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Marine Environmental Emergency Preparedness and Response
Regional Activity Centre

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Negative Impacts of Marine Litter in the NOWPAP Region: Case Studies

Regional Seas

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PREFACE

In recent years the global community has been recognizing the seriousness of marine litter. The heartbreaking calamity of the Great Tohoku Earthquake in Japan in March 2011 alarmed the world of how natural disaster can bring about secondary impacts to nature. Aside from the great number of casualties it has inflicted, the earthquake washed away enormous amounts of litter and part of them is predicted to reach the west coasts of Canada and US.

In the same month of the 2011 Tohoku Earthquake, UNEP and NOAA co-organized the 5th International Marine Debris Conference (5th IMDC) which has culminated in the adoption of the Honolulu Commitment and the Honolulu Strategy. As the outcomes of the Conference clearly show, the global community is ready to take action against marine litter, and we have already witnessed many actions being taken around the world.

In line with the global efforts on marine litter, NOWPAP has been taking lead in responding to the marine litter issue in the Northwest Pacific region since 2005. It is encouraging to see much progress in the battle against marine litter being reported in this region. However, marine litter is a challenging foe of our era and we are in a nascent state in addressing the issue. This is the reason we should collaborate to effectively address the problem as a whole.

This publication has endeavored to gather information relating to the adverse impacts of marine litter. As documented in the report, marine litter is affecting almost all aspects of our society. The case studies provide concrete evidence of how communities are affected by marine litter, and present an opportunity for us to contemplate measures to be taken to mitigate negative effects. Although there are many documents relating to marine litter produced/published by UNEP and other organizations, this report takes a regional perspective to look at the environmental, social and economic impacts of marine litter.

I trust that this publication would provide valuable information to the global community in addressing the marine litter issue.

Dr. Seong-Gil Kang
Director of NOWPAP MERRAC

ACKNOWLEDGMENTS

This document has been prepared by the Marine Environmental Emergency Preparedness and Response Regional Activity Centre (MERRAC) of the Northwest Pacific Action Plan (NOWPAP) with inputs from national experts as agreed at the 13th MERRAC Focal Points Meeting and the 6th Competent National Authorities Meeting on 8-11 June 2011. The study has been conducted as a part of activities within the framework of the NOWPAP Regional Action Plan on Marine Litter (RAP MALI). MERRAC compiled and edited the reports on negative impacts of marine litter submitted by: Dr. Linlin HU of China, Mr. Norihisa TSUNETANI of Japan, Dr. Won Soo KANG of Korea and Dr. Yana BLINOVSKAYA of Russia with the cooperation of Ms. Miyuki ISHIBASHI of Japan and Mr. Seon Dong KIM of Korea. The following MERRAC staff contributed to the editing and production of this document: Dr. Seong-Gil KANG, Dr. Jeong-Hwan OH, Ms. Hyon-Jeong NOH, Ms. Sungkook JOH, Ms. Jae-Im LEE, and Ms. Jung-Hyun LIM with technical support of MERRAC Focal Points, NOWPAP Marine Litter Focal Points, NOWPAP Regional Coordinating Unit (RCU), NOWPAP Regional Activity Centres (RACs), and International Maritime Organization (IMO). The draft of this report has been technically reviewed and edited by Dr. Won-Tae SHIN of Global Ocean, Inc. The Government of Korea has graciously provided partial financial support for the production of this report.

EXECUTIVE SUMMARY

This report is an outcome of a joint research and collaboration among MERRAC Focal Points, Marine Litter Focal Points and experts of the NOWPAP region. The research has been granted by the 13th NOWPAP MERRAC Focal Points Meeting and Competent National Authorities Meeting in 2011 as part of the activities of NOWPAP Regional Action Plan on Marine Litter (RAP MALI) 2010-2011, which was approved by the 14th NOWPAP Intergovernmental Meeting (IGM). The aim of this publication is to assess the negative impacts of marine litter in the Northwest Pacific region where the marine litter issue has been highlighted over the past 10 years. As demonstrated in the report, we can find numerous tangible cases of negative impacts of marine litter in our region.

Chapter I provides general information on the definition, characteristics, spatial distribution and status of research on marine litter. It is apparent that many publications on marine litter are already available including many published by UNEP. We made reference to the definition and classification of marine litter from UNEP publications.

Chapter II presents a comprehensive account of the current state of marine litter in the NOWPAP region through information gathered from the four NOWPAP member countries, i.e., People's Republic of China, Japan, Republic of Korea and Russian Federation. The marine litter monitoring programmes in each country are briefly introduced. Also, spatial distribution of marine litter including litter on seashores, sea surface and seabed has been analyzed.

Chapter III attempts to provide cases of negative impacts of marine litter to the most affected sectors including: i) fishing and aquaculture; ii) marine ecosystems, habitats and biodiversity; iii) shipping and navigation and iv) tourism and recreational activities. It is concluded that Fishing and Aquaculture are the most heavily affected by marine litter while the sector is blamed as one of the biggest sources of marine litter. There are ample cases of losses and damages caused by marine litter in this chapter.

Chapter IV presents the negative impacts of marine litter by identifying its causes and types and its social, environmental and economic impacts. Although it is difficult to quantify the impacts of marine litter, the cases of negative impacts shown in this chapter demonstrate that marine litter is affecting our environment in many different

areas. The findings of this report invite immediate action towards marine litter.

Chapter V suggests some readily implementable actions in order to respond to imminent threats of marine litter. Among others, actions against priority constituents such as plastics which represent the largest portion of marine litter, and derelict fishing gear which cause the heaviest damage to oceanic life in the form of ghost fishing are urgent. Participation in cleanup activities and improvement of public awareness of the marine litter issue as well as regular and efficient monitoring of marine litter are suggested as priority actions towards mitigating the negative impacts of marine litter.

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1. INTRODUCTION

The term marine litter or marine debris is defined by UNEP (2005) as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. Marine litter consists of i) items carried indirectly to the sea by rivers, sewage, storm water or winds, ii) material such as fishing gear and cargo accidentally lost at sea, and iii) items deliberately discarded by people into rivers and the sea, or on beaches and shores.

There are a variety of sources that generate marine litter, but the main sources can be grouped into two categories: i) land-based activities and ii) sea-based activities. Land-based sources of marine litter may include:

- Municipal landfills (waste dumps) located on the coast
- Riverine transport of waste from landfills or other sources along rivers and other inland waterways (canals)
- Discharge of untreated municipal sewage and storm water (including occasional overflows)
- Industrial facilities (solid waste from landfills and untreated water)
- Tourism (littering by visitors to the coast and beach goers).

Sea-based sources of marine litter may include:

- Merchant shipping, ferries and cruise liners
- Fishing vessels
- Military fleets and research vessels
- Pleasure craft
- Offshore oil and gas platforms
- Fish farming installations.

Random materials including but not limited to cotton, wood, cigarette butts, plastic, and derelict nets from the above land and sea-based sources are distributed not only on the beach and sea surface, but in the water column and seabed as well. The very slow rate of degradation of most marine litter items causes them to accumulate in the seas, gradually destroying the marine environment. Therefore, marine litter, which can be found anywhere in the marine and coastal region, has been recognized as a major form of marine pollution that destroys ecological, economic, recreational and aesthetic values of the marine and coastal environment.

In recognition of the gravity of the marine litter issue in the Northwest Pacific region, the NOWPAP member states – People's Republic of China, Japan, Republic of Korea, and Russian Federation (hereinafter referred to as China, Japan, Korea and Russia) – have commenced various activities and projects to address the marine litter issue within the NOWPAP framework.

In 2005, the 10th NOWPAP IGM approved implementation of Marine Litter Activity (MALITA). After successful implementation of MALITA for two years, RAP MALI has been implemented since 2008. MERRAC, being in charge of preparedness and response for sea-based marine pollution within the NOWPAP region, has conducted activities for the reduction and management of sea-based marine litter in cooperation with other RACs and has published several guidelines and technical reports as listed below:

- Guidelines for Monitoring Marine Litter on the Seabed in the Northwest Pacific Region (2007);
- Guidelines for Providing and Improving Port Reception Facilities and Services for Ship-Generated Marine Litter in the Northwest Pacific Region (2007);
- Sectoral Guidelines for Marine Litter Management: Fishing, Commercial Shipping, Recreational Activities, Passenger Ships (2007);
- Brochure on Sea-Based Marine Litter: Problem & Solution (2007);
- Regional Report on Sea-Based Marine Litter (2008);
- Marine Litter Management: The Approach of Incheon City, Korea (2008);
- Port Reception Facilities in the NOWPAP Region (2009); and
- Report on the Technologies and Research Outcomes on Prevention, Collection and Treatment of Marine Litter in the NOWPAP Region (2010).

Upon the approval of RAP MALI workplan (2010-2011) at the 14th NOWPAP IGM (2009), the meeting requested MERRAC to conduct a study on specific cases of the negative impacts of marine litter in the NOWPAP region. For efficient implementation of the study, NOWPAP MERRAC formed an Expert Group consisting of national experts, nominated by NOWPAP MERRAC Focal Points and Marine Litter Focal Points.

This case study has been prepared based on the national reports on negative impacts of marine litter submitted by national experts, including information on the distribution of marine litter in the NOWPAP region in order to understand the severity of the marine litter issue and to improve public awareness.

2. THE CURRENT STATUS OF MARINE LITTER IN THE NOWPAP REGION

2.1. Monitoring Programmes of NOWPAP Member States

The NOWPAP member states have implemented national marine litter monitoring programmes to understand the situation of marine litter in the respective countries. Also, the NOWPAP Data and Information Network Regional Activity Center (DINRAC) has collected monitoring data submitted by Marine Litter Focal Points and established a database through RAP MALI. This report made reference to the information on the DINRAC Database (http://dinrac.nowpap.org) and the relevant data submitted by national experts.

Depending on the spatial distribution, marine litter can be categorized into three groups, namely: i) marine litter on the shoreline, ii) marine litter on the sea surface, and iii) marine litter on the seabed. Most regular monitoring activities conducted by the member states are being focused on shoreline litter, which is considered relatively convenient and inexpensive to survey whereas regular monitoring on marine litter on the sea surface and seabed is being conducted only in China. The following is a brief introduction of monitoring activities of member states.

In China, the State Oceanic Administration (SOA) has been organizing annual marine litter monitoring activities in coastal and offshore areas since 2007. The monitoring activities have covered marine litter on the beaches, sea surface and seabed, and monitoring parameters include type, count and weight of the collected marine litter.

In Japan, the Northwest Pacific Region Environmental Cooperation Center (NPEC) has been investigating the current extent of marine litter pollution on the coast since 1996. NPEC has also examined 48 beaches in China, Japan, Korea and Russia through 24 local governments of the four member states since 2003 (NPEC, 2003). Data collected by experts through RAP MALI were used for reference.

In Korea, the marine litter issue has received much attention since 1999. As a result, Korea has participated in the International Coastal Cleanup (ICC) since 2001. The government set out the first nationwide beach monitoring programme from 2000 to 2003, and subsequently the five-year Korea National Marine Debris Monitoring

Program (KNMDMP) was commenced in 2008 in order to understand the distribution and sources of marine litter scattered along coastal areas.

In the Russian Far East, a regular monitoring programme has not been reported except for the ICC events. This report referred to the NPEC survey results carried out in the three coastal provinces of the Russian Far East in 2009 and information from 1999 to 2010 submitted by Russian experts.

Regular monitoring of floating and seabed litter is carried out only in China whereas Japan, Korea and Russia do not have regular monitoring programmes. The most recent data, which was collected from NPEC and member states' monitoring activities in 2009, was used for analysis. Deficient information was supplemented from related research papers or reports.

2.2. Marine Litter on the Shoreline

As a result of investigation on the distribution of marine litter in the NOWPAP region, it has been found that plastic accounts for the largest portion in all member states (24.7-70.0%). Although the four countries have different classification systems for marine litter, they share the fact that plastic, including styrofoam and polystyrene, accounts for the largest portion (51-92%). In terms of the percentage of plastic in marine litter Japan is ranked at the top (92%) followed by Russia (70.7%), Korea (65.7%), and China (51%). Other types of litter are wood (7.4-24%), cigarette butts (16.4%) and glass (2.0-10.3%). The dominant type and quantity of marine litter differ between countries. The major source of coastal garbage turned out to be coastal/recreational activities.

1) People's Republic of China

SOA has conducted annual monitoring on marine litter in China's coastal waters since 2007. The 2009 beach litter monitoring areas and analysis results of each area are shown in Figure 1.

