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National Actions on Marine Microplastics in the NOWPAP Region

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1. Introduction

In recent years, marine plastic litter (MPL) has been a critical environmental issue in the ocean. Plastic material is non-degradable; therefore, plastic litter remains in the ocean for thousands of years (Barnes *et al*., 2009). Plastic litter is easily broken into smaller pieces by waves and/or sunlight. Small plastic particles less than 5 mm in diameter are called microplastics (MPs). Along with increased MPL, the amount of MPs has also increased in the ocean. The Ellen MacArthur Foundation predicts that the number of plastic particles in the ocean will be larger than the number of fish by 2050 (The New Plastics Economy: Rethinking the Future of Plastics). Concerning the seriousness of MP problems, at the Group of Twenty (G20) Osaka Summit in 2019, the participating nations discussed the issues regarding MPL and MPs, and defined a shared goal: to decrease the input of MPL into the ocean to zero by 2050.

The northwest Pacific is one of the regions that is most polluted by MPs, globally (Isobe *et al*., 2015). Therefore, MPs are recognized as a very serious environmental concern in this region. In the northwest Pacific region, Northwest Pacific Action Plan (NOWPAP), one of the Regional Seas Programmes within the United Nations Environment Programme (UNEP), was adopted by four countries: the People's Republic of China, Japan, the Republic of Korea, and the Russian Federation. The objective of NOWPAP is to protect the regional marine environment under international cooperation between the four member states. NOWPAP initiated marine litter (ML) activities following the decision at the Tenth NOWPAP Intergovernmental Meeting in 2005. NOWPAP established a new project, the Marine Litter Activity (MALITA), and developed the NOWPAP Regional Action Plan on Marine Litter (RAP MALI) in 2008 to address ML issues.

Because of the serious nature of MPL including MPs pollution in the NOWPAP region, the NOWPAP member states need to share information on their respective national actions that enhance their respective capacities to tackle this problem. The best practices carried out by the NOWPAP member states can also be useful examples for other countries and regions. Therefore, the Special Monitoring and Coastal Environmental Assessment Regional Activity Centre (CEARAC) collected information regarding actions taken against MPs by the NOWPAP member states, with the support of national experts Dr. Weiwei Zhang (National Marine Environmental Monitoring Center) of China, Dr. Sang Hee Hong (Korea Institute of Ocean Science and Technology) of Korea, and Mr. Nikolai Kozlovskii (Pollution Monitoring Regional Activity Centre) of Russia, who were nominated by the NOWPAP RAP MALI Focal Points. CEARAC summarized the information provided by these experts and prepared this summary report, which classifies information as: national actions taken against MPs by central governments, mainly in the forms

of legislation, national strategies, and actions (Chapter 2); MP monitoring actions (Chapter 3); and MP prevention and/or removal and awareness raising activities (Chapter 4). Information in Chapters 3 and 4 includes not only actions taken by central governments, but also those taken by other stakeholders such as local governments, research institutes, Non-Profit Organizations/Non-Government Organizations (NPOs/NGOs), and private companies.

2. National Actions on Marine Microplastics by Central Governments

In this chapter, the relationships between national legislation, strategies/plans, and actions on marine microplastics (MPs) in each member state are explained. However, information in this chapter is focused only on the central government of each NOWPAP member state. Similar information obtained by other entities is introduced in Chapters 3 and 4.

2.1. General Information

2.1.1. National Legislation and National Strategies/Plans

NOWPAP member states do not have legislation with clear descriptions of MPs, but they do have legislation regarding marine plastic litter (MPL). Some legislation has been revised (or is planned to be revised) to address MP issues through articles, such as the "Act on Promoting the Treatment of Marine Debris Affecting the Conservation of Good Coastal Landscape and Environments to Protect Natural Beauty and Variety" in Japan. By now, each member state has developed national strategies or plans to tackle MP issues based on legislation that considers MPLs (including MPs). For example, the "Basic Policy on the Comprehensive and Effective Promotion of Measures against Articles that Drift Ashore" in Japan and "The 3rd Basic Plan for Marine Debris Management" in Korea describe clearer objectives and/or policies regarding MPs for each respective nation.

2.1.2. National Actions Based on National Legislation and/or National Strategies/Plans

Based on relevant national legislation and/or strategies/plans, the NOWPAP member states have implemented extensive monitoring, prevention, and awareness raising activities on MPs than previously existed. In particular, the amount of MPL monitoring and prevention has grown drastically since 2014.

2.2. People's Republic of China

In China, seven pieces of legislation (shown in Table 1) are related to MPL, and the following five are major legislation related to actions against MPs issues.

1. The Environmental Protection Law of the People's Republic of China (1989)
2. The Law on Prevention and Control of Water Pollution of the People's Republic of China (1984)
3. The Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste (1995)
4. The Marine Environment Protection Law of the People's Republic of China (1982)

5. Circular Economy Promotion Law of the People's Republic of China (2008)

Table 1. Relationships between legislation, strategies, and actions in China.

Legislation	Strategy/Plan	Action
The Environmental Protection Law of the People's Republic of China	On the full implementation of the river chief system	Improve the rural water environment and waste management
	Action Plan for Soil Pollution Prevention and Control	Promote the treatment of rural household waste
	Action plan for preventing and controlling pollution in Bohai Sea	Regular prevention and control of wastes in rivers and coastal waters
	Notice of the General Office of the State Council on restricting the production and sale of plastic shopping bags	Prohibit to use the ultra-thin plastic bags
	Guide catalogue for industrial structure adjustment (2019 version)	Forbidding disposable foamed plastic tableware and disposable plastic cotton swabs
		Prohibit to product and use of daily chemical products containing plastic microbeads
	Pilot program for the construction of "waste-free cities"	Promoting the reduction of household waste at the source and recycling
	The implementation plan for reform of the management system for the import of solid waste	Completely ban the import of solid waste that poses a great threat to the environment
	Notice on further strengthening supervision and inspection and illegal investigation of plastic shopping bag production enterprises	Intensify the investigation and punishment of the illegal production of plastic shopping bags
	Implementation plan of household waste classification system	Mandatory Garbage Classification
		Special action to crack down on environmental violations of solid waste

Table 1. (Continued.)

