marine debris, which poses significant danger to the marine environment (Thom 2009). Ribic identified the correlation between ocean-based indicator debris and the regional fishing sector in his 1999 study; overall, the results support the expectation that oceanic fishing activity is related to the amount of oceanic debris deposited on coastal beaches.

3.2 HALIFAX HARBOUR

Ross et al. (1991) assessed the type and source of persistent marine debris in Halifax Harbour in 1989. The majority (62%) of waste on the shores of the Halifax Harbour originated from recreation and land-based sources. They recorded the highest amounts of waste in recreational areas. Their data reveal that over one half (54%) of total marine debris in the Harbour was plastic. Styrofoam accounted for 12%, glass 8.4%, paper and wood 5.2%, and rubber 3%.

Halifax, as a the population centre of Nova Scotia and as a major port in the Atlantic Region shows high percentages of land-based marine debris, which can likely be attributed to its location, accessibility, status as a tourist-hub, and human behaviour. The study concluded that waste in the Halifax Harbour is created mainly by citizens in the area rather than by industry, the military, or other sources. Other studies on the Atlantic coast echo this finding; a study undertaken by Thom

Table 3: Canadian Shoreline Cleanup Results: Recovered Waste Items by Province and Activity (Maritimes Provinces)

PROVINCE	SHORELINE AND RECREATIONAL ACTIVITIES		OCEAN WATERWAY ACTIVITIES		SMOKING RELATED ACTIVITIES		DUMPING ACTIVITIES		MEDICAL PERSONAL HYGIENE ACTIVITIES	
	n	%	n	%	n	%	n	%	n	%
New Brunswick	5148	27.1	1273	6.7	293	1.5	11570	60.9	721	3.8
Newfoundland and Labrador	1093	9	179	1.5	8482	69.9	367	3	2012	16.6
Nova Scotia	2051	6.8	1273	4.3	19290	64.4	457	1.5	6708	22.4
Prince Edward Island	881	32.8	9	0.3	862	32.1	31	1.2	75	2.8

(2009) traced markings on plastics recovered to primarily local sources such as household or small ship waste. The results of Ribic et al.'s (2010) study on marine debris in the North Atlantic reveal that land-based indicator-waste decreases as distance to the nearest population centre decreases. Similarly, the number of ocean-based indicator items declines with increasing distance from a port.

3.3 SABLE ISLAND

The amount of debris washing up on shore of Sable Island is substantial. Lucas undertook surveys of marine debris on the shores of Sable Island between May 1984-September 1986. Unlike other Atlantic coastal shorelines, persistent waste on Sable Island comes from the ocean and does not originate on the island itself. A total of 11 183 persistent litter items were collected and sorted, representing 219 items/km/month. 92% of this total was plastic material such as tampon applicators, polystyrene cups, packing materials, bags, liquor and soft drink bottles, lightbulbs, rope and fishing gear. Lucas identified 30% of the items to be of domestic origin, with 20% clearly originating from the fishing industry (i.e. gear, nets, etc.). Lucas documented deposition rates as being fairly consistent from year to year and site to site, and extrapolated from this study that waste is accumulating at a monthly rate of 219 items per km, or over 18,000 items per month on the entire island.

It is also important to note that accumulation and deposition rates on Sable Island may be influenced by natural conditions such as ocean circulation. Ribic et al. (2010) found that large scale circulation systems affected ocean-based indicator debris loads in his study of marine debris in the North Atlantic. The Northeast and Mid-Atlantic regions are influenced by the southward flowing Labrador current as part of the western North Atlantic Gyre (Ribic et al. 2010). The surface circulation of the area is proposed as a southward movement along the length of the Nova Scotian coast which then circles back offshore toward Sable Island and beyond creating a large cyclonic eddy centre at Sable Island (Dufault & Whitehead 1994).

3.4 THE GULLY

In the 1990s, floating marine debris was surveyed, visually and by net tow, in the Gully in three separate studies (1990, 1996/7, 1999). The results of the surveys suggest that, during this period, the quantity of marine debris decreased. Data revealed a continuous drop in quantity and density.

Dufault and Whitehead (1994) observed that all items with identifiable labels were traced to domestic sources. They found greater concentrations of large debris (visible floating items) and lower concentrations of smaller debris (captured in a fine-meshed, 0.308 mm net) than reported in the literature for other areas of the world (Scarfe, 1999). They attributed a great deal of marine debris to the local fishing industry or other small pleasure craft in the area.