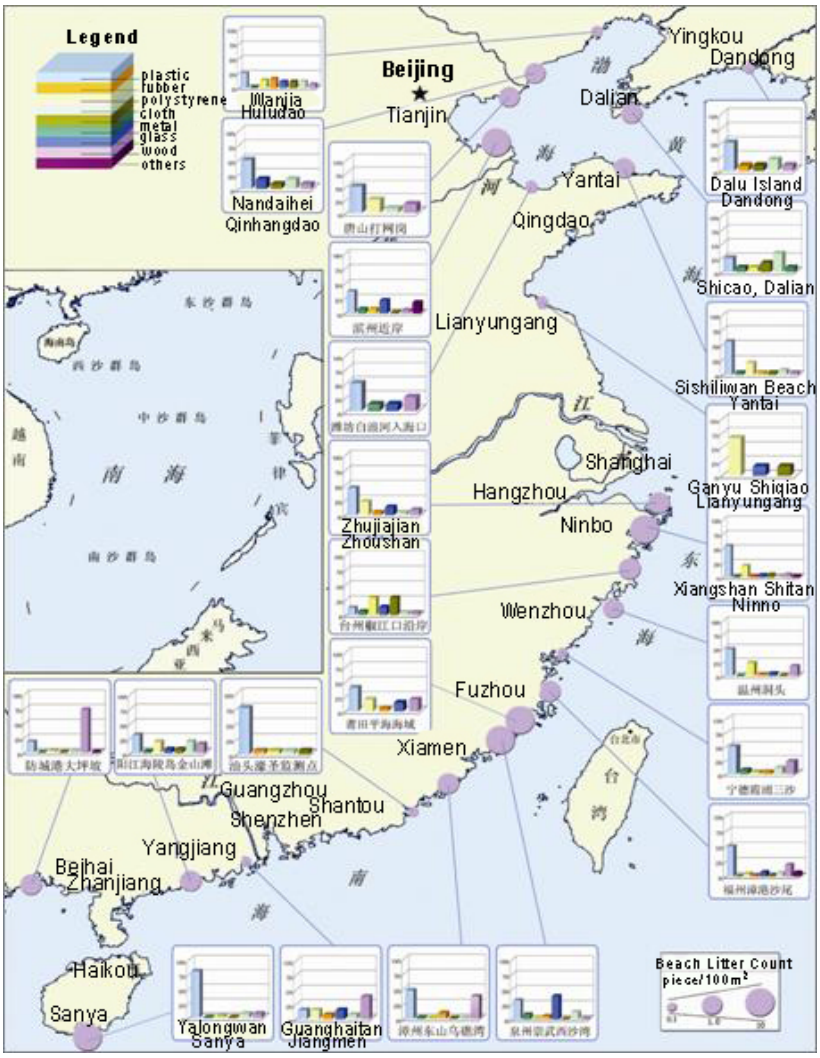

Figure 1. Type and number of beach marine litter in the monitoring area of China (SOA, 2009).

The monitoring categories were plastic, rubber, polystyrene, cloth, metal, glass, wood and other. The litter found was mostly in the form of plastic bags, plastic bottles, polystyrene snack containers, etc. The average count of beach litter is 1.2 pieces per 100 m^2, in which plastic ranked first at 41%, wood second at 24%, polystyrene third at 10% and glass fourth at 9% (Figure 2). The total density of beach litter is 69.8 g per 100 m^2, in which wood is 17.5 g, fabric 14.2 g and glass 11.5 g per 100 m^2, respectively.

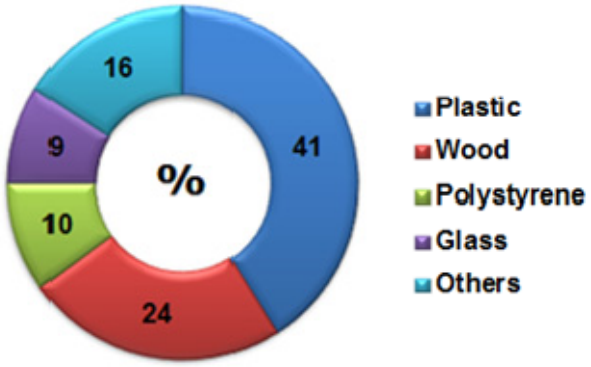

Figure 2. Composition ratio of marine litter collected on the coast in China

Figure 3 shows that the main sources of beach litter in 2009 are recreation/coastal activities (56%), littering (33%), and navigation/fishing marine activity (6%).

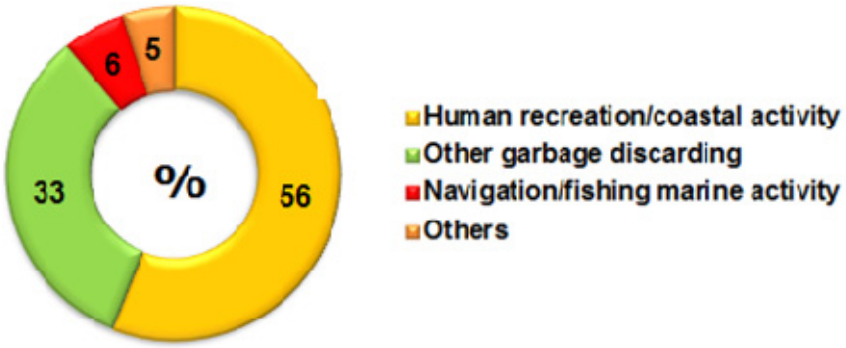

Figure 3. Composition ratio of marine litter by source in China

2) Japan

The amount and type of washed ashore marine litter were analyzed in detail on 11 coasts of 7 prefectures in 2007-2008 (Figure 4) and on 6 coasts of 6 prefectures in 2009-2010.

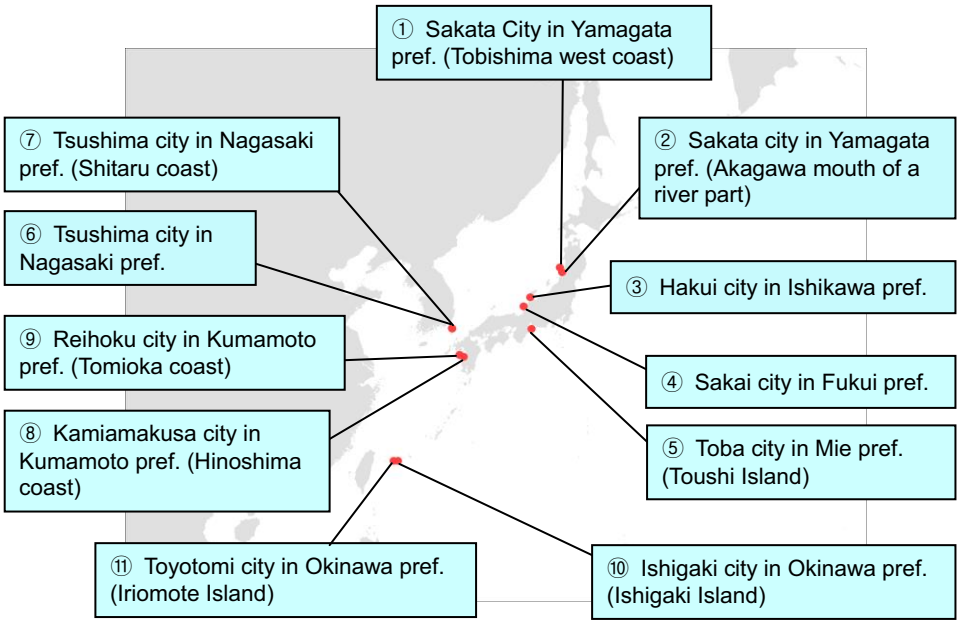

Figure 4. Model Survey Areas (Norihisa Tsunetani, 2011)

According to the survey results of 17 coasts, plastic accounted for 30-40% of the total marine litter on the beaches of Japan. In some areas, glass and natural objects such as driftwood and shrubs were also found.

Household solid waste including lid/caps, PET bottles, food packaging and containers account for large portions of marine litter. Such wastes are presumed, after being generated in daily activities, to somehow enter rivers and be transported to the ocean. Fisheries-related waste including rope, string, fishing nets and floats take up a large percentage as well. Construction waste including wooden packaging material, most likely generated by industrial activities, also constitutes a great portion of marine litter in terms of weight. The total estimated amount of washed ashore marine litter in the 17 coasts surveyed, ranges from 2 to 138 tons/km per year, and is subject to increase depending on the weather condition. The estimated collection/disposal cost is between JPY 10,000/ton and JPY 160,000/ton, and between JPY 2,200,000/km and JPY 11,230,000/km, excluding isolated islands.

The NPEC has investigated floating and washed ashore marine litter on 48 coasts of 24 municipalities in the four member states since 2003 (Figure 5). This investigation surveyed 8 items: plastic, rubber, polystyrene, paper, cloth, glass/ceramic, metal and others.

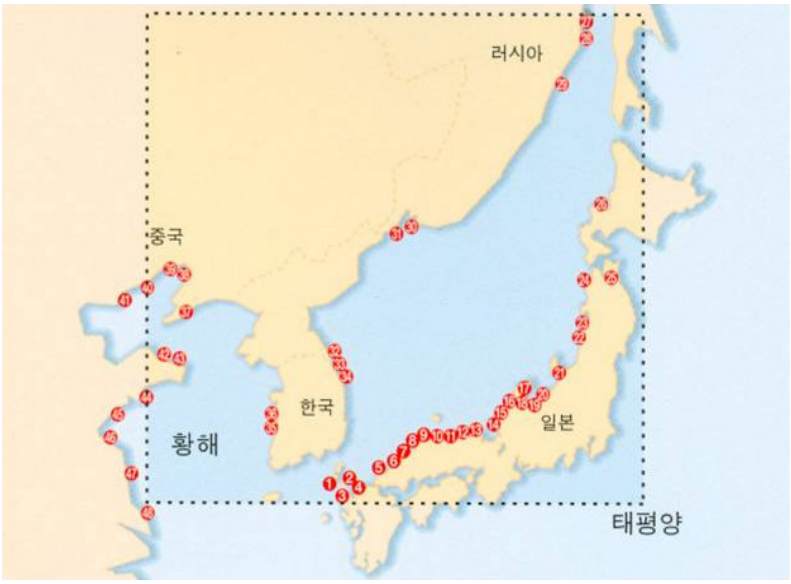

Figure 5. The coastal beaches surveyed on the floating and washed ashore marine litter (NPEC, 2003)

According to the 2009 research results of NPEC on floating and washed ashore marine litter on coastal beaches, approximately 92.2 pieces (911g) of marine litter were found per 100m^2 in 53 coastal areas of Japan. Plastic litter was the most prevalent along the coastal areas, accounting for 69.5% in number of items and 59.1% in weight of the total collected litter. The second dominant item in the total number and weight collected was glass and ceramic, followed by rubber (Figure 6).

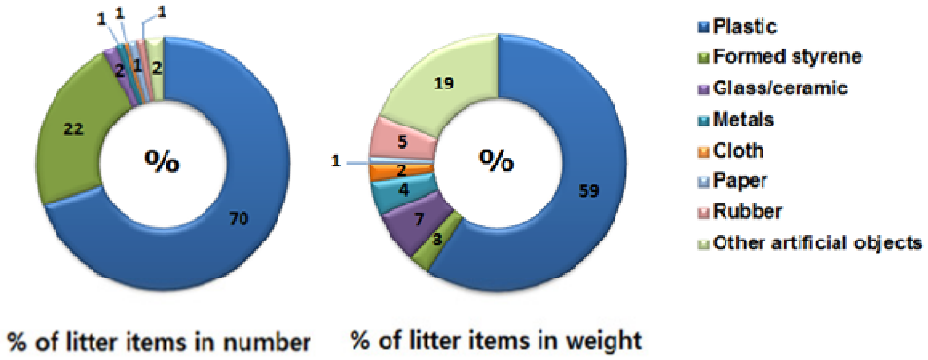

Figure 6. Composition ratio of coastal litter in Japan

3) Republic of Korea

The Korea National Marine Debris Monitoring Program (KNMDMP) has been conducted for 5 years to investigate sources and distribution of coastal litter since 2008. The monitoring program has been implemented in a total of 20 areas, on 2 km of shoreline each, and is examined every two months adding up to a total of six times per year. This investigation classified marine litter into 8 types: plastic, rubber, styrofoam, paper, wood, cloth, glass and metal; and 3 categories: medical waste, cigarettes/ fireworks and foreign origin, in terms of number, weight and volume (Table 1).