Legislation	Strategy/Plan	Action
The Law on Prevention and Control of Water Pollution of the People's Republic of China	On the full implementation of the river chief system	Improve the rural water environment and waste management
		Special action to crack down on environmental violations of solid waste
Law of the People's Republic of China on the Prevention and Control of Soil Pollution	Action Plan for Soil Pollution Prevention and Control	Promote the treatment of rural household waste
The law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste	Three-year action plan for improving rural living environment	Improve the rural household waste disposal
	Pilot program for the construction of "waste-free cities"	Promoting the reduction of household waste at the source and recycling
	The implementation plan for reform of the management system for the import of solid waste	Completely ban the import of solid waste that poses a great threat to the environment
	Implementation plan of household waste classification system	Mandatory Garbage Classification
The Marine Environment Protection Law of the People's Republic of China	Action plan for preventing and controlling pollution in Bohai sea	Regular prevention and control of wastes in rivers and coastal waters
	Implementation plan of special action on pollution prevention and control of ships and ports (2015-2020)	Ensure that pollutants from ships are disposed of in accordance with relevant regulations
		Microplastics monitoring along coastal area of China
Regulation on the Prevention and Control of Vessel-induced Pollution to the Marine Environment	Implementation plan of special action on pollution prevention and control of ships and ports (2015-2020)	Speed up the construction of receiving facilities for pollutants such as domestic sewage and garbage
Circular Economy Promotion Law of the People's Republic of China	Pilot program for the construction of "waste-free cities"	Promoting the reduction of household waste at the source and recycling
	Notice on further strengthening supervision and inspection and illegal investigation of plastic shopping bag production enterprises	Intensify the investigation and punishment of the illegal production of plastic shopping bags

2.2.1. National Legislation and National Strategies/Plans

These five pieces of legislation lead many plans and strategies. For example, the "Water Pollution Prevention and Control Action Plan" is based on Legislation 1 and 2 shown in the previous section. The "Pilot Program for the Construction of Waste Free Cities (*Pilot Program*)" are implemented under 1, 2, and 5. The objectives of most of the plans and strategies are countermeasures against illegal dumping, regulating plastic products, and promoting a circular economy. In addition to national legislation, specific legislation was established in Hainan and Jilin Provinces. One of the newest plans is the *Pilot Program*, in which, an integrated waste management system will be developed by 2020 in 11 selected cities (Shenzhen, Baotou, Tongling, Weihai, Chongqing, Shaozing, Sanya, Xuchang, Xuzhou, Panjin, and Xining). The Yangtze River Economic Belt and Bohai Sea area are the most populated areas in China. For these specific areas, Special Action Plans were also developed.

2.2.2. National Actions Based on National Legislation and/or National Strategies/Plans

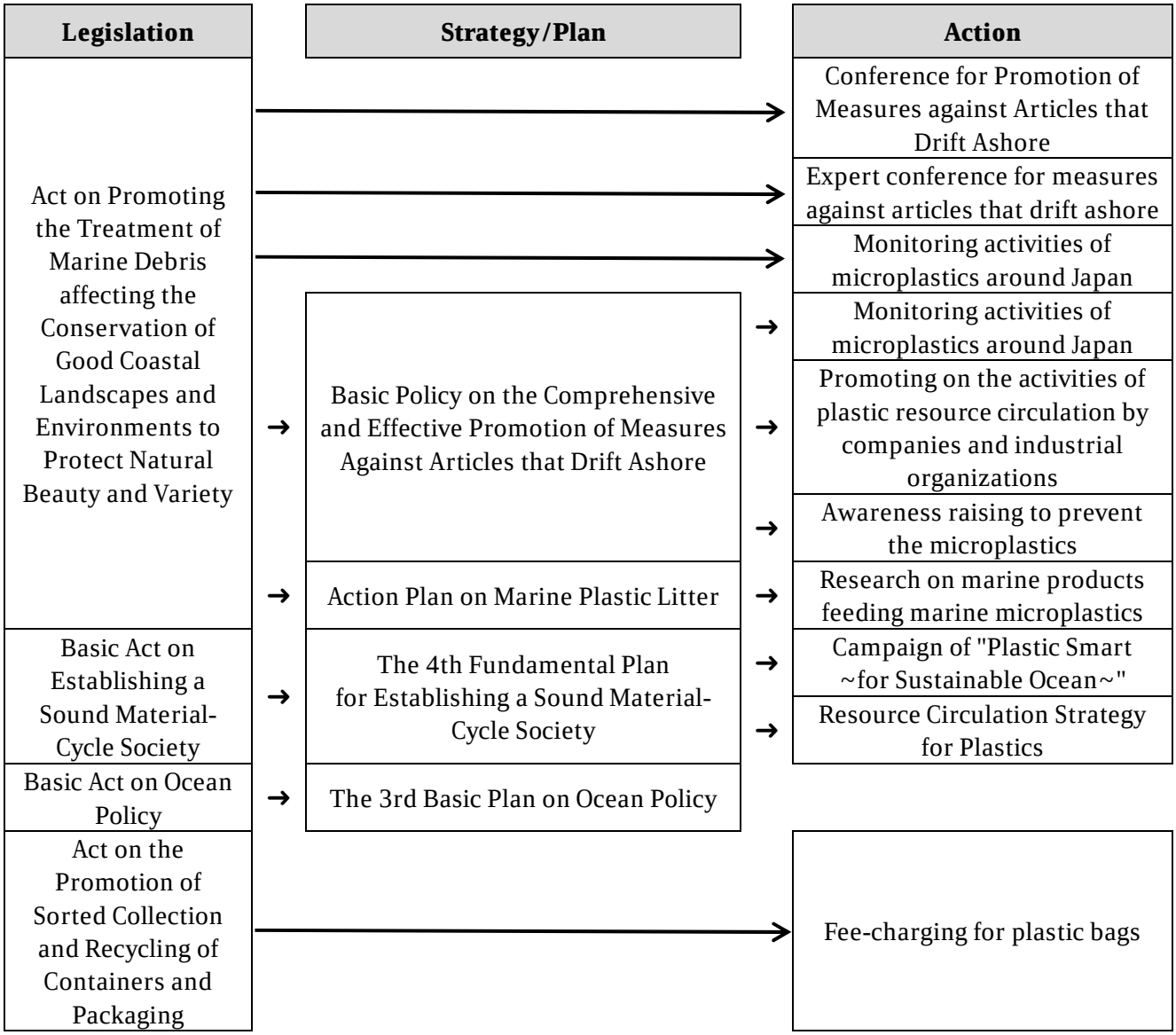
Most of the Chinese national actions aim to prevent generation of MPs through waste management. Countermeasures against illegal dumping were strengthened by Legislation 1, which lead to ban the use of ultra-thin (thickness < 0.025 mm) plastic bags and polyethylene agricultural film with a thickness of less than 0.01 mm. Legislation 1 also led establishment of regulations on the use of disposable foamed plastic tableware and disposable plastic cotton swabs, and on the production and use of daily chemical products that contain plastic microbeads.