In 1999, Scarfe also found that the quantity of large debris in the Gully had decreased since the original 1990 survey. Floating marine debris was only noted in half of the visual surveys, as opposed to almost all in the original 1990 study. Small plastic debris was found in 90% of the garbage tow surveys.

It has been suggested that the 1998 designation of the Gully as a pilot Marine Protected Area was successful in contributing to overall public awareness and the decreasing amount of debris in the area, particularly debris originating from fishing and shipping vessels.

4 IMPACTS

Photo credit: Canadian Sea Turtle Network.

4.1 ENVIRONMENTAL IMPACTS

The marine environment experiences the effects of marine waste both directly and indirectly. Biota can be physically harmed by debris through entanglement, ingestion, smothering or through the transportation of invasive species to new environments. Indirectly, marine habitats can be harmed when beach clean ups result in changes within coastal ecosystems (US EPA 2011).

Entanglement

Sea life can become entangled in marine debris causing injury or death. Entanglement can lead to suffocation, starvation, drowning, increased vulnerability to predators my restricting the animal's movement, or other injury such as wonuds from tightening material (UNEP 2011b). Lost or abandoned fishing nets pose a particular risk to both fish and marine mammals. Ghost nets continue to catch animals even if they sink or are lost on the seabed.

Around the world, people have reported entanglement for several marine species – notably, species of endangered sea turtles (UNEP 2011b), sea birds (Mallory 2008) and seals (Lucas 1992). Volunteers participating in the 2008 International Coastal Cleanup event discovered 443 animals and birds entangled or trapped by marine debris (US EPA 2011).

On the Scotian Shelf plastic debris is a particular threat to marine diversity (Derraik 2002). Sampling of marine birds has shown that pollution by plastic debris has increased in Canada's oceans in the past few decades (Derraik 2002; Mallory 2008). The Atlantic Fisheries International Observers Program has documented numerous cod and dogfish entangled in gillnets and other forms of plastic. Other surveys have also found plastics in the contents of the stomachs of cod. Young seals are attracted to floating debris and can easily become entangled (Derraik 2002). Of 241 grey seal pups handled during a research program in May 1987, 2.5% were entangled in trawl net (Lucas 1992) (pictured in **Figure 3**).

Grey seal entangled in trawl net on Sable Island. Photo courtesy of The Sable Island Green Horse Society

At least 267 marine species worldwide are affected by entanglement in or ingestion of marine debris, including 86 percent of all sea turtle species, 44 percent of all seabird species and 43 percent of all marine mammal species…

– UNEP, 2011b

In 1978, 99 dead seabirds and over 200 dead salmon were recorded during the retrieval of a 1500 m ghost net on the Scotian Shelf (Derraik 2002).

Ingestion

Many species mistake marine debris for food. A plastic bag floating on the surface of the water resembles a jelly-fish, which are eaten by many species of fish and turtles (UNEP 2011b). In 1992, a Sable Island study reported ingestion of plastics by leatherback turtles on the Scotian Shelf (Lucas 1992). A 2009 report revealed that plastic ingestion by leatherback turtles was as high from 1885-1968 (Mrosovsky et al. 2009). From the 1960's to the 1980's the percentage of turtles with ingested plastics peaked; up to 37% of reports indentified plastics in the remains of turtle stomachs Mrosovsky et al. 2009). Also, at least 26 species of cetaceans on the Scotian

Shelf, have been documented to ingest plastic debris (Derraik 2002),

The effects of ingestion are broad. Plastics and other debris can accumulate in an animal's stomach causing it to feel full. Eventually, this can be fatal since debris material reduces meal size and prevents nutrients from being absorbed (Derraik 2002; US EPA 2011). Internal injuries, infections, hormone imbalances, and reproductive failure may also result from ingestion. Threat can also be chemical; toxic chemical leaching from ingested debris have been documented in birds and turtles (Fisheries and Oceans Canada 2010).

Invasive species

Marine debris contributes to the movement of aquatic organisms since floating debris in the marine ocean can acquire encrusting organisms and other fauna. Alien species use debris to increase their range and migrate to new territory, where they can colonize and overwhelm local marine ecosystems (US EPA 2011; Derraik 2002). Lucas (1992) identified marine organisms encrusted to 5-10% of plastic containers and fragments collected during beach surveys. There is also evidence that drifting plastic could be contributing to the introduction of exotic species in coastal ecosystems with resulting detrimental impacts (Fisheries and Oceans Canada 2010).