Table 1. Component ratio of beach litter in number, weight, and volume by category in Korea (MLTM, 2009)

Category	Number		Weight (kg)		Volume (ℓ)	
Plastic	27,056	49.3%	3,013.3	29.5%	17,434.8	28.6%
Paper	814	1.5%	38.5	0.4%	636.0	1.0%
Styrofoam	9,029	16.4%	1,212.4	11.9%	17,867.8	29.3%
Wood	4,044	7.4%	3,613.1	35.4%	13,131.2	21.5%
Metal	1,366	2.5%	486.3	4.8%	1,935.1	3.2%
Cloth	1,267	2.3%	247.5	2.4%	1,507.6	2.5%
Glass	5,661	10.3%	274.7	2.7%	739.2	1.2%
Rubber	384	0.7%	332.9	3.3%	1,174.3	1.9%
Medical waste	204	0.4%	8.2	0.1%	27.1	0.0%
Cigarettes/ fireworks	2,199	4.0%	73.2	0.7%	246.5	0.4%
Foreign-originated	2,254	4.1%	522.4	5.1%	4,665.1	7.7%
Other	619	1.1%	377.7	3.7%	1,569.4	2.6%
Total	54,897	100.0%	10,200.4	100.0%	60,934.0	100.0%

The composition ratio of coastal litter surveyed in Korea is shown in Figure 7. Based on the survey of 2009, plastic accounts for half of the litter. The ratio of plastic would be larger if marine litter from medical waste, smoking and fireworks, and of foreign

origin were included in the plastic category. Styrofoam occupies the next largest portion, followed by glass. In terms of weight (kg) wood ranks first, followed by plastic and styrofoam. In terms of volume (ℓ), styrofoam and plastic have similar volumes and wood ranks third.

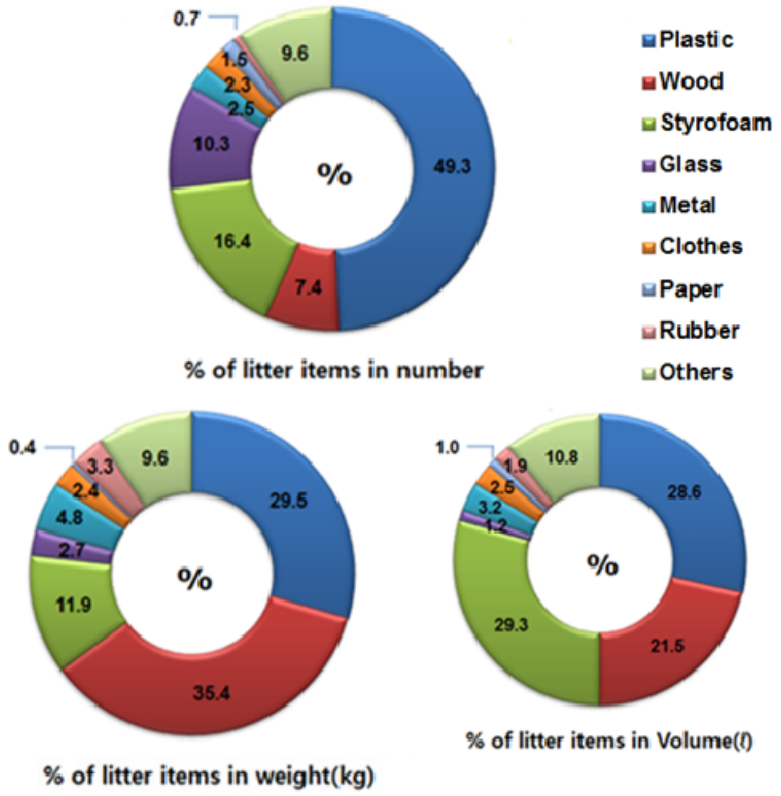

Figure 7. Composition ratio of coastal litter in Korea

4) Russian Federation

According to the NPEC surveys, an average of 83 pieces (687 g) of marine litter was found per every 100m^2 of the coastal areas of the Russian Far East in 2009. As shown in Figure 8, the top 5 items monitored turned out to be plastic pieces (24.7%), cigarette butts (16.4%), plastic bags (7.6%), food wrappers/containers (6.5%) and caps and lids (5.3%).

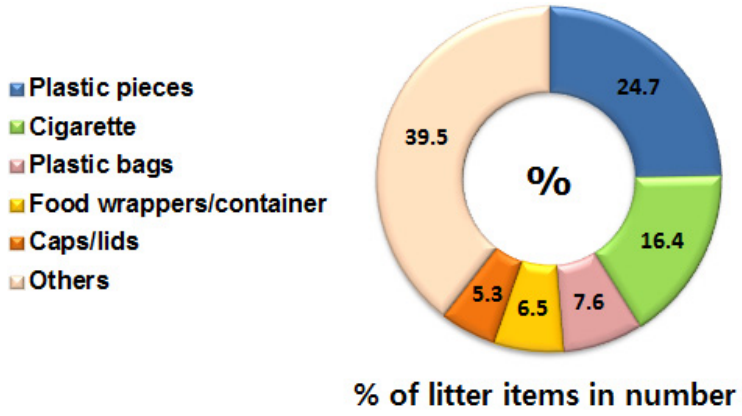

Figure 8. Composition ratio of number of coastal litter in Russia

Figure 9 shows that the main sources of coastal litter are from shoreline and recreational activity (42%), local activity (31%), smoking-related activity (19%), ocean/waterway activity (6%), dumping activity (1%) and medical or personal hygiene (1%).

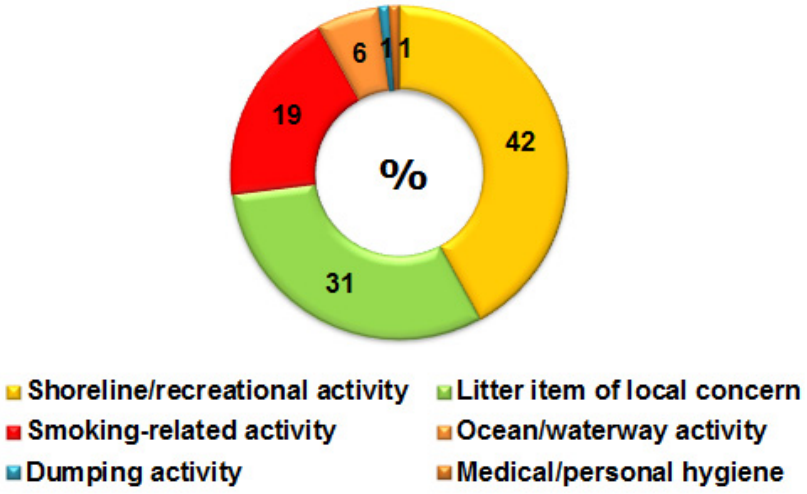

Figure 9. Composition ratio of coastal litter by source in Russia

2.3. Floating Litter

Data on floating litter were collected from the SOA report, and relevant reports and/or papers submitted by Japan and Korea were cross-checked for reference. In agreement with many other studies, plastic accounted for the largest number of marine litter in the Northwest Pacific region at 72-81%.

1) People's Republic of China

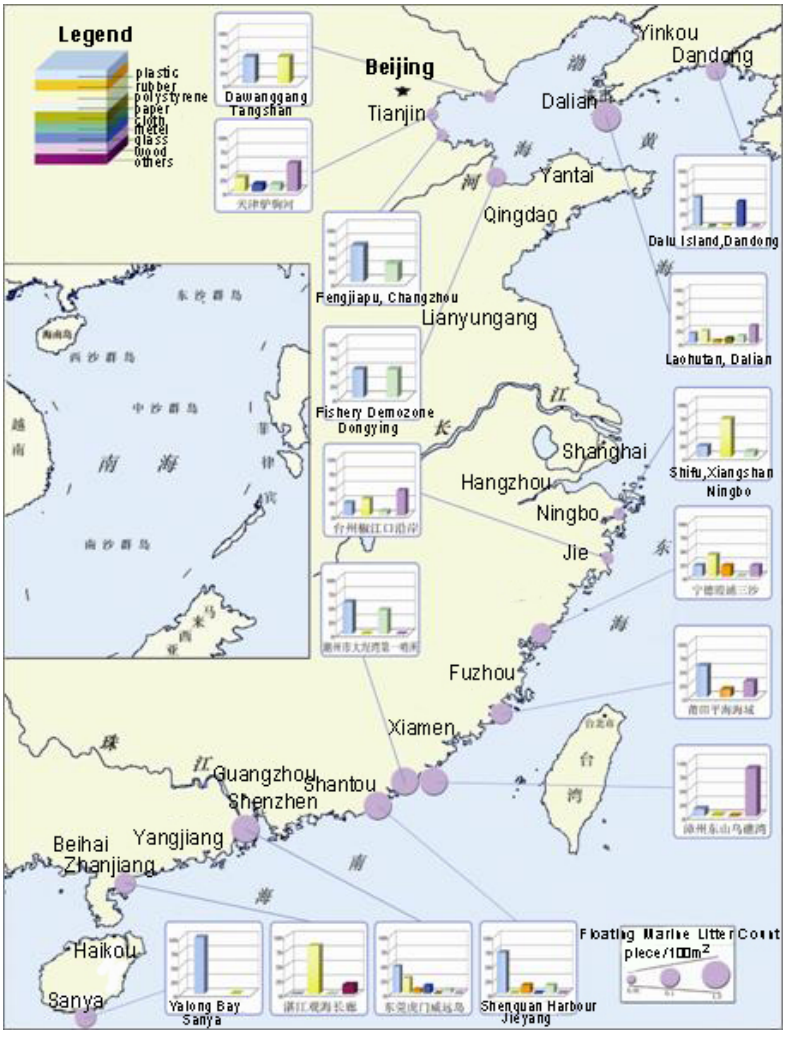

Figure 10. Type and number of floating marine litter in the monitoring area of China (SOA, 2009)

The results of monitoring conducted by SOA in 2009 (Figure 10) show that the common types of floating marine litter are plastic bags, plastic bottles, wood chips, etc. The average number of large/extra-large sized floating marine litter is 0.002 pieces per 100 m^2, and small/medium sized floating litter is 0.37 pieces per 100 m^2.

The majority of floating litter is plastic (41%) followed by polystyrene foam (31%) and wood (14%). Plastic, including styrofoam, accounts for 72% (Figure 11). The total density of small/medium sized floating litter is 0.8g per 100m^2 of which plastic litter amounts to 0.5g per 100m^2 while polystyrene foam is 0.1g per 100m^2.

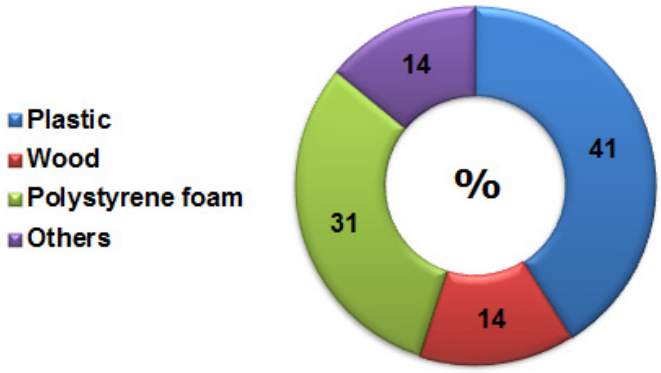

Figure 11. Composition ratio of the number of floating marine litter in China

The main sources of floating marine litter are from recreation/coastal activity (47%), other garbage discarding (31%), navigation/fishing activity (5%) and other (Figure 12).

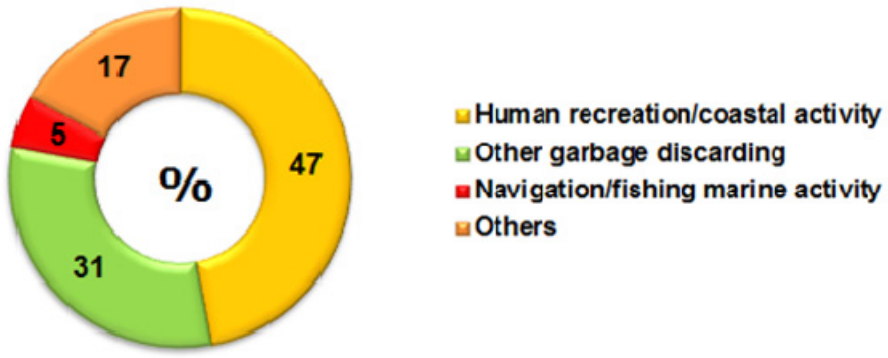

Figure 12. Composition ratio of floating marine litter by source in China

2) Japan

Although Japan does not have a regular monitoring program for floating litter, Japan Meteorological Agency (JMA) has been monitoring floating plastic in seas adjacent to Japan as well as the Northwest Pacific region. JMA monitors floating plastics along several observational lines including 137° E, which was fixed in 1977. Floating items are counted by continuous observation from research vessels during the daytime. When observers find a piece of floating litter, they record its location and type. In some parts of the sea adjacent to Japan, more than 50 pieces per 100km were found during the four surveys in 2007. In addition, 10 to 20 pieces per 100km were found around the Kuroshio and the Kuroshio Extension (MERRAC, 2008).