In addition, Hainan Province has banned the production, sale, and use of disposable non-degradable plastics, and Jilin Province has banned the production, sale, and use of disposable non-degradable plastic shopping bags and tableware under Legislations 1, 3, and 5. ML and MP monitoring along coastal areas of China has also been implemented under Legislation 4.

2.3. Japan

Japan has enacted legislation that directly links to ML: the "Act on Promoting the Treatment of Marine Debris Affecting the Conservation of Good Coastal Landscapes and Environments to Protect Natural Beauty and Variety (*Act on ML*)" has been enforced since 2009. As mentioned in section 2.1.1., the basic policy and most of the actions against MPs are based on this *Act on ML* (Table 2).

Table 2. Relationships between legislation, strategy, and actions in Japan.



2.3.1. National Legislation and National Strategies/Plans

The *Act on ML* is the main ML legislation in Japan and its main objectives are the removal and effective reduction of ML. Based on this Act, the "Basic Policy on the Comprehensive and Effective Promotion of Measures against Articles that Drift Ashore (*Basic Policy*)" was developed. In 2018, *Act on ML* was revised to include descriptions of MPs. Based on this revision, the *Basic Policy* was also revised in 2019 and the effective prevention of MP waste was added. The revised *Basic Policy* encourages preventing waste plastic discharge by promoting resource cycling in society, and prevents the input of MPs into the ocean by regulating the use of microplastics, including microbeads. The other two plans, "The 4th Fundamental Plan

for Establishing a Sound Material-Cycle Society (*4th Fundamental Plan*)" was approved in 2018 under the Basic Act on "Establishing a Sound Material-Cycle Society," and the "3rd Basic Plan on Ocean Policy" was approved in 2018 under the "Basic Act on Ocean Policy." Both plans contain clear descriptions of MPs.

The "Resource Circulation Strategy for Plastics" was developed in 2019 and is based on the *4th Fundamental Plan*. Developing and implementing countermeasures against ML is one of the main goals of this strategy. Practical countermeasures are the appropriate treatment of plastic waste, MPL removal, MPL monitoring, preventing microplastic discharge, and promoting alternative materials. This strategy aims to reduce the use of disposable plastic products by 25 % and increase to double the use of biomass plastics by 2030.

The "Action Plan on Marine Plastic Litters" was developed in 2019 by the Conference of relevant ministers to promote countermeasures against MPL. This plan contains eight main actions: 1) removing and treating plastic waste, 2) preventing illegal dumping and unintentional discharge into the ocean, 3) collecting illegally dumped waste, 4) removing MPL, 5) developing alternative materials, 6) strengthening cooperation among the involved stakeholders, 7) international contributions to developing countries, and 8) accumulating scientific information.

2.3.2. National Actions Based on National Legislation and/or National Strategies/Plans

Based on the *Act on ML*, the "Conference for Promotion of Measures against Articles that Drift Ashore" and the "Expert Conference for Measures against Articles that Drift Ashore" are conducted. The objective of the first conference is to share information among the relevant ministries and agencies in order to comprehensively, effectively, and efficiently promote ML countermeasures, while the objective of the expert conference is to provide scientific information to the attendees of the first conference. Various strategies/plans and actions (shown in Table 2) are discussed during these two conferences.

The Japanese government implemented actions based on the "Basic Policy and 4th Fundamental Plan." Most of these actions are MPs monitoring and research that assess the current MPs situation in Japanese waters. Prevention and awareness raising have just begun. "Plastic Smart" is one of the good practices which has been implemented with the cooperation of local governments, private companies, and NPOs/NGOs.

2.4. Republic of Korea

Table 3. Relationships between legislation, strategy, and actions in Korea.

Legislation		Strategy/Plan		Action
Marine Environment Management Act	→	3rd National Marine Litter Management Plan	→	Master plan on Marine Plastic Litter
			→	National Marine Litter Monitoring Program
			→	Microplastic Monitoring along the Coasts of Korea

2.4.1. National Legislation and National Strategies/Plans

Korea has enacted extensive legislation related to ML issues and among these, the Marine Environment Management Act is the major legislation that encompasses MPs. Under this act, "The 3rd National Marine Litter Management Plan (*3rd Management Plan*) (2019-2023)" was approved in 2019. As the major strategy to combat ML and MPs, the *3rd Management Plan* aims to evaluate the previous "2nd National Marine Litter Management Plan (*2nd Management Plan*) (2014-2018)" by investigating global and domestic trends in ML management and estimating the volume of domestic ML. The evaluation of the *2nd Management Plan* will help establish objectives and strategies for the *3rd Management Plan*, as well as to implement and execute the proposed plans. Marine Waste and Marine Pollutant Sediment Management Act was passed at the National Assembly in 2019 and will be enacted in 2020.

2.4.2. National Actions Based on National Legislation and/or National Strategies/Plans

Based on the *3rd Management Plan*, three kinds of MPs monitoring have been implemented by the Ministry of Oceans and Fisheries. The Ministry of Oceans and Fisheries and the Ministry of Environment developed the "Master Plan on Marine Plastic Litter (*Master Plan*)" in 2019 under the *3rd Management Plan*. The *Master Plan* aims to provide comprehensive countermeasures to enhance the MPL management infrastructure in order to address MPL sources and to encourage recycling of plastics. The Ministry of Oceans and Fisheries developed the "Marine Litter and Marine Sediment Management Act" in 2019. The objective of this act is to establish an exclusive and concrete ML management system with a focus on reducing ML, as well as introducing recycling methods that reflect the characteristics of ML.