Disturbance

Smothering of the seabed occurs when debris collects in benthic environments. Debris can suffocate seabed animals and plants, while other debris items can be dragged along the seabed, tearing up the fragile habitat for bottom dwellers (US EPA 2011). Plastics and fishing nets are particularly detrimental, while abandoned fishing gear and other large marine debris can break sensitive corals (US EPA 2011). Ultimately, this can alter the composition of life on the sea-floor (Goldberg 1994).

Sometimes, efforts to clean marine debris contribute to habitat disturbance. Mechanical techniques like raking disturb nests or result in ecosystem changes that alter the function of the area (UNEP 2011b). Beach raking can also contribute to beach erosion if the natural vegetation is disturbed (US EPA 2011).

4.2 SOCIO-ECONOMIC IMPACTS

Social and economic impacts caused by marine debris are difficult to assess (Fisheries and Oceans Canada 2010). Generally, socio-economic impacts fall under two categories: damage to fisheries and potential lost tourism.

Fishing Industry

Debris can damage boats used for recreation and fishing. It can become entangled in propellers, clogs valves or break hulls. Repairing boats damaged by marine debris is costly and contributes to lost fishing opportunities (Ross et al. 1994; US EPA 2011).

For commercial fisheries, there is damaged market potential for fish and fish products which are entangled in marine debris or have ingested marine debris (US EPA 2011).

Tourism

The tourism industry needs clean, healthy beaches to attract visitors (Fisheries and Oceans 2010).The major impact of marine debris is its negative aesthetic effect, which is unwelcoming to beachgoers (Ross et al. 1991; UNEP 2011b. Marine debris makes public spaces less attractive and less safe, which can lead to beach closures or lost revenue from tourism (US EPA 2011; UNEP 2011b). Accordingly, marine debris can also have a serious economic impact on communities who are dependent on tourism for their livelihood (UNEP 2011b).

5 ACTIONS AND RESPONSES

Despite growing awareness of marine debris, the problem is still largely unexplored and unreported (Derraik 2002; Thom 2009), and little solid scientific information exists about the nature and scope of the issue (National Science Foundation 2010). The United Nations Environmental Programme stated that contemporary and historical measures to prevent and reduce marine waste were inadequate, and the problem will likely worsen in the 21st Century. However, the following actions are being taken to address this growing problem in the marine environment.

5.1 INTERNATIONAL COMMITMENTS

The International Convention for the Prevention of Pollution from Ships (MARPOL) is an international agreement that recognizes that vessels present a significant and controllable source of pollution into the marine environment (Centre for Marine Conservation 1994; Derraik 2002). In 1973, Canada joined other nations in drafting the Convention (and is signatory to it), which prohibits disposal at sea of persistent pollutants; it restricts any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms, or other man-made structures at sea (Pearce 1992). Annex V of the MARPOL Convention, called the London Convention, specifically prohibits the disposal of plastics and garbage from ships (Centre fot Marine Conservation 1994).Transport Canada reports that if MARPOL restrictions were not in place, up to 35 percent of pollution in the world's marine environment would be the direct result of marine transport (Transport Canada 2010).

Derraik 2002 reported that the legislation is widely ignored and ships are still estimated to discard 6.5 million tons per year of plastics The compliance of individuals is partly a question of economics and logistics; in order to discourage waste disposal in the marine

environment, ships need to have access to adequate and affordable waste reception facilities at ports (National Academy of Sciences 2008).

5.2 CANADIAN POLICY AND LEGISLATION

In 1987, Canada's Oceans Policy noted increasing concern with the issue of marine debris (Pearce 1992). Taking political action, Canada ratified the MARPOL Convention, and meets its international obligations and supports its own pollution prevention objectives for disposal at sea through the *Canadian Environmental Protection Act* (CEPA). Consistent with the Marpol Convention, the CEPA controls disposal of substances into waters from activities taking place at sea through legislated general prohibition; disposal of any substance into the sea is not allowed unless it is done in accordance with a permit issued by Environment Canada (Environment Canada 2011). Only a small list of wastes or other matter can be considered for permits and these are individually assessed to ensure that disposal at sea is the best environmental alternative, that pollution is prevented, and that any conflicts with other marine users are avoided (Environment Canada 2011).

The disposal at sea permit also triggers the *Canadian Environmental Assessment Act* and therefore requires at least a screening assessment of all Disposal at Sea activities in addition to the assessment conducted under CEPA (Environment Canada 2011).
It is still unclear how existing waste and debris is being dealt with. Environment Canada has a mandated responsibility to deal with waste in the marine environment. However, there are no known federally-led programs which aim to reduce existing waste or prevent new waste accumulation.