3) Republic of Korea

Although monitoring of floating litter has not been regularly conducted in Korea, a rough estimation of its distribution has been obtained from the results of a research paper on the distribution of floating litter in the sea surrounding Korea. According to the study by Kim, et al. (1997), floating litter was categorized into 5 types: styrofoam and plastic, wood, paper, nylon nets, floating metal and glass containers. The quantity of marine litter showed a wide range from at least 1.8 to 52 pieces per km^2. The vicinity of Busan and Ulsan had the highest density of marine litter where styrofoam and plastic were distributed 13.66 pieces per km^2, accounting for 81%, and wood scraps and paper followed at 9.1% and 0.9% respectively (Figure 13).

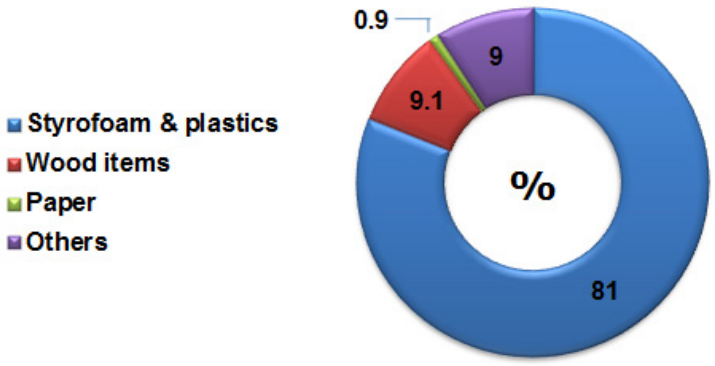

Figure 13. Composition ratio of the number of floating litter by type on the east coast of Korea

2.4. Marine Litter on the Seabed

According to the monitoring data of SOA, the most common seabed litter in China was plastic whereas monitoring data presented in the report by Kang (2001) in Korea shows that derelict rope and abandoned fishing gear account for the largest portion of seabed litter. This difference is highly dependent on the areas being monitored; China is most likely to monitor areas near the coast or estuary, while Korea examines ports or fishing grounds.

1) People's Republic of China

The results of monitoring conducted by SOA in 2009 along the coasts of six provinces in China showed that the common types of sea-bed marine litter are glass bottles, plastic bags, and abandoned fishing nets with an average count of sea-bed litter of 0.02 pieces per 100m^2 and average density of 48.9g per 100m^2. In the litter count, plastic occupies 61%, rubber 9% and fabric 9% (Figure 14).

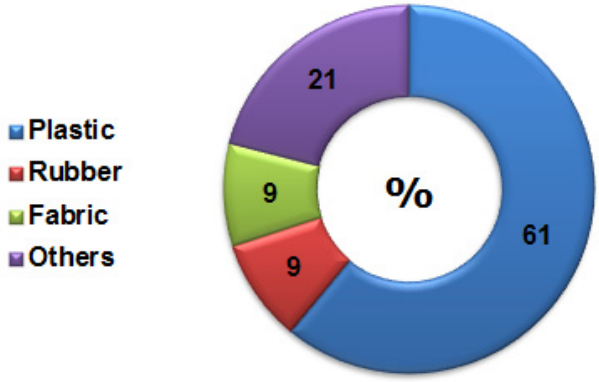

Figure 14. Composition ratio of the number of seabed litter by type in China coastal waters

2) Japan

The actual situation of seabed marine litter is unknown with the exception of the Seto Inland Sea area. The seabed litter survey was performed in offshore Mizushima of Okayama Prefecture on the Seto Inland Sea in December 2007. The amount of the seabed litter collected by one dragnet was approximately 4kg within a 4km x 1.5km area.

3) Republic of Korea

Although regular monitoring of seabed litter is not conducted in Korea, reference was made to a research result regarding the distribution of seabed litter in the coast of Korea. Kang (2001) surveyed 137 ports to understand the seabed litter distribution using Differential Global Positioning System (DGPS) and Side Scan Sonar (SSS). About 35,000 tons of marine litter was estimated to have settled in the seabed. The composition of marine litter by type revealed that derelict rope accounts for 25%, metals 22%, wire-rope 16%, wood 8%, and tire 5% and other 24% (Figure 15).

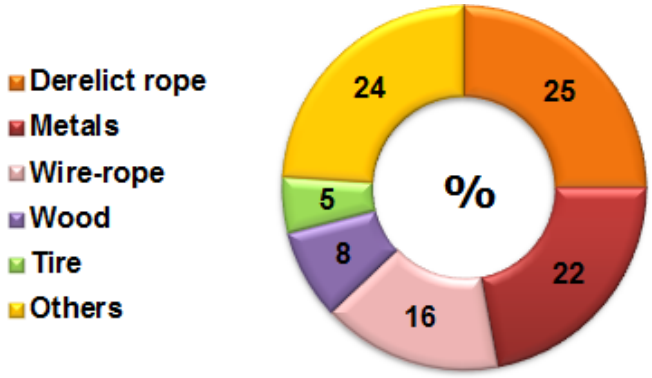

Figure 15. Composition ratio of the number of seabed litter by type in Korea coastal waters

From 1996 to 2005, Lee et al. (2006) surveyed the distribution characteristics of marine litter on the seabed in the East China Sea and the South Sea of Korea using bottom trawl nets. They found that the distribution of seabed litter varies from 30.6kg/km^2 to 109.8kg/km^2. Fishing gear, such as pots, nets, octopus jars, and fishing lines, accounted for about 42-72% and 37-62% of the litter items in the East China Sea and the South Sea of Korea respectively, while the contribution of rubber, vinyl, metal, plastic, glass, wood, and clothing were generally below 30%.

3. CASE STUDIES ON NEGATIVE IMPACTS OF MARINE LITTER

Marine litter gives rise to a wide range of negative environmental, social, and economic impacts causing direct or indirect damage to marine ecosystems and human activities and properties such as fishing and aquaculture, shipping and tourism and recreational activities. This chapter touches upon the environmental, social, and economic impacts of marine litter in the NOWPAP region based on the information on the cases of negative impacts of marine litter collected and analyzed by experts in each member state.

In order to investigate the negative impacts of marine litter, governmental reports, research papers and newspaper articles were referred to as information sources. Based on the sources listed above, marine litter could give impacts on largely four sectors: 1) fishing and aquaculture; 2) marine ecosystems, habitats and biodiversity; 3) shipping and navigation; and 4) tourism and recreational activities (Table 2).

Table 2. Negative impacts of marine litter

Sectors	Impacts
Fishing and aquaculture	Damage to fishing gear
	Damage to aquaculture facilities
	Interruption of fishing operation
	Human casualties (death, injury, disease, etc.)
Marine ecosystems, habitats and biodiversity	Ghost fishing
	Destruction of marine species habitats
	Decrease of fishery resources
	Entanglement
Shipping and navigation	Sailing delay
	Breakdown/repair of vessel
	Sinking and other deadly accidents
Tourism and recreational activities	Hazards to beach goers, swimmers and divers
	Destruction of aesthetic value / Costs for removal

3.1. Fishing and Aquaculture

Fishing and aquaculture rely on marine flora and fauna which are valuable resources for human well-being. While fishing and aquaculture sectors are major victims of marine litter, they are also major sources of marine litter. There are myriad ways that marine litter brings damage to fishing and aquaculture including, but not limited to: i) damage of fishing gear, ii) damage of aquaculture facilities, iii) interruption of fishing operation, and iv) human casualties (death, injury, disease, etc.).

1) Damage to Fishing Gear

Damage to fishing gear brings direct economic losses to fishermen. A report from Tsuchima, Nagasaki, Japan in 2007 shows that drifting rope and ghost nets can entangle active fishing nets resulting in damage to fishing equipment. The process of untangling rope can be considered interruption of fishing operation as it takes a significant amount of time and effort. In Nagasaki, marine litter to fill an 8-ton container was collected during a six month period in 2007.

2) Damage to Aquaculture Facilities

Marine litter can result in economic loss to aquaculture farmers as a result of damage to facilities and equipment. Marine litter can also inflict adverse effects to aquatic species such as fish, crustaceans, mollusks and aquatic plants, which result in direct economic loss. It was reported in Toba, Mie Prefecture, Japan in 1993 that driftwood plume struck a Nori farm and inflicted damage to aquaculture facilities making the farmed black seaweed unsalable.

3) Interruption of Fishing Operation

Marine litter can damage active fishing gear and facilities and contaminate seafood, resulting in direct economic loss. Also, when heavy rain or typhoons cause large amounts of marine litter to flow from land into aquafarms or ports, they not only disturb the sail of fishing vessels but require large disposal costs. In fact, there have been many reports of fishing boats that failed to depart because of garbage that had floated after heavy rain and typhoon, blocking the harbor (Table 3).

Table 3. Cases of interruption of fishing operation

Year	Location	Cause	Contents
July 2002, September 2004, April 2006, July 2007, September 2008	Toba, Mie, Japan	Driftwood	On the beach of Nasa, Mie Prefecture, after heavy rain and typhoons, large amounts of driftwood entered the fishing port or formed large floating driftwood plumes. The driftwood plumes created obstacles for sailing boats, and the fishermen could not leave port to fish until the driftwood was collected, and a safe path cleared.
2004	Mihamacho, Aichi, Japan	Driftwood	Torrential downpours caused by Typhoon No. 21 caused an enormous amount of wood to enter Ise Bay. Fishing activities were interrupted as the fishing boats could not leave port.

4) Human Casualties

Marine litter is a major threat to divers who harvest marine organisms from the seabed. It is difficult to spot marine litter because of poor visibility and colonies of marine organisms. Once entangled by marine litter such as derelict rope or nets, divers often face difficulties in escaping and/or seeking help. In Korea, two incidents resulting in the death of divers because of derelict nets have been reported (Table 4).

Table 4. Cases of human casualties (death, injury, disease, etc)

Year	Location	Cause	Contents
2007 July 25	Coastal waters of Sinam-ri, Seosaeng-myeon, Ulju-gun, Ulsan, Korea	Derelict nets	A woman diver was drowned by entanglement in derelict nets while picking sea urchins with other divers.
2008 Feb 3	Coastal waters, Bangagin harbor, Dong-gu, Ulsan, Korea	Derelict nets	A woman diver was drowned by entanglement in derelict nets while working underwater.

3.2. Marine Ecosystems, Habitats and Biodiversity

Negative impacts of marine litter on marine ecosystems, habitats and biodiversity are increasing and it can consequently bring huge economic losses. Unlike direct damage such as damaged fishing gear or facilities, it is difficult to estimate the exact scale and impact of damage to marine ecosystems. Also, it takes a long time for habitats and biodiversity to recover from the impacts.

Damage caused by marine litter in marine ecosystems, habitats and biodiversity may include, but not limited to: 1) ghost fishing, 2) destruction of habitat of marine species, 3) decrease in fisheries resources and 4) entanglement and ingestion.

1) Ghost Fishing

Derelict fishing gear, such as nets, wires and traps continue to catch fish long after they have been abandoned in the marine environment, reducing potential catch and commercial fishing profit. Consequently, seabirds that feed on fish can also be caught by 'ghost fishing gear' when they attempt to catch an entangled fish. Ghost fishing is regarded as a cruel and serious problem all over the world and the NOWPAP region is no exception.

In the process of collecting derelict fishing gear in Korea, a herd of blue crabs was found dead from derelict fishing nets (Figure 16). Recognizing the decrease in number of crabs catch, the Korean government decided to remove derelict fishing gear. The Navy was mobilized to remove about 235 tons of derelict nets during the period of 2008 to 2010. After the cleanup, there was about a two-fold increase in the blue crab catch. In China a school of dead fish was found caught in a derelict fishing net by diving club members at a depth of 40 meters (Table 5). Although ghost fishing has not been investigated in detail in the NOWPAP region, it is often claimed that ghost fishing can impose particularly detrimental effects on the conservation of vulnerable fish stocks.

Table 5. Cases of ghost fishing

Year	Location	Cause	Contents
2004	Coastal water of Dalian, China	Derelict fishing net	A school of dead fish was found in the derelict fishing net by diving club members at a depth of 40 meters.
2010	Coastal water of Yeonpyeng-do, West coasts of Korea	Derelict fishing gear, derelict nets	A pile of rotten blue crab was discovered in derelict nets. The Navy started removing derelict nets in 2008, and collected 70 tons of derelict nets in 2008, 84 tons in 2009, and 81 tons in 2010.
2009	Coastal water of Yeongdeok-gun, Kyeongsangbuk-do, Korea	Derelict fishing gear	Fish entangled in derelict fishing gear are equivalent to approximately 30% (KRW 50 billion) of commercial landings annually.