2.5. Russian Federation

2.5.1. National Legislation and National Strategies/Plans

The Russian Federation has enacted extensive legislation related to ML, such as the “Environment Protection Law” and the “Water Code of Russian Federation.” However, these legislative measures do not mention MPs issues in any of their articles. In 2019, it was announced that the central government would revise the “Production and Consumption Wastes Law” to address reducing the production of single-use plastic packaging.

2.5.2. National Actions Based on National Legislation and/or National Strategies/Plans

In the Russian Federation, while all MPs actions have been developed without relevant legal bases or national strategies, MPs monitoring has been implemented since 2014 by some academic institutes, such as Far East Branch of the Russian Academy of Sciences (FEB-RAS).

3. Monitoring Microplastics

In this chapter, information on microplastics (MPs) monitoring by central/local governments, research institutes, NPOs/NGOs, and private companies in the NOWPAP member states is introduced. The monitoring areas include not only ocean areas, but also beaches and rivers, and the monitoring targets are the water (sea surface or river water), sediment, and marine species (biota) in these environments.

3.1. General Information

MPs monitoring in the NOWPAP member states began in 2012. In recent years, various kinds of monitoring (in water, sediment, and biota) have been implemented in different areas (offshore, inshore, beaches, and rivers) (Table 4). Particularly in China, monitoring is very active and is implemented in all areas where MPs exist. Common monitoring activities among the member states include monitoring the surface water in coastal areas and monitoring beaches. In 2016, MP monitoring was implemented at 270 sites (189 offshore/inshore sites and 81 beach sites) in total in the NOWPAP member states, which was the largest number of monitoring sites in the collected information. More detailed information on monitoring microplastics in each member state is shown in Annex.

Measures against MPs need to be considered and taken, based upon scientific knowledge. However, comparing and synthesizing measured data of MP abundance obtained by various researchers are difficult due to diversified monitoring methods taken. Thus, harmonization of monitoring methods for MPs is required. The Japanese government has led to harmonize the microplastics monitoring globally (http://www.env.go.jp/en/water/marine_litter/method.html), and constructed a guideline on the monitoring: “Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Method” in 2016 through international experts conferences including the experts in the NOWPAP member states.

Some countries have conducted monitoring on unique targets/items. Some monitoring efforts by China and Korea have targeted MPs in marine species, while other monitoring efforts in Japan and Korea have investigated MP associated chemicals, such as the concentrations of Polychlorinated biphenyl (PCBs), Dichloro-diphenyl-dichloroethylene (DDE), Hexaborocyclododecans (HBCDs), and antioxidants, and the Russian Federation monitors the settling speed of MPs. It has been reported that MPs adsorb toxic chemicals (PCBs and DDE) onto their surfaces (*e.g.*, Mato *et al.*, 2001) and additive chemicals (HBCDs and antioxidants) that are added during manufacturing processes to enhance the performance of plastics (*e.g.*, Jang *et al.*, 2017; Rani *et al.*, 2017). MPs that have adsorbed chemicals and additives can have impacts on fishes and higher predators, including humans, through accidental ingestion or absorption (Browne *et al.*,

2013; Farrell and Nelson, 2013). Recent studies have reported MPs dynamics such as the settling speed based on the MPs particle size (Cózar *et al.*, 2014). These monitoring results may be useful for estimating MPs dynamics.

Table 4. Summary of microplastics monitoring by the NOWPAP member states.

Monitoring organizers are classified into two groups: (C.G.: central government; and others: local governments, research institutes, and private companies). Check-marks in the table indicate which action the NOWPAP member states implement.

Area	Target	China		Japan		Korea		Russia	
		By C.G.	By others	By C.G.	By others	By C.G.	By others	By C.G.	By others
Offshore	Seawater	✓	✓	✓		✓			
	Sediment		✓			✓			
	Biota		✓						
Inshore	Seawater	✓	✓	✓		✓			✓
	Sediment		✓						✓
	Biota	✓	✓			✓			
Beach	Sediment	✓	✓	✓	✓	✓			✓
River	River water		✓	✓	✓	✓			✓
	Sediment		✓						

3.2. People's Republic of China

In China, the central government (National Marine Environment Monitoring Center: NMEMC) and research institutes (*e.g.*, East China Normal University and Institute of Oceanology, Chinese Academy of Sciences) have many MPs monitoring projects in various environments, from offshore areas to rivers (Table 5). The NMEMC has five monitoring targets (density, size, color, shape, and polymer type). On the other hand, the number of monitoring targets chosen by research institutes is different for each individual organizer. The Bohai Sea and Yangtze River are areas targeted by the national plans; therefore, monitoring these areas has been more actively implemented than in other areas.

Table 5. Microplastics monitoring actions in China

Area	Target	Item	Organizer	Year
Offshore	Seawater	Density, size, color, shape, polymer type	Central government	2016-2018
		Density, size, shape, polymer type	Academic institute	2017-2019
	Sediment	Density, size, shape, polymer type	Academic institute	2017-2018
	Biota	Density, size, color, shape, polymer type	Academic institute	2019
Inshore	Seawater	Density, size, color, shape, polymer type	Central government	2016-2018
		Density, size, shape, polymer type	Academic institute	2014, 2018-2019
	Sediment	Density, size, color, shape, polymer type	Academic institute	2017-2019
	Biota	Density, size, color, shape, polymer type	Central government	2016
		Density, size, shape, polymer type	Academic institute	2015-2016, 2018-2019
Beach	Sediment	Density, size, color, shape, polymer type	Central government	2016-2017
		Density, size, shape, polymer type	Academic institute	2014-2016, 2018
River	River water	Density, size, shape, polymer type	Academic institute	2014-2019
	Sediment	Density, size, color, shape, polymer type	Academic institute	2015-2017

3.3. Japan

MP monitoring has been implemented by the central government (Ministry of the Environment: MoE and Japan Coast Guard), local governments, academic institutes, and a private company (Table 6). In 2014, the central government began monitoring 1-5 items from number, weight, density, size, sharp, polymer type, and chemical adsorption at offshore, inshore, beach, and river sites. Then from 2016-2018, local governments, an academic institute, an NGO, and a private company began monitoring 1-4 items from number, weight, density, size, polymer type, color, shape, and chemical adsorption only at beach and river sites.