5.3 PROVINCIAL AND COMMUNITY-LED INITIATIVES

In Nova Scotia, the Clean Nova Scotia Foundation has been partnering with the public, governments, and businesses to advocate for a clean marine and coastal environment in the province for over 20 years (The Clean Nova Scotia Foundation 2009). In cooperation with various agencies including the Small Craft Harbours Branch of Fisheries and Oceans Canada, the Foundation has launched an outreach and monitoring program aimed at eliminating the disposal of wastes at sea by the commercial fishing sector and encouraging proper waste receptacles on shore at fishing harbours. This program, called Ship-to-Shore, is a pilot program administered through 21 fishing harbours throughout Nova Scotia.

The Clean Nova Scotia Foundation also administers a provincial shoreline clean up project titled 'The Great Nova Scotia Pick-Me-Up', which aims to beautify Nova Scotia's beaches as well as to identify and characterize the source of marine waste in the province. Similar initiatives are undertaken on a nation-wide scale, including the World Wildlife Foundation-sponsored 'Great Canadian Shoreline Cleanup' and Pitch-In Canada-sponsored beach clean ups.

Efforts are also being made by the Nova Scotia government to reduce the amount of land-based waste generated per capita throughout the province. With a target of 300 kg per person, Nova Scotia will have to cut waste generated by 50% (Nova Scotia Environment 2010). To achieve this, the Nova Scotia Department of Environment is developing new programs to promote environmental stewardship and implementing waste regulations.

5.4 EDUCATION AND MONITORING

Education and public outreach are the most significant drivers for change related to the problem of marine debris in Canada (Derraik 2002). Many national and regional education programs have been undertaken to reduce the problem of marine debris in Canadian waters. These programs have been targeted at both the general public as well as specific sectors.

Fisheries and Oceans Canada recently undertook an initiative regarding marine debris aimed at public education. A four-part DVD was produced which provided a comprehensive overview of the problem, both worldwide and in Canada. As part of the Federal Health of the Oceans initiative, Transport Canada is also developing and implementing a Ship Waste Reduction Strategy to further prevent marine pollution from ships.

Pitch-In Canada is a national non-profit organization started by several volunteers concerned about plastics and other packag-

ing and their effects on the land and marine environments (Pitch-In Canada 2006). They recognized that personal action, with assistance from governments and other stakeholders, is needed to conserve, enhance and protect the environment and to reduce waste. Pitch-in Canada has been informing and educating the public about marine debris, through youth programs and other forums, for 40 years and also supports and promotes beautification of shorelines nationwide.

Locally, Clean Nova Scotia's Ship-to-Shore program currently works with commercial fishermen and has, in the past, worked with recreational boaters on waste disposal habits at sea and on land. The Ship to Shore program involves outreach at community and public events, presentations and materials distribution on responsible boating through proper waste management.

Therefore, debris management strategies targeted at changing people's behaviour have some potential for reducing debris load on beaches (Ribic et al. 2010).The Ross et al. (1991) study suggests that public education and municipal law enforcement could reduce the marine debris problem in the Halifax Harbour by 82%.

Nova Scotia does have a waste management strategy, properly managing waste requires extra time and effort. Garbage or recycling centers may not be efficient, which can lead to inappropriate or illegal disposal (US EPA 2011).

INDICATOR SUMMARY

INDICATOR	POLICY ISSUE	DPSIR	ASSESSMENT	TREND
Waste per capita (Halifax)	Human Behaviour, Waste Management	Pressure	Fair	-
Shoreline Cleanup Results	Human Behaviour, Waste Management	State	Poor	+
Marine mammals entangled in debris	Waste Effect on Animals	Impact	Poor	+
Plastics ingested by marine mammals	Waste Effect on Animals	Impact	Poor	+

Data Confidence:
- Much of the evidence that exists on the Scotian Shelf is circumstantially collected
- Worldwide, current statistics and future trends for marine debris are uncertain
- Unsure of accuracy of marine waste studies

Data Gaps:
- More recent (2000-2010) comparative studies are needed to examine trends in marine debris on the Scotian Shelf
- Landfill data for Nova Scotia unavailable

Key:
Negative trend: -
Unclear or neutral trend: /
Positive trend: +
No assessment due to lack of data: ?

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