Figure 16. Dead blue crab entangled in derelict nets (left) / Collection of derelict fishing gear (right) (SBS News, 2004)

2) Destruction of Marine Species Habitats

Marine litter poses significant threats to the habitats of marine species. Habitat destruction by marine litter may be examined in terms of the location of litter – seabed litter and coastal litter.

Seabed litter can interfere with the gas exchange between the pore waters of sediment and overlying waters, leading to oxygen deficiency (DERRAIK, 2002;

Mouat et al 2010). This may suffocate benthic species and pose adverse effects on the ecosystem. Marine litter can also cause physical damage to the habitats by erosion and burial of underwater habitats. The case in Japan of coral reefs damaged by golf balls demonstrates an example of the destruction of habitats (Table 6).
Coastal litter also destroys the habitats of marine flora and fauna. It was reported in Japan that sea turtles suffer difficulties in egg production due to large amounts of coastal litter. In Russia, there was a case of habitat pollution due to illegal dumping of litter (Figure 17).

Table 6. Cases of marine organism habitat destruction

Date	Location	Cause	Contents
August 12, 2007	Tsushima, Nagasaki, Japan	Golf balls	A large number of golf balls was found scattered amongst the Acropora coral colonies, off Otaura Beach, Mitsushima. The balls are presumed to be hit from the beach.
June 18, 2006	Tsushima, Nagasaki, Japan	Beach Litter	Sea turtles suffered from a serious blockage in laying eggs due to a large amount of marine litter that drifted to a town on the west coast of Toyotama, which is famous for Loggerhead sea turtle spawning.
August 19, 2010	Cape Vyatlina (Russkiy island), Russia	Domestic waste	The housing-and-municipal enterprise “Russkiy Island” was fined for an unapproved dumping on Cape Vyatlina. The coastal dump can lead to pollution of the Peter the Great bay area.

Figure 17. Marine litter piled on the beach (left, DEITA, 2010); Coral reefs damaged by golf balls (right, Nagasaki Newspaper, 2007)

3) Decrease in Fisheries Resources

If marine litter continues to cause ghost fishing and habitat destruction, it will put additional pressure on already vulnerable species and threaten their survival. In other words, marine litter is a threat to biological diversity in the marine environment and may lead to a decrease in fisheries resources.

It should be noted that the main causes of reduction in fisheries resources are illegal fishing and overfishing rather than marine litter. Also, ghost fishing catches less fish than commercial fishing. However, evidence proved that the fish catch did increase after the removal of derelict fishing gear. Marine litter is therefore a putative source that causes reduction in fisheries resources (Table 7).

Table 7. Cases of decrease in fisheries resources

Year	Location	Cause	Contents
2006	Tsushima, Nagasaki, Japan	Beach litter	The cost of beach and sea bottom cleaning activities accounted for JPY 72 million in 2006. “Subsidies for supporting fishery revitalization in Solitary Island” was founded in 2005; beach and sea bottom cleaning activities were undertaken in an effort to improve fishery productivity. The total amount of marine litter collected through this program was 1,690m^3. Each village disposes marine litter within range of the subsidies.
2008	Wangdolcho Waters near Ulgin-gun, Korea	Derelict fishing gear	About 100 tons of derelict fishing gear was collected using specialized ships. About 30 tons of derelict nets were collected in east coast of Korea by the Kyungbuk National Shipowners Association of Red Crab Traps. The process lasted 2 nights 3 days and cost KRW 180 million.
May 5, 2007	Yeoja bay, the Southern Coast of Korea	Derelict fishing gear, domestic waste	The number of commercial species (e.g. octopus, crayfish, rockfish etc.) in this particular area, which are a main source of income to fishermen, decreased by 31% from 67 to 46 species in 2 years.

4) Entanglement and Ingestion

Entanglement and ingestion are primary ways of direct injury to wildlife caused by marine litter. Entanglement means that an animal becomes trapped or ensnared by marine litter, leading to difficulty in mobility, finding food and escaping predators, and eventually, death. Ingestion happens when animals swallow litter items, which can lead to starvation or malnutrition.

Entanglement or ingestion may occur accidentally or because the animal is naturally attracted to litter items – curiosity or search for food or shelter (Miljö, 2001). Birds may collect marine litter to build their nests, or an animal may also mistake marine litter as food. If seabirds feed on fish already entangled in derelict nets or rope, they could consequently become entangled. Animals may swallow litter items because of their resemblance to particular prey. Such ingestion can lead to starvation or malnutrition if the litter items accumulate inside the animal, making it feel full. This confusion will deter the animal from searching for real food, leading to starvation.

In the NOWPAP region, several cases of protected species suffering or dead because of marine litter were reported in the media (Table 8 and Figure 18). Research and actual observations of marine species affected by marine litter is difficult because such disabled or dead animals are likely to be consumed by predators or decompose rapidly at sea (Laist, 1987).

Table 8. Cases of animal entanglement in marine litter

Year	Location	Cause	Contents
October 8, 2007	Dapeng Bay, Shenzhen, China	Marine litter	A green turtle discovered on the shore had ingested some litter items, resulting in damage to its gastrointestinal system.
2010	Leqing county, Zhejiang Province, China	Plastic bags	A fisherman found plastic bags inside the stomach of certain fish. It was assumed that the fish confused plastic bags with food, i.e. jellyfish.
September 9, 2010	Tokushima, Japan	Floating litter, Driftwood	In Kii Channel, 13km off Komatsujima City, Tokushima a 2-year old sea turtle was caught by an ocean-cleaning vessel. The turtle entangled in litter was found entering the collection container of the vessel during removal activity of driftwood and floating grass.

Year	Location	Cause	Contents
2010	Jeju-si, Jeju-do, Korea	Derelict nets	A loggerhead turtle, a protected species, entangled in derelict nets was rescued and released by local residents in Jeju.
2010	The East Coast of RO Korea	Derelict nets	A leatherback turtle, probably killed by ingestion of derelict vinyl or entanglement in nets was found on the shore.
2005	Coastal water of Yangyang-gun, Gangwon-do, Korea	Nets	A harbor seal, Natural Monument No. 331, was found dead entangled in nets.
2009	The East coast of Korea	Nets	8 dolphins were found dead from entanglement in nets on the coastal waters of Yangyang and Goseong.
2008	Korea	Nets	7 Risso's dolphins and other fish were found dead from entanglement in nets.
Oct 18, 2010	Korea	Fishing hooks, lead weights, derelict fishing gear, derelict nets	Death by marine litter in 17 species of marine animals and 29 incidents have been recorded. The biggest victim is the sea bird (14 species, 24 cases) and the most frequent cause is fishing hooks (16 cases).

Figure 18. Rescue and release of a sea turtle entangled in derelict nets (Yonhap News Jeju 2010)

3.3. Shipping and Navigation

Marine litter poses numerous safety risks to vessels. Plastic bags are common causes of blocked water intakes, resulting in overheating of water pumps of recreational vessels (Sheavly and Register 2007). In particular, fouling and entanglement of a vessel's propeller caused by derelict fishing gear reduce a vessel's stability in the water and ability to maneuver. This puts vessel crews in danger, especially during poor weather conditions.

There are many instances of ship accidents and navigational hazards caused by marine litter and they may include but not limited to: 1) sailing delay, 2) breakdown/repair of vessel, and 3) sinking and casualties.

1) Sailing Delay

Entanglement of a vessel's propeller in derelict nets can result in sailing delay or returning back to harbor. An oil tanker was reported of sailing delay due to entanglement in floating litter (Table 9). Under bad weather conditions, this could have led to collision which may cause an oil spill accident.

Table 9. Cases of sailing delay

Year	Ship name	Cause	Contents
2008	Sea Flower No.2	Garbage	Sea Flower No.2, a passenger ship with 214 passengers travelling from Busan Harbor Pier 1 to Harbor Izhara, Tsushima, Japan on February 1, 2008 became entangled with garbage by the propeller, causing the left main engine to be overloaded and shut down. The vessel had to return back to Busan Harbor using its right engine.
2007	Daeueng Ferry No.5	Derelict nets	Daeueng Passenger Ferry was delayed because of entangled derelict nets.
2005	Dongyang No.7	Garbage	An oil tanker travelling from Incheon Harbor got entangled in garbage, which coiled around the propeller, causing the vessel to suspend sailing and request help.

2) Breakdown/Repair of Vessel

Marine litter can cause damage to boats, sometimes irreparable. Fishing nets and rope are easily entangled with propellers, anchors, or drive shafts and result in the breakdown of vessels. In addition, breakdown/repair of vessels may lead to the interruption of fishing operation and result in economic loss.

Breakdown and repair of vessel is the most frequently reported case of damage caused by marine litter. According to the Korean Maritime Safety Tribunal (KMST), there were 59 vessel breakdown accidents caused by marine litter in Korea during 2005-2010 which is attached in Annex 1. This is closely related to the damage of fishing activities because most damaged vessels are fishing vessels. Annex 1 presents cases of damaged fishing vessels which include breakdown/repair of vessel and damage of fishing gear.

There have also been reports of damaged vessels due to marine litter in Japan, including shaft and propeller damage from entanglement in floating rope. According to the questionnaire from the 12 Fisheries Cooperative Associations in Tsushima, Japan, there were up to 46 cases of propeller and shaft damage in the 2006 fiscal year. The reported number of damaged fishing nets and ships was 175 cases per year. It was also reported that about one third of the 30 ships belonging to the Fisheries Cooperative Association of Ina were damaged (Figure 19).

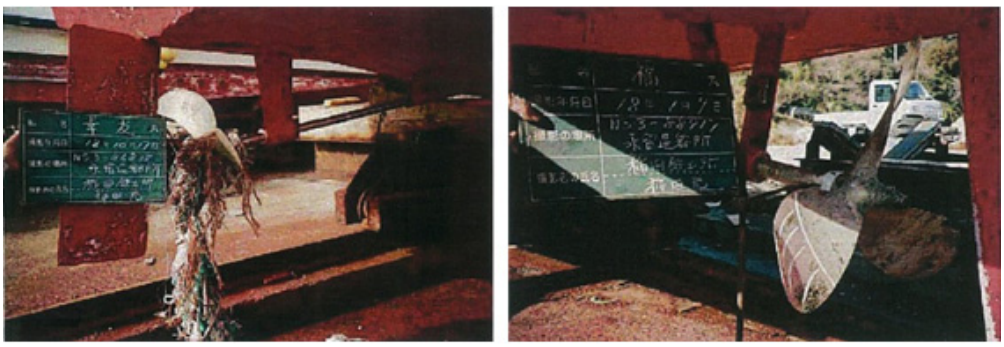

Figure 19. Vessel propeller entangled in marine litter (NPEC, 2008)

3) Sinking and Casualties

Marine litter may get entangled in propellers causing the vessel to malfunction or lose driving force, thereby endangering the lives of the crew and passengers. This is especially serious if control is lost in a storm and the boat cannot turn back to port, or steering is disabled and eventually the boat cannot avoid collision (UNEP GPA, 2001).

In October 1993, the sinking of the Seohae Ferry which was returning back to its port at Wido, Buan-gun, Jeollabuk-do in Korea due to harsh weather condition was caused by a combination of bad weather and carelessness towards navigation safety rules. The Ferry was returning to port due to bad weather but became entangled in derelict rope, which got caught in the propeller and reduced the speed of the engine; then a huge wave caused the vessel to capsize and sink, claiming 292 of the 362 passengers' lives. Because such accidents can happen not only to small fishing boats, but even to oil tankers, it should be recognized that marine litter is a problem to be addressed in respect of marine pollution as well as the navigational safety.

3.4. Tourism and Recreational Activities

Marine litter on the shorelines and floating litter near the seashore significantly reduce aesthetic value of the coasts, hindering recreational activities such as fishing, swimming, diving and boating. This may lead to loss and reduction in revenues from tourism of the coastal communities of concern. In addition, accumulated litter requires clean-up operations that cost substantial financial resources and causes damage to the health and safety of people who visit the coast.

There are many negative impacts of marine litter on tourism and recreational activities including, but not limited to: 1) hazards to swimmers and divers 2) damage of aesthetic value and requiring costs for removal.

1) Hazards to Beachgoers, Swimmers and Divers

Entanglement in marine litter such as derelict nets and rope can be serious hazards for swimmers and divers. There was report of an accident in Korea that a scuba diver died because of entanglement in derelict nets (Table 10).