Table 6. Microplastics monitoring actions in Japan

Area	Target	Item	Organizer	Year
Offshore	Seawater	Number, weight, density, size, polymer type	Central government	2014-2019
		Number, density, size, chemical absorption	Central government	2014-2019
Inshore	Seawater	Number, density, shape, polymer type	Central government	2014-2019
		Weight, size, polymer type, chemical absorption	Central government	2014-2019
Beach	Sediment	Weight, size, polymer type, chemical absorption	Central government	2014-2019
		Number, shape	Local government	2016
		Number, polymer type	Local government	2017-2018
		Number, density	Local government	2018-2019
		Chemical absorption	NPO/NGO	2005-2019
River	River water	Number	Central government	2018-2019
		Number, weight, transport	Academic institute	2017
		Weight, size, color, polymer type	Private company	2018

3.4. Republic of Korea

The central government (Korea Institute of Ocean Science and Technology (KIOST)) has implemented MP monitoring around the Korean coastline (inshore areas and beaches) since 2012 (Table 7). The monitoring items are the same (number, size, color, shape, and polymer type) at all sites and all marine matrices. For all marine matrices, microplastic particles down to 20 μm in size were sampled and analyzed. Water sampling sites were at offshore, inshore and river, where waters from surface layer and water columns (*e.g.*, mid and bottom layers) were taken. Offshore core sediment was also monitored to understand the temporal trend of MPs. For beach sediment, mesoplastics (plastic particles in 5-25 mm) was also monitored for the comparison with MPs. In 2017, MP monitoring was conducted for inshore marine species, mainly bivalves (mussel, oyster and Manila clam). River water monitoring has been conducted at the five major rivers of Korea since 2017.

Table 7. Microplastics monitoring actions in Korea

Area	Target	Item	Organizer	Year
Offshore	Seawater	Number, size, color, shape, polymer type	Central government	2019
	Sediment	Number, size, color, shape, polymer type	Central government	2019
Inshore	Seawater	Number, size, color, shape, polymer type	Central government	2012, 2015-2017
	Biota	Number, size, color, shape, polymer type	Central government	2017
Beach	Sediment	Number, size, color, shape, polymer type	Central government	2016
River	River water	Number, size, color, shape, polymer type	Central government	2017-2019

3.5. Russian Federation

Monitoring of MPs has been implemented by research institutes (e.g. FEB-RAS and Kovalevsky Institute of Marine Biological Research RAS: IMBR RAS) and an NGO (Project MicroplAstics Research in the BaLtic marine Environment: MARBLE) since 2014 (Table 8). The major monitoring items are number, density, size, and chemical pollution (inshore and beach sites), and the settling speed (inshore sites) is also monitored.

Table 8. Microplastics monitoring actions in Russia

Area	Target	Item	Organizer	Year
Inshore	Seawater	Density, settling speed	Academic institute	2014-2015
		Number, density, size, shape, polymer type	Academic institute	2015-2019
		Number, density, size, chemical absorption	Academic institute	2016-2019
	Sediment	Number, density, size, chemical absorption	NPO/NGO	2015
Beach	Sediment	Number, density, size, chemical absorption	Academic institute	2016-2019
River	River water	Number, density, size, shape, polymer type	Academic institute	2015-2019

4. Prevention, Removal, and Awareness Raising on Marine Microplastics

Actions on the prevention, removal, and awareness taken by the central governments of the NOWPAP member states are reported in this chapter. In addition, actions taken by other stakeholders, including local governments and private companies found via internet searches, are introduced. Actions that were conducted within the last 5 years (2015-2019) by the NOWPAP member states are collected and introduced here.

4.1. General Information

All actions (except monitoring) are classified into three categories: prevention, removal, and awareness raising (Table 9). In the case of an action that can be classified as both prevention and awareness raising, the categorization was determined by the degree of the action's focus. Various actions to reduce marine plastic litter are planned in the NOWPAP member states including actions against MPs issue.

Prevention and awareness raising about MPs are the main actions taken by the central governments and other stakeholders in the NOWPAP member states. Thirty preventative actions and four actions that raise awareness are reported. Removal actions on MPs except for those on ML have not yet started in any of the NOWPAP member states. Most preventative actions involve the reduction of plastic product usage and the development of alternative materials. Actions that raise awareness aim to disseminate information regarding MP issues to the public through various media (e.g., websites and SNS) and/or through environmental education.

Table 9. Summary of preventative actions, removal actions and awareness raising actions about marine plastic litter in the NOWPAP member states by two groups: (C.G.: central government, others: local government, academic institute, NPO/NGO, and private company). Check-marks in the table indicate which activity the NOWPAP member states have.

Type of action	Category of major activity	China		Japan		Korea		Russia	
		By C.G.	By others	By C.G.	By others	By C.G.	By others	By C.G.	By others
Prevention	Conference to prevent marine litter including microplastics - such as ministerial and/or experts conference to reduce ML or MPs	✓	✓	✓	✓	✓			
	Limitation or ban on plastic products - such as fee-charging of plastic bags, and ban of the use of microbeads	✓	✓	✓	✓	✓		✓	
	Research or collecting information on microplastics - such as research on impact of MPs, and analysis on MPs information	✓	✓	✓	✓	✓	✓		✓
	Recycling plastics, developing alternatives, and others - such as promotion recycled plastic, development biodegradable products	✓	✓	✓	✓	✓		✓	✓
Removal	Removal on marine litter - such as cleanup on the beach and/or river mouth	✓	✓	✓	✓	✓	✓		✓
	Removal on marine microplastics - such as extraction MPs in sea/river water								
Awareness raising	Publicity campaign, education program, and others - such as events to aware MP dynamics, lecture for students or general public	✓	✓	✓	✓	✓	✓	✓	✓

4.2. People's Republic of China

As explained in 2.2.2, the Chinese central government has taken actions to prevent MPs through waste management. In addition to these, the central government has actively implemented actions for reducing solid waste (Table 10). The National Development and Reform Commission and the Ministry of Housing and Urban-Rural Development started "Mandatory Garbage Classification" in 2017. In 4 directly controlled municipalities (Beijing, Tianjin, Shanghai, and Chongqing), provincial capitals, major cities, and 10 other special cities, the local governments have tried to introduce garbage classification and to develop appropriate collection and transportation systems. The goal of this action is: the sorted collection rate of household waste will reach more than 90 % and the recycling of household waste will achieve more than 35 % by 2030.

For actions that raise awareness, the central government has collaborated with NGOs (*e.g.*, Dalian Environmental Protection Volunteers Association and Shanghai Rendu) to implement a cleanup campaign and to educate citizens with regard to ML and MP problems. A local government (Publicity Department of Weihai Municipal Party Committee) also held a "World Ocean Day and National Marine Awareness Day" in 2017 to encourage active public participation in raising public awareness on marine protection, and to clean up ML.

Table 10. Major preventative actions and awareness raising actions about microplastics in China.

Type of action	Category of major activity	Title/subject	Organizer	Enforced year
Prevention	Limitation or ban on plastic products	Prohibit to use the ultra-thin plastic bags	Central government	2008
		Disposable foamed plastic tableware and disposable plastic cotton swabs are forbidden	Central government	2020 (planning)
		The production and use of daily chemical products containing plastic microbeads are prohibited	Central government	2020 (planning)
		Hainan province has banned the production, sale and use of disposable non-degradable plastics	Local government	2019
		The production, sale and supply of disposable non-degradable plastic shopping bags and plastic tableware are prohibited in Jilin Province	Local government	2015
	Recycling plastics, developing alternatives, and others	Mandatory Garbage Classification	Central government	2017
Awareness raising	Publicity campaign, education program, and others	World Ocean Day and National Marine Awareness Day Theme Public Welfare Activities in Weihai City	Local government	2017

4.3. Japan

In Japan, various prevention actions were initiated not only by the central government, but also by private companies (Table 11). The Ministry of Environment (MoE) established programs such as the "Campaign of Plastic Smart" under public–private cooperation program to solve the MPL problem by combining the efforts of individuals, local governments, NGOs, private companies, and research institutes. As of January 2020, over 1,000 actions have been registered by companies and NGOs. In 2019, the MoE also established the Liaison Conference among the relevant ministries and agencies to promote countermeasures against ML, in order to enhance national actions taken to prevent MPs. The MoE also plans to ban free plastic bags in stores beginning in 2020 based on "The Resource Circulation Strategy for Plastics."

As for actions to prevent MP pollution from the fishery industry, the central government (Fisheries Agency and Japan Coast Guard) has organized "Research on marine products feeding marine microplastics" to estimate the residence time and MP absorption in fish (e.g., red sea bream), and a project called "Awareness raising to prevent microplastics" which includes visiting and providing instruction on fishing vessels.

Since 2016, many private companies have conducted various actions to reduce MPs, such as restricting or banning plastic products and developing and/or promoting alternative materials. Producing clothes from fibrous proteins, the biodegradable polymer "PHBH," or other materials are unique actions taken by private companies.

Table 11. Major preventative actions and awareness raising actions about microplastics in Japan.

Type of action	Category of major activity	Title/subject	Organizer	Enforced year
Prevention	Conference to prevent microplastics	Conference for Promotion of Measures against Articles that Drift Ashore	Central government	2009
		Expert Conference for Measures against Articles that Drift Ashore	Central government	2009
	Limitation or ban of plastic products	Fee-charging on plastic bags	Central government	2020 (planning)
		Request of self-restraint of microbeads in cosmetic products	Private company	2016
		Abolishing the disposable plastic straws derived from fossil fuels	Private company	2019
	Research or collecting information on microplastics	Research on marine products feeding marine microplastics	Central government	2018
		Harmonization of microplastics monitoring methodologies in the ocean	Central government	2016
	Recycling plastics, developing alternatives, and others	Promoting activities of plastic resource circulation by companies and industrial organizations	Central government	2018
		Resource Circulation Strategy for Plastics	Central government	2018
		Japan Initiative for Marine Environment (JaIME)	Private company	2018
		Clean Ocean Material Alliance (CLOMA)	Private company	2019
		Prevention of resin-pellet leakage	Private company	1992

Table 11. (Continued.)

Type of action	Category of major activity	Title/subject	Organizer	Enforced year
Prevention	Recycling plastics, developing alternatives, and others	Development of clothes from fibrous protein “Brewed Protein” instead of plastic materials	Private company	2019
		Product development used the biodegradable polymer “PHBH”	Private company	2018
		Starting to sell shirts that use recycled polyester “ECO i-short”	Private company	2019
		Development of the biodegradable plastics “BioPBS”	Private company	2018
		Development of the biodegradable microbeads “Techpolymer EF series”	Private company	2019
		Development of the recycled fiber material “ASTY”	Private company	2020 (planning)
		Adoption the biodegradable plastics derived from plants	Private company	2019
		Recycling plastic bottles using the collected marine plastic litters	Private company	2019
Awareness raising	Publicity campaign, education program, and others	Campaign of “Plastic Smart –for Sustainable Ocean-	Central government	2018
		Awareness raising to prevent microplastics	Central government	2018

4.4. Republic of Korea

Since 2017, the central government (Ministry of Food and Drug Safety (MFDS) and the Ministry of Environment (MOE)) have implemented preventative actions against MPs by restricting or banning plastic bags and microbeads in cosmetics (Table 12).

To raise public awareness, the Korean government has announced a campaign to inform tourists how to prevent the generation of ML during the summer vacation season. The Korean government has also organized a contest for ideas to prevent ML called the “Nationwide Idea Contest for Litter Free Sea.”

Table 12. Major preventative actions and awareness raising actions about microplastics in Korea.