Broken glass, pieces of rusty metal, and medical waste can cause injuries to beach goers and swimmers. In Japan, harmful medical wastes such as injection needles were found on the beach. The prefecture government closed the beach and the injection needles were collected and disposed of in a proper procedure by a waste disposal company (Figure 20). Although the prefecture government declared the beach off-limit at the entrance and conducted frequent patrol, a boy playing in the off-limit area was injured by a stray needle.

Table 10. Cases of hazards to beachgoers, swimmers and divers

Year	Location	Cause	Contents
Nov. 2009	Qingdao City, China	Discarded construction materials	Waste construction materials were used for land reclamation, and glass fragments were scattered throughout the coast. After the reclamation, no one can go fishing without wearing shoes.
2004	Kagawa, Japan	Medical waste	A boy playing in the off-limit area was injured by a stray needle.
2005	Goseong-gun, Gangwon-do, Korea	Derelict nets	A man died while scuba diving.

Figure 20. Collection of injection needles discarded on the beach (Shikoku Newspaper, 2004)

2) Damage to Beachscapes / Clean-up Costs

If the coastal environment is polluted by marine litter, coastal communities may lose substantial revenues in tourism. In addition, significant costs are required to collect the garbage. All member states reported a number of cases of damaged beach vistas and costs for removal due to coastal litter as shown in Figure 21. The reported cases are attached in Annex 2. It should be noted that although a large amount of marine litter is generated after typhoons and heavy rains, the litter generated by tourists should not be ignored.

Figure 21. People enjoying leisure on littered beaches (upper left, Vladtime, 2010; upper right and bottom left, Novostivl, 2010 bottom right, Primamedia, 2010)

4. RESULTS AND DISCUSSION

4.1. Causes and Types of the Negative Impacts of Marine Litter

In this study, a total of 169 cases of negative impacts caused by marine litter were collected and analyzed. These consist of 11 cases, 60 cases, 83 cases, and 15 cases from the experts of China, Japan, Korea, and Russia respectively (see Table 11).

Table 11. The number of negative impacts of marine litter by type

Category	Impact	China	Japan	Korea	Russia	Total
Fishing activities and aquaculture	Damage of fishing gear		1			1
	Damage of aquaculture facilities		1			1
	Interruption of fishing operation		2			2
	Human casualties (death, injury, disease, etc.)			2		2
Marine ecosystems, habitats and biodiversity	Ghost fishing	1		2		3
	Destruction of habitat of marine organism		2		1	3
	Decrease of fishery resources		1	3		4
	Entanglement	2	1	7		10
Ship accident	Sailing delay			3		3
	Breakdown /repair of vessel	1	46	59		106
	Sinking and deadly accidents			1		1
Tourism and recreational activities	Hazards to beach goers, swimmers and divers	1	1	1		3
	Destruction of aesthetic value/ Costs for removal	6	5	5	14	30
Total		**11**	**60**	**83**	**15**	**169**

Among all the cases of damage caused by marine litter, Figure 22 shows that ship accidents are the most frequently reported cases at 110 (65.0%) followed by tourism and recreational activities at 33 (19.5%), marine ecosystems, habitats and biodiversity at 20 (12.0%), and fishing activities and aquaculture at 6 (3.5%).

Cases of ship accidents or discarded marine litter on the beach, which affect tourism and leisure activities, tend to be reported frequently, whereas marine litter impacts that occur in the water and have long-lasting effects on marine ecosystems, habitats and biodiversity were less reported. In considering the biological impacts of marine litter, OSEAN, a non-profit organization in Korea, has recently collected case studies on coastal wildlife suffering from marine litter since 2010 and published the report (Jang, 2012).

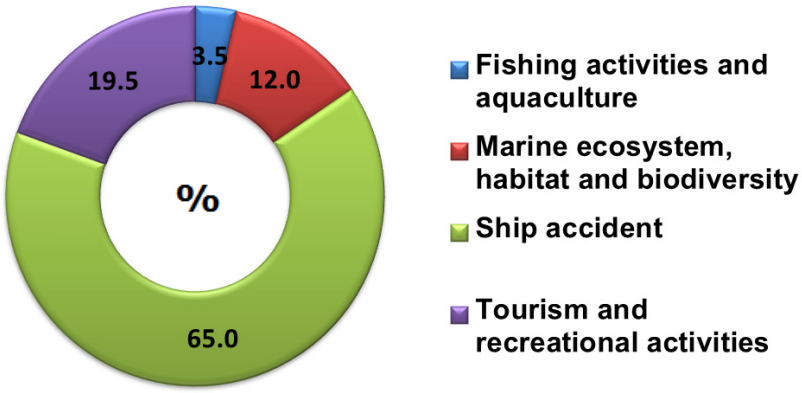

Figure 22. Composition ratio of the negative impacts of marine litter by type

Figure 23 shows that derelict fishing nets and ropes are accountable for more than half of the damage caused by marine litter (52%), followed by general waste (31%). Although general waste is not identified in detail, it generally includes driftwood, litter items washed ashore, etc. Domestic waste refers to litter items discarded on beaches, and the others category includes medical waste, construction waste, etc.

The second most common impact was on tourism and recreational activities (19.5%), caused by garbage discarded on the beach by tourists and land-based litter that has drifted in heavy rain or typhoon.

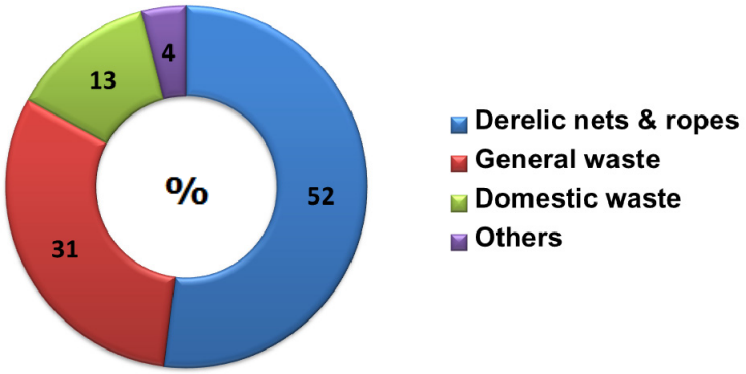

Figure 23. Composition ratio of the negative impacts of marine litter by cause

Considering the fact that most ship accidents happen to fishing vessels, it can be said that the biggest victim of marine litter is the fishery and aquaculture sector. It is interesting to know that the source of most ship accidents is none other than derelict fishing gear and nets, which result from fishing and aquaculture activities. In the same way, coastal litter, which is considered a significant factor of the decline of tourists, is largely a by-product of the tourists who visit to enjoy recreation on the beach.

4.2. Impacts of Marine Litter

As we can see throughout this report, marine litter not only damages the marine environment, but also directly and indirectly affects human activities and property. The following section summarizes the impacts of marine litter in social, environmental and economic aspects.

1) Environmental Impacts of Marine Litter

Among damages that have been caused by marine litter in the NOWPAP region, specific cases of 1) ghost fishing, 2) decrease of fishery resources, 3) destruction of habitats of marine species and 4) entanglement of animals may be included in the environmental impacts of marine litter.

Many marine species are directly affected by ghost fishing or entanglement by derelict fishing gear. Cases of dead animals (e.g. blue crabs, sea birds, dolphins,

loggerheads and seals, of which most are protected species) being entangled in fishing line or derelict nets were reported (Figure 24). Marine litter can be a major threat to the diversity of endangered marine species, and furthermore, result in the reduction of marine resources.

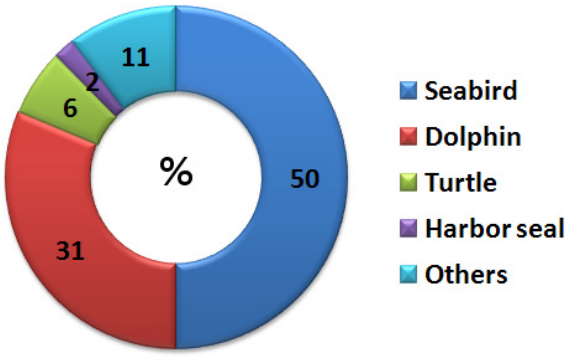

Figure 24. Composition ratio of marine animals entangled in marine litter by species

Seabed and coastal litter severely affects the marine ecosystem through destruction of habitats of marine flora and fauna. Cases of coral reefs damaged by golf balls, sea turtles suffering a serious blockage of laying eggs, and habitats destructed by illegal dumping were also reported. As such, detrimental impacts of marine litter to the marine environment can result in decrease in the population of marine organisms.

2) Economic Impacts of Marine Litter

Marine litter itself has implication of economic expenditure even excluding its secondary or compounding effects caused by accidents and disasters. Among damages that have been caused by marine litter in the NOWPAP region, specific cases of 1) interruption of fishing operation, 2) damage to aquaculture facilities, 3) breakdown or repair of fishing gear 4) breakdown/repair of vessels and 5) cost of marine litter cleanup may be considered as the economic impacts of marine litter.
In Korea, KRW 2.3 billion was spent to collect 12,483 tons of marine litter in 2009. It is estimated that collecting 1 ton of marine litter on the shoreline requires about US$181. Japan conducted a model survey in 2008 to estimate costs for removal, collection, transportation and disposal of coastal litter (Table 12). According to the model survey results, the collection/transportation cost ranged from US$ 100 to US$ 3,300 per ton of marine litter.

Table 12. Model survey on the collection and disposal cost of coastal litter (Unit: US$ 1,000) (Ministry of Environment of Japan, 2008)

Model survey point	Estimated annual amount of beach litter (t)	Removal cost (1000$)	Collection transportation cost (1000$)	Disposal cost (1000$)	Total cost (1000$)	Beach length within the survey area (km)	Cost per km (1000$/km)	Cost per ton (1000$/t)
Tobishima west coast in Sakata City, Yamagata Pref.	13	27.4	9.3	6.8	43.5	1.7	25.6	3.3
Akagawa river mouth in Sakata City, Yamagata Pref.	207	116.3	7.2	53.8	177.3	4.5	39.4	0.9
Hakui City, Ishikawa Pref.	16	14.4	6.9	3.7	25.0	8.6	2.9	1.6
Sakai City, Fukui Pref.	21	4.3	0.3	1.7	6.4	2.8	2.3	0.3
Toushi Island in Toba City, Mie Pref.	64	2.5	2.6	0.4	5.5	1.0	5.5	0.1
Koshidaka and Shitaru coasts in Tsushima City, Nagasaki Pref.	11	1.2	1.0	0.5	2.7	0.5	5.4	0.2
Hinoshima coast in Kamiamakusa City, Kumamoto Pref.	99	22.3	14.1	4.4	50.8	0.8	63.5	0.5
Tomioka coast in Reihoku City, Kumamoto Pref.	35	8.9	7.7	5.6	22.1	3.0	7.4	0.6
Ishigaki Island of Okinawa Pref.	54	4.7	6.4	4.1	25.2	3.6	7.0	0.5
Iriomote Island of Taketomi City, Okinawa Pref.	32	2.9	11.3	9.9	24.1	2.7	8.9	0.8

(JPY 10,000 = approx. US$ 100)

3) Social Impacts of Marine Litter

The social impacts of marine litter include deterioration in the quality of human life, reduced recreational opportunities, loss of aesthetic value and loss of non-use value. More studies are needed to elucidate the social impacts of marine litter because there is little research on the level of social damage caused by marine litter (Mouat et al, 2010).

Among damage that has been caused by marine litter in the NOWPAP region, cases of 1) destruction of aesthetic value and 2) human casualties may be included as specific examples of social impacts.

Several cases on coastal litter causing damage to aesthetic value were included in the reports by NOWPAP members. Although it is difficult to convert aesthetic value into a monetary equivalent, coastal litter causes economic losses including decline of tourism and generation of cleanup costs, and furthermore, may be translated into a social issue such as distrust of governments.

Marine litter can endanger the lives of humans directly. A vessel's entanglement in marine litter such as derelict nets and rope may cause ship accidents, which could lead to sinking and furthermore, human casualty. The threat of entanglement is also present to swimmers and divers. Such concern for the safety of people is a social impact of marine litter.

5. CONCLUSIONS AND RECOMMENDATIONS

Most marine litter consists of any persistent, manufactured or processed solid material disposed of or abandoned in the marine and coastal environment (UNEP 2005). Although there are differences between the classification systems used in NOWPAP member states, plastic, wood, glass, metal, cloth and paper have been considered as most common types of marine litter. Various types of marine litter are found along the coasts, sea surface and seabed. Plastic accounts for the majority of marine litter and considerable amounts of wood, derelict fishing gear can also be found during some particular seasons or at sites.