Type of action	Category of major activity	Title/subject	Organizer	Enforced year
Prevention	Limitation or ban of plastic products	Ban of the use of microbeads in cosmetics (especially cleaning products)	Central government	2017
		Ban of disposable plastic bags from big supermarkets	Central government	2019
Awareness raising	Publicity campaign, education program, and others	Nationwide Idea Contest for "Litter Free Sea"	Central government	2018

4.5. Russian Federation

The central government (Ministry of Natural Resources, Ministry of Economic Development, Ministry of Construction, Ministry of Industry and Commerce, and other federal agencies) promotes the incineration and recycling of plastic waste to reduce potential MP generation (Table 13). As a future initiative to prevent MPs, the 'use of biodegradable packaging' and 'environmental friendly disposal' will be promoted by revising the existing legislation "Production and Consumption Wastes Law." These new initiatives will begin in 2024.

Table 13. Major preventative actions and awareness raising actions about microplastics in Russia.

Type of action	Category of major activity	Title/subject	Organization	Enforced year
Prevention	Limitation or ban of plastic products	Initiative for the step-by-step refuse of single-use plastics	Central government	2024 (planning)
	Recycling plastics, developing alternatives, and others	National project "Clean Country" (Reduction of negative environmental impacts by elimination of related hazards and excessive amounts of landfills)	Central government	2018

5. Proposed Responses and Future Work on Marine Microplastics Issues

In the NOWPAP member states, many actions regarding MPs have been implemented by various stakeholders, and the number of actions continues to increase in each member state. However, it is expected that more actions will be implemented in the future. Also, each individual action should be improved to be more effective for MP issues. Future monitoring actions, preventative actions, and awareness raising are described in detail below.

Monitoring actions:

MP monitoring has been implemented by various stakeholders, including central governments, local governments, research institutes, and private companies. However, the methodology and monitoring targets often differ among monitoring organizer. Thus, it is often difficult to compare the data collected by these groups. It is recommended that the monitoring methods and targets should be harmonized among the member states.

In order to harmonize methods, the Japanese government developed a guideline for harmonizing ocean surface MP monitoring methods in 2019 (http://www.env.go.jp/en/water/marine_litter/guidelines/guidelines.pdf) and shared it with the other member states. In the near future, it is expected that the NOWPAP member states will begin their own national monitoring initiatives using this common methodology and share their data in a uniform format in order to more precisely assess the current MPs situation in the NOWPAP region. It is important to understand microplastics dynamics in the global oceans including the NOWPAP region. Ministry of the environment, Japan has a plan to collect/summarize harmonized monitoring data based on their guideline, and publicize the data on a 2D-map in their website.

Cooperation between central/local governments, academic institutes, NPOs/NGOs, and private companies is also important. In the NOWPAP member states, several local governments and NGOs already monitor MPs. The monitoring methodology should also be shared with these groups in order to enable data sharing among all stakeholders.

Prevention, removal, and awareness raising actions:

There are many good prevention and awareness raising practices on MPs in the NOWPAP member states. It is useful to share such information regularly among the member states in order to promote actions in each member state.

In this report, information provided from the experts on preventative actions and those that raise awareness taken by private companies is limited. Also, removal activities on MPs except for those on ML have not yet begun in the NOWPAP member states. However, the “Development of the clothes made of fibrous protein instead of the materials of plastics” in Japan is a good example of a very interesting prevention action taken by a private company that developed an artificial spider yarn as an alternative material to plastic fibers. Considering the seriousness of current MP issues, many private companies are thinking about what they can and should do now, and might have different skillsets from those of central governments that can be used to tackle MP issues. Therefore, information should be constantly provided to every stakeholder through various channels, including the Northwest Pacific Regional Node, a website containing ML information and a database, presented by NOWPAP (http://114.251.10.253:186).

References

Barnes, D.K.A., F. Galgani, R.C. Thompson, M. Barlaz (2009), Accumulation and fragmentation of plastic debris in global environments, *Philosophical Transactions of The Royal Society B: Biological Sciences*, **364**(1526), 1985-98, doi:10.1098/rstb.2008.0205.

Browne, M.A., S.J. Niven, T.S. Galloway, S.J. Rowland, R.C. Thompson (2013), Microplastic Moves Pollutants and Additives to Worms, Reducing Functions Linked to Health and Biodiversity, *Current Bio.*, **23**(23), 2388-2392, doi:10.1016/j.cub.2013.10.012.

Cózar, A., F. Echevarría, J.I. González-Gordillo, X. Irigoien, B. Úbeda, S. Hernández-León, Á.T. Palma, S. Navarro, J. García-de-Lomas, A. Ruiz, M.L. Fernández-de-Puelles, and C.M. Duarte (2014), Plastic debris in the open ocean, *Proc. Natl. Acad. Sci. U.S.A.*, **111**(28) 10239-10244, doi:10.1073/pnas.1314705111.

Farrell, P., K. Nelson (2013), Trophic level transfer of microplastic: Mytilus edulis (L.) to Carcinus maenas (L.), *Environ. Pollut.*, **177**, 1-3, doi:10.1016/j.envpol.2013.01.046.

Isobe, A., K. Uchida, T. Tokai, S. Iwasaki (2015), East Asian seas: a hot spot of pelagic microplastics, *Marine Pollution Bulletin*, **101**, 618-623, doi:10.1016/j.marpolbul.2015.10.042.

Jang, M., W.J. Shim, G.M. Han, M. Rani, Y.K. Song, S.H. Hong (2017), Widespread detection of a brominated flame retardant, hexabromocyclododecane, in expanded polystyrene marine debris and microplastics from South Korea and the Asia-Pacific coastal region, *Environ. Pollut.*, **231**, 785-794.

Mato, Y, T. Isobe, H. Takada, H. Kanehiro, C. Ohtake, T. Kaminuma (2001), Plastic Resin Pellets as a Transport Medium for Toxic Chemicals in the Marine Environment, *Environ. Sci. Technol.*, **35**(2), 318-324, doi:10.1021/es0010498.

Rani, M., W.J. Shim, G.M. Han, M. Jang, Y.K. Song, S.H. Hong (2017), Benzotriazole-type ultraviolet stabilizers and antioxidants in plastic marine debris and their new products, *Sci. Total. Environ.*, **579**, 745-754.