Various cases of negative impacts of marine litter on aquaculture, marine ecosystems, habitats and biodiversity, navigational safety, tourism are reported in the NOWPAP region. The sectors most affected by marine litter are fishing and aquaculture, followed by tourism and recreational activities. In such cases the cause of damage is derelict fishing gear that has been abandoned after fishing activities.

Recognizing the numerous effects of marine litter through case studies on the negative impacts of marine litter, and noting that polluters can be victims of marine litter too, people concerned should be mobilized in preventing marine litter from being generated and reducing its negative impact. In order to mitigate the negative impacts of marine litter in the NOWPAP region, the following actions are suggested.

1. Actions regarding plastic, which constitutes the largest portion of marine litter:
   - Reduce use of plastic and encourage reusable materials (e.g., reusable shopping bags, reusable cups and dishes);
   - Conduct effective disposal and recycling of used plastic on land in order to prevent the influx of plastic into the sea by land-based activities;
   - Raise awareness among general public and regularly collect and remove plastic litter on the coast;
   - Conduct surveillance and monitoring in order to prevent dumping of plastic into the sea during maritime activities;
   - Encourage the use of eco-friendly degradable plastics

2. Actions regarding derelict fishing gear, which cause the most serious damage to oceanic life:
   - Promote the use of biodegradable fishing gear and nets

- Minimize loss of fishing gear at sea (e.g., use labeled fishing gear);
- Report and collect derelict fishing gear found during fishing operations, and bring them back to land;
- Raise awareness among fishermen of abandoned fishing gear impacts.

3. Enhance the public awareness of the marine litter issue and encourage participation in cleanup activities:
   - Conduct a systematic and detailed survey on damage to ecosystems caused by marine litter in order to inform to the public effectively;
   - Develop national educational and awareness raising programmes on the marine litter issue targeted for school kids as well as for general public;
   - Conduct beach clean-up campaigns regularly, for example, the International Coastal Cleanup Campaign (ICC).

4. Regular monitoring of marine litter for data collection:
   - Increase frequency and range of monitoring not only on beaches but also floating and seabed litter;
   - Establish a common classification system by member states for objective analysis;
   - Analyze and evaluate sources of marine litter in the region.

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REFERENCES

DEITA (2010) http://www.deita.ru/incidents/primorskij-kraj_19.08.2010_154210_vo-vladivostoke-a-100-tysjach-rublej-nakazali-ooo-zhek-ostrov-russkij.html [accessed 20 January 2013.]

Derraik J.G.B. (2002) The pollution of the marine environment by plastic debris: a review. Marine Pollution Bulletin 44: 842-852.

Jeftic, L., and S.B. Sheavly. (2009) Marine litter: a global challenge. Nairobi, Kenya: Regional Seas, United Nations Environment Programme.

Jang, Y.C., S. Hong, J. Lee, and M. Lee. (2012) The Impact of Marine Debris on Wildlife in South Korea: Cases and Photographs. Our Sea of East Asia Network (OSEAN) Inc., Design Jiho, 101p.

Kang. W.S. (2001) The Methodology for Investigation on Seabed Litters and the Distribution of Seabed Litters in Ports around the Korean Coastline. *Journal of Korean Society for Marine Environmental Engineering*, Vol. 4, No. 3, pp. 74-80 (in Korean).

Kim, J.H., S.G. Kim, C.D. Park, and S.D. Joo (1997) Distribution and Composition of Floating Debris in the East Coast of Korea. *The Korean Society for Fisheries and Marine Sciences Education Journal*, Vol.9, No.1, pp.31-39 (in Korean).

Laist, D.W. (1987) Overview of the biological effects of lost and discarded plastic debris in the marine-environment. *Marine Pollution Bulletin* 18: 319-326.

Lee, D.I., H. S. Cho, and S.B. Jeong. (2006) Distribution Characteristics of Marine Litter on the Sea Bed of the East China Sea and the South Sea of Korea. *Estuarine, Coastal and Shelf Science*, Vol.70, No.1-2, pp. 187-194.

MERRAC (2007) Guidelines for Monitoring Marine Litter on the Seabed in the Northwest Pacific Region.

MERRAC (2007) Guidelines for Providing and Improving Port Reception Facilities and Services for Ship-Generated Marine Litter in the Northwest Pacific Region.

MERRAC (2007) Sectoral Guidelines for Marine Litter Management: Fishing, Commercial Shipping, Recreational Activities, Passenger Ships.

MERRAC (2007) Brochure on Sea-Based Marine Litter: Problem & Solution.

MERRAC (2008) Regional Report on Sea-Based Marine Litter.

MERRAC (2008) Marine Litter Management: The Approach of Incheon City, Republic of Korea.

MERRAC (2009) Port Reception Facilities in the NOWPAP Region.

MERRAC (2010) Report on the Technologies and Research Outcomes on Prevention, Collection and Treatment of Marine Litter in the NOWPAP Region.

Miljö, A. (2001) Marine Litter – Trash that Kills. Stockholm: Swedish Environmental Protection Agency.

Ministry of the Environment, Japan (2008) Model Survey on the Domestic Methodology for Reduction of Marine Litter.

Ministry of Land Transport and Maritime Affairs (current Ministry of Oceans and Fisheries), Korea (2009) KNMDMP

Mouat, J., R.L., Lozano and H. Bateson (2010) Economic Impacts of Marine Litter. Kommunenes Internasjonale Miljøorganisasjon (KIMO).

Nagasaki Newspaper (2007) http://www.nagasaki-np.co.jp [accessed in 2010].

Norihisa Tsunetani (2011) Case Study on Negative Impacts of Marine Litter in Japan

Novostivl (2010) http://novostivl.ru/msg/11534.htm [accessed 20 January 2013.]

Northwest Pacific Region Environmental Center (NPEC) (2008) Survey Report of Marine Litter Damage in Solitary Island.

NPEC (2003) Research on Washed-Up Driftage on the Coast of the Northwest Pacific Region, Toyama, Northwest Pacific Regional Environmental Cooperation Center (NPEC)

Primamedial (2010) http://primamedia.ru/news/09.07.2010/128805/bolee-30-nekonditsionnih-plyazhey-viyavila-na-dalnem-vostoke-proverka-mchs.html [accessed 20 January 2013.]

Sheavly, S.B. and K.M. Register. (2007) Marine Debris and Plastics: Environmental Concerns, Sources, Impacts and Solutions. *Journal of Polymers and the Environment 15*, pp. 301-305.

Shikoku Newspaper (2004) http://www.shikoku-np.co.jp [accessed in 2010.]

SOA (2009) Marine Litter Monitoring Data in Coastal and Offshore in China
UNEP (2005) Marine Litter: An Analytical Overview. Nairobi: UNEP.

UNEP (2008) Regional Overview: Marine Litter in the NOWPAP Region, Vol. 2.

UNEP GPA (2001) Marine litter – trash that kills

Vladitime (2010) http://www.vladtime.ru/2010/05/21/v-slavnom-gorode-u-morya-opyat-problemy-s.html [accessed in 2010.]

Yoo, Y.S. (2004) Yeonpyeong Island Restores Blue Crab Fishing Grounds, SBS News 30 July 2004. http://news.naver.com/main/read.nhn?mode=LPOD&mid=tvh&oid=055&aid=0000025688 [accessed 20 January 2013.]

Yonhap News Agency, 08 July 2010
http://news.naver.com/main/read.nhn?mode=LSD&mid=sec&sid1=101&oid=001&aid=0003371494 [Accessed 20 January 2013.]

ANNEX 1. Cases of Breakdown and Repair of Vessels

Year	Ship name	Cause	Contents
2010	Haram No.1	Garbage	Haram No.1, a fishing boat, sent an SOS when a propeller got entangled in garbage, causing the vessel to suspend sailing.
2010	Gangnam	Derelict nets	On 2 February, Gangnam, a fishing boat from Jangseungpo Harbor in Geoje-si, sent an SOS when it became entangled in derelict nets which coiled around the propeller.
2010	Gwangcheon	Derelict nets	On 13 July, Gwangcheon, a coastal longliner sent an SOS when a propeller became entangled in derelict nets while casting rope in Busan.
2010	Seungbem No.2003	Derelict nets	Seungbem No.2003, a fishing boat, sent an SOS when a propeller got entangled in derelict nets.
2010	Geumbada	Garbage	Geumbada, a fishing boat, sent an SOS when a propeller got entangled in garbage.
2010	Okyoung No.101	Derelict nets.	Okyoung No.101, a fishing boat, sent an SOS when it became entangled in floating derelict nets.
2010	Daegil No.707	Garbage	Daegil No.707, a fishing boat, sent an SOS when a propeller got entangled in garbage.
2010	Geumseong No.2003	Derelict rope	On 18 January, Geumseong No.2003, a fishing boat, was sailing from Minrak harbor in Busan and had to send an SOS when a propeller got entangled in derelict rope.
2010	Wonjin No.2	Derelict nets	On 16, June, Wonjin No.2, a fishing boat from Guryongpo Harbor became entangled in derelict nets and sent an SOS.
2010	Hangdo	Derelict nets	Hangdo, a fishing boat, got a propeller entangled in floating derelict nets and sent an SOS.
2010	Dongwon	Garbage	Dongwon, a fishing boat, sent an SOS after suspending sailing because of garbage that got entangled in a propeller.
2010	Changseong No.55	Derelict rope	On 9 December, Changseong No.55, a fishing boat traveling from Dongho Harbor in Tongyeong, got a propeller entangled in rope and sent an SOS.
2010	Myeonggyeong	Derelict nets	Myeonggyeong, a fishing boat, had to suspend sailing and send an SOS when a propeller got entangled in derelict nets.

Year	Ship name	Cause	Contents
2010	Gangryong No.27	Derelict rope	On 20 June, Gangryong No.27, a fishing boat sailing from Changseungpo Harbor, sent an SOS when a propeller got entangled in derelict rope.
2010	Sooseong No.5	Derelict rope	On 20 June, Sooseong No.5, a fishing boat sailing from Guryongpo Harbor, sent an SOS when a propeller got entangled in derelict rope while moving to a different fishing area.
2010	Geumgwang	Derelict nets	On 16 April, Geumgwang, a fishing boat sailing from Minrak Harbor in Busan, sent an SOS when a propeller got entangled in derelict nets.
2010	Daeseong	Derelict nets	Daeseong, a fishing boat, sent an SOS when a propeller got entangled in derelict nets.
2010	Daegyeong No.107	Derelict nets	Daegyeong No.107, a fishing boat, sent an SOS when a propeller got entangled in derelict rope while sailing to a different fishing area.
2009	Donggwang No.18	Derelict nets	On 9 October, Donggwang No.18, a fishing boat sailing from Mijo Harbor, sent an SOS when a propeller got entangled in derelict nets.
2009	Nagyeong No.311	Derelict nets	On 10 December, Nagyeong No.311, a fishing boat sailing from Bangagin Harbor in Ulsan, sent an SOS when a propeller got entangled in derelict nets.
2009	Dongcho	Derelict nets	On 7 January, Dongcho, a fishing boat sailing from Bangagin Harbor in Ulsan, sent an SOS when a propeller got entangled in derelict nets.
2009	Dongjin No.102	Derelict nets	Dongjin No.102, a fishing boat, sent an SOS when a propeller got entangled in derelict nets.
2009	Palgwang	Derelict nets	Palgwang, a fishing boat, sent an SOS when a propeller got entangled in floating derelict nets.
2009	Haeseong No.88	Derelict nets	Haeseong No.88, a fishing boat, sent an SOS when a propeller got coiled by derelict nets.
2009	Jinyang	Derelict rope	Jinyang, a fishing boat, sent an SOS when a propeller got coiled by derelict nets.
2009	Dongdo	Derelict nets	Dongdo, a fishing boat that was slowly sailing northwest of Jukbeon Harbor, sent an SOS when a propeller got coiled by derelict nets.
2009	Manseong No.123	Derelict rope	Manseong No.123, a fishing boat, sent an SOS when it suspended sailing because a propeller got entangled in derelict rope.

Year	Ship name	Cause	Contents
2009	Dongcho	Derelict nets	Dongcho, a fishing boat, sent an SOS when a propeller got entangled in derelict nets.
2009	Dongwon	Derelict nets	On 7 September, Dongwon, a fishing boat sailing from Jeongja Harbor in Ulsan, sent an SOS when a propeller got entangled in derelict rope.
2009	Wooshin	Derelict rope	Wooshin, a fishing boat, had to suspend sailing and send an SOS when a propeller got entangled in derelict rope while returning home.
2009	Incheon	Derelict nets	A fishing boat Incheon sailing became entangled in derelict nets, which coiled a propeller, causing the vessel to suspend sailing and called for help.
2009	Sooseong No.3	Derelict rope	Sooseong No.3, a fishing boat sailing from Bangajin Harbor in Ulsan, sent an SOS when a propeller got entangled in derelict rope.
2009	Namyeong	Garbage	Namyeong, a fishing boat, went adrift when a propeller got entangled in garbage.
2009	Jaegyeong	Derelict nets	Jaegyeong, a fishing boat, sent an SOS when a propeller got entangled in derelict nets.
2009	Geumseong No.2003	Garbage	On 29 January, Geumseong No.2003, a fishing boat sailing from Minrak Harbor in Busan, sent an SOS when a propeller got entangled in garbage.
2009	Boseong No.708	Derelict nets	On 21 November, Boseong No.708, a fishing boat sailing from Busan Harbor, sent an SOS when a propeller got entangled in derelict nets.
2009	Shinheung No.108	Derelict rope	Shinheung No.108, a fishing boat, sent an SOS when a propeller got entangled in derelict rope, causing the front gears of the main engine clutch to be overloaded and damaged.
2009	Cheongshin No.1	Garbage	Cheongshin No.1, a fishing boat, sent an SOS when a propeller got entangled in garbage.
2008	Youngshin No.99	Derelict rope	Youngshin No.99, a fishing boat, sent an SOS when a propeller got entangled in derelict ropes while returning home, damaging the clutch.
2008	Kyungdong	Derelict rope	On 25 October, Kyungdong, a fishing boat sailing from Gampo harbor, sent an SOS when a propeller got entangled in derelict rope.
2008	Juyeong No.509	Derelict nets	Juyeong No.509, a fishing boat, sent an SOS when a propeller got entangled in derelict nets, causing the engine to break down.

Year	Ship name	Cause	Contents
2008	Baeyang	Derelict nets	Baeyang, a fishing boat, sent an SOS when a propeller got entangled in derelict nets while returning home.
2008	Guweon No.77	Derelict nets	Guweon No.77, a fishing boat, sent an SOS when a propeller got entangled in derelict nets, causing the engine to break down.
2008	Dongun No.3	Derelict rope	Dongun No.3, a fishing boat, sent an SOS when a propeller got entangled in derelict rope, causing the clutch to break down. The vessel was towed to Guryongpo harbor.
2008	Dapung No.5	Derelict nets	On 1 January, Dapung No.5, a fishing boat sailing from Changseungpo Harbor in Geoje Island to the southern coast of Korea, sent an SOS when a propeller got entangled in derelict nets.
2008	Changheung No.1	Derelict nets	Changheung No.1, a fishing boat, sent an SOS when a propeller got entangled in derelict nets, causing the vessel to suspend sail.
2007	Cheongho	Derelict nets	Cheongho, a fishing boat, sent an SOS when a propeller got entangled in derelict nets.
2007	Eoryeong No.800	Garbage	Eoryeong No.800, a fishing boat, sent an SOS when a propeller got entangled in garbage, causing the vessel to suspend sail.
2007	Guweon No.77	Derelict rope	Guweon No.77, a fishing boat, sent an SOS when a propeller got entangled in derelict rope.
2007	Haejin No.207	Garbage	Haejin No.207, a fishing boat, sent an SOS when a propeller got entangled in garbage, causing the vessel to suspend sail.
2006	Dongik No.33	Garbage	Dongik No.33, a fishing boat, sent an SOS when a propeller got entangled in floating garbage; the vessel was towed by a coast guard patrol boat.
2006	Blackshark	Garbage	On 12 December, Blackshark, a 9.77 ton fishing boat, sent an SOS and had to be towed when a propeller got entangled in floating garbage; it had been returning home after fishing 30 miles east of Ulgi.
2006	Seojin	Derelict rope	Seojin, a fishing boat, sent an SOS when a propeller got entangled in derelict rope.
2006	Sahye	Derelict rope	Sahye, a fishing boat that had been sailing in Busan, sent an SOS when a propeller got entangled in derelict ropes; the vessel was towed.

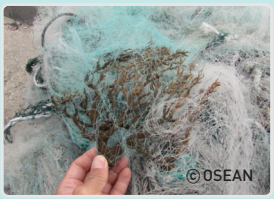
Year	Ship name	Cause	Contents
2006	Youngshin No.401	Unidentified object	Youngshin No.401, a fishing boat, sent an SOS after crashing into an unidentified object and breaking a propeller.
2006	Donghyun No.12	Derelict rope	Donghyun No.12, a fishing boat, sent an SOS when a propeller got entangled in derelict ropes, causing the vessel to suspend sail.
2006	Youngshin	Derelict rope	Youngshin, a fishing boat, sent an SOS when a propeller got entangled in derelict rope, causing the vessel to suspend sail.
2006	Daeseong	Derelict nets	A fishing boat turning back to Geojin harbor became entangled in derelict nets, which coiled a propeller, and the vessel was towed. Daeseong, a fishing boat that had been returning to Geojin harbor, sent an SOS when a propeller got entangled in derelict nets; the vessel was towed home.
2005	Yuchang No.93	Derelict nets	Yuchang No.93., a fishing boat got entangled in derelict nets, which got caught in a propeller, causing the vessel to suspend sailing and send as SOS.

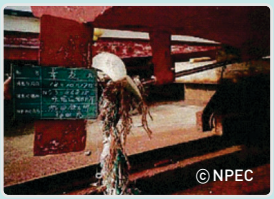
ANNEX 2. Cases of Damaged Beach Vistas and Costs for Recovery

Year	Location	Cause	Contents
Jun. 13 2004	Dalian, China	Floating litter	4 salvaging ships were used to collect floating litter such as Styrofoam, board, and municipal solid waste in Dalian Bay with many environmental protection volunteers.
2005, 2010	Xiamen, China	Wood and other marine litter	Every day, about 60-70 tons of waste including wood was collected by cleanup ships of Xiamen city in 2005. In 2010, the amount of piled waste along the shoreline of Xiamen city increased significantly (600 tons in total) after the flood.
July 24 2006	Qinhuangdao, China	Beach litter	The beautiful scenery of the sea was destroyed by floating garbage and various domestic waste dumped by visitors.
2008	Xiamen, China	Marine litter	3 cleaning ships were used to keep the sea area between Gulangyu Island and the mainland clean. For three years, the ships collected 10,246 tons of marine litter.
July 19 2009	Changle County, Fujian Province, China	Beach litter	Several local residents were employed to clean up the beach litter daily.
2010	Xiyong beach, Shenzhen City, China	Waste materials	8 workers spent 5 whole working days cleaning up waste materials on a beach.
2008	Okinawa, Japan	Beach Litter	The Iriomote and Ishigaki Islands are constantly polluted by marine litter from abroad. Various countermeasures are undertaken in the area, including beach cleanups by local volunteers and regular cleanups by tourist agents on major tourist sites. The economic effect of maintaining a clean beach was estimated; the study found that total tourist consumption would increase approximately JPY 3,300 million (US$ 41 million) for Iriomoto Island and JPY 1,100 million (US$ 13 million) for Ishigaki Islands.
Every year	Tsushima, Nagasaki, Japan	Mainly Beach Litter	In Tsushima City, Nagasaki Prefecure, beach cleaning is conducted several times a year. The yearly cleaning cost is estimated to be approximately JPY 500 million (US$ 6 million), including JPY 3 to 4 million for labor cost (beach and toilet cleaning) and JPY 500 to 600 thousand for heavy equipment to remove heavy marine litter.
August 25, 2008	Saga, Japan	Beach Litter	The Morotomi Police Office in Saga Prefecture reported that a crane, while transporting driftwood from the beach to the embankment (4 m height), overturned, and the 13m-long arm hit the man driving the crane.

Year	Location	Cause	Contents
October 31, 2010	Mihama-cho, Aichi, Japan	Driftwood	The mangrove forest on Amami-ohshima Island, Kagoshima, the second largest in Japan after Okinawa (70 h), suffered severe damage during heavy rain. Large amounts of litter, dirt and driftwood entered the forest. Many tourists cancelled their trips after the damage until early November. In Mangrove Park, staff collected litter using canoes, since the landscape of the park is not accessible by large vessels. According to the Amami-ohshima tourist association, the loss of the tourist business in October amounted to JPY 300 million or more, due to cancellation of the group tours.
February 11, 2005	Aomori, Japan	Log	In February 2005, the "HELENA II", a Cambodian-registered vessel carrying wood, became stranded off Cape Kodomari. Approximately 9,700 logs drifted onto a nearby beach; 3,300 of the logs were collected. Several thousands of logs affected a popular fishing place which is also known for turban shells, abalone and seaweed. The removal was completed at a cost of JPY 163 million; the "Regional Green New Deal Fund" funded the exercise.
2010	Geoje Yacht School, Korea	Floating garbage	The beauty of the sea was ruined by floating garbage caused by typhoon 'MALOU'.
2009	Sinan-gun, Jeollanam-do, Korea	Beach litter	20 tons of marine litter was collected and their components were analyzed.
2004	Coast of Gangwon-do, Korea	Beach litter	Typhoon 'MEGI' generated 5,100 tons of marine litter on the east coast of Korea and the costs for cleaning were KRW 710 million.
2004	Coast of Jeollanam-do, Korea	Marine litter	Typhoon 'MEGI' generated 6,924 tons of marine litter on the coast of Jeollanam-do and the costs for cleaning were KRW 1.409 billion.
2006	Coast of Gangwon-do, Korea	Beach litter	459 tons of marine litter in Gangneung-si created by Typhoon 'SHANSHAN' was collected for 15 days at cleaning cost of KRW 150 million.
October 11, 2010	Golden Horn Bay, Vladivostok, Russia	Plastic	Golden Horn Bay was developed by port construction and mooring on the wharf. The bulk of enterprises dump garbage in the bay.
July 9, 2010	Russian Far Eastern beaches	Plastic, glass, domestic waste	More than 30 beaches in the Far East are in unsatisfactory condition. Many beaches don't correspond to the safety standards of marine litter.

Year	Location	Cause	Contents
July 21, 2010	Vladivostok beaches, Russia	Domestic waste	The main source of pollution is the domestic waste of the townspeople vacationing on the beaches.
August 12, 2010	Sadgorog Beach (Vladivostok), Russia	Domestic waste	Journalists have cleaned up Sadgorog beach, located in the suburbs of Vladivostok. Most garbage is left behind by vacationers.
November 10, 2010	Zarubino Settlement (Primorsky Kray), Russia	Domestic waste	Zarubino beaches are popular among tourists. As a result there is a lot of domestic waste on the beaches. The Zarubino administration has organized domestic waste cleanup on the beaches.
October 11, 2010	Andreevka Settlement (Primorsky Kray), Russia	Domestic waste	Veteran rowers spent two hours cleaning up 300 meters of the Andreevka Beach.
August 16, 2010	Zolotari Beach (Nakhodka), Russia	Domestic waste	A group of Nakhodka boxers has taken part in the clean-up of the heavily polluted Zolotary Beach.
August 27, 2010	Volna Beach (Nakhodka), Russia	Domestic waste	Recreation on Volna beach in Nakhodka is restricted due to large amounts of pollution. Volunteers removed the litter that vacationers left behind.
June 7, 2010	Fedorova Bay (Vladivostok), Russia	Domestic waste	Vladivostok divers participated in the “Day of Reservoir Clearing” and removed the marine litter sitting at the bottom of Fedorova Bay.
September 30, 2010	Elena Island (Vladivostok), Russia	Domestic waste	Schoolchildren picked up Elena Island’s marine litter. The initiators of this operation are the nonprofit organization, “Green Cross” and the ecological department of Russian Pacific Fleet.
June 11, 2010	Vladivostok beaches, Russia	Domestic waste	Townspeople must spend their vacations on the litter-filled unsanitary beaches.
June 9, 2010	Peter the Great Bay, Russia	Domestic waste	The Peter the Great Gulf area is seriously polluted by littering and drainages. Additional measures on cleaning of water area are necessary.
June 28, 2010	Vladivostok beaches, Russia	Domestic waste	Journalists of the "Komsomolka" newspaper have decided to clean up Vladivostok beaches. The most popular Vladivostok beaches are Gornostay, Steklyannaya, Lazurnaya, Sedanka beaches. But sanitary conditions are unsatisfactory because of the large amount of garbage on the beaches.
October 11, 2010	Prigorodnoye Coast (Sakhalin island), Russia	Domestic waste	Employees of the “Rosneft-Shelf-Far East” company have picked up garbage left by tourists and carried it away in their own cars.





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