ANNEX: Detail information on Major Monitoring Microplastics

	Survey Area	Target		Name of survey	Number of sites	Period	Organizer	Monitoring items
China	Offshore	seawater	surface	Microplastics monitoring along coastal area of China	20 sites	2016-2018	National Marine Environmental Monitoring Center (NMEMC)	density, size, color, shape, polymer type
			surface	Microplastic monitoring in the Yellow Sea and the East China Sea	25 sites	2017-2019	Institute of Oceanography, Chinese Academy of Sciences	density, size, color, shape, polymer type
		sediment	surface	Microplastic monitoring in the Bohai Sea and the Yellow Sea	-	2017-2018	Zhejiang University	density, size, color, shape, polymer type
		biota		Microplastics monitoring along coastal area of China	3 sites	2019	NMEMC	density, size, color, shape, polymer type
	Inshore	seawater	surface	Microplastics monitoring along coastal area of China	20 sites	2016-2018	NMEMC	density, size, color, shape, polymer type
			surface	Microplastic monitoring in the Bohai Sea	11 sites	2016-2018	NMEMC	density, size, color, shape, polymer type
			surface	Microplastic monitoring in the East China Sea	15 sites	2014, 2018-2019	East China Normal University	density, size, shape, polymer type
		sediment		Microplastic monitoring in the Bohai Sea and the Yellow Sea	-	2017-2019	Zhejiang University	density, size, color, shape, polymer type
		biota		Microplastics monitoring along coastal area of China	3 sites	2016	NMEMC	density, size, color, shape, polymer type
				Microplastic monitoring in Shanghai	-	2015-2016, 2018-2019	East China Normal University	density, size, shape, polymer type
				Microplastic monitoring along the coastal waters of China	22 sites	2015-2016, 2018-2019	East China Normal University	density, size, shape, polymer type
				Microplastic monitoring in the Yellow Sea	-	2015-2016, 2018-2019	Institute of Oceanology, Chinese Academy of Sciences	density, size, shape, polymer type
	Beach	sediment		Microplastics monitoring along coastal area of China	6 sites	2016-2017	NMEMC	density, size, color, shape, polymer type
				Microplastic monitoring in six tourism beaches around the South China Sea	6 sites	2014-2016, 2018	East China Normal University	density, size, shape, polymer type
				Microplastic monitoring in beaches of the Bohai Sea	3 sites	2014-2016, 2018	Ningbo University	density, size, shape, polymer type
	River	river water	surface	Microplastic monitoring in the Yangtze Estuary	7 sites	2014-2019	East China Normal University	density, size, shape, polymer type
			surface	Microplastic monitoring in Pearl River	8 sites	2014-2019	Jinan University	density, size, shape, polymer type
		sediment		Microplastic monitoring in the Changjiang Estuary	-	2015-2017	East China Normal University	density, size, color, shape, polymer type

	Survey Area	Target		Name of survey	Number of sites	Period	Organizer	Monitoring items
Japan	Offshore	seawater	surface	Monitoring and classification of the microplastics in the offshore regions	25 sites in 2014; 78 sites in 2015; 69 sites in 2016	2014-2019	Ministry of the Environment	number, weight, density, size, polymer type
			surface	An experiment of microplastics sampling	12 sites	2014-2019	Japan Coast Guard	number, density, size, chemical
	Inshore	seawater	surface	Monitoring and classification of the microplastics in the coastal region	7 sites in 2014; 20 sites in 2015; 9 sites 2016	2014-2019	Ministry of the Environment	number, density, shape, polymer type
			surface	Monitoring and assessment on pollution in the microplastics in the coast	18 sites in 2015; 8 sites in 2016	2014-2019	Ministry of the Environment	weight, size, polymer type, chemical
	Beach	sediment		Monitoring and assessment on pollution in the microplastics in the coast	7 sites in 2014; 10 sites in 2015; 12 sites in 2016	2014-2019	Ministry of the Environment	weight, size, polymer type, chemical
				Consideration for monitoring method on microplastics	10 sites	2016	Okinawa Prefectural Government	number, shape
				Monitoring of the drifted microplastics in the coasts focusing on the river mouths	4 sites	2017-2019	Kanagawa Prefectural Government	number, polymer type
				Monitoring of the drifted microplastics in the coasts	14 sites in 2018; 18 sites in 2019	2018-2019	Toyama Prefectural Government	number, density
				Monitoring on chemical pollution in plastic resin pellet	2 sites in 2006; 1 site in 2007; 2 sites in 2008; 2 sites in 2009; 1 site in 2010; 8 sites in 2011; 2 sites in 2012; 4 sites in 2013; 2 sites in 2014; 7 sites in 2015; 21 sites in 2016; 6 sites in 2017; 10 sites in 2018; 3 sites in 2019	2005-2019	International Pellet Watch	chemical
	River	river water	surface	Survey on actual condition of microplastics in the rivers	14 sites (7sites*2rivers)	2018-2019	Ministry of the Environment	number
			surface	Development of visualization monitoring on micro/macroplastics	2 sites	2017	Tokyo University of Science	number, weight, transport
			surface	Monitoring for the microplastics in the rivers and coasts	35 sites	2018	Pirika Inc.	weight, size, color, polymer type

	Survey Area	Target		Name of survey	Number of sites	Period	Organizer	Monitoring items
Korea	Offshore	seawater	surface	Monitoring of floating microplastics	-	2019	Korean Institute of Ocean Science and Technology (KIOST)	number, size, color, shape, polymer type
			water column	Monitoring of floating microplastics	-	2019	KIOST	number, size, color, shape, polymer type
		sediment	surface	Monitoring of floating microplastics	-	2019	KIOST	number, size, color, shape, polymer type
			core	Monitoring of floating microplastics	-	2019	KIOST	number, size, color, shape, polymer type
	Inshore	seawater	surface	Monitoring of floating microplastics	10 sites in 2012; 40 sites in 2015; 30 sites in 2016; 20 sites in 2017	2012, 2015-2017	KIOST	number, size, color, shape, polymer type
			water column	Monitoring of floating microplastics	-	2012, 2015-2017	KIOST	number, size, color, shape, polymer type
		biota	intertidal zone	Monitoring of microplastics in marine bivalves	10 sites	2017	KIOST	number, size, color, shape, polymer type
	Beach	sediment		Monitoring of microplastics in beach sediment	20 sites	2016	KIOST	number, size, color, shape, polymer type
	River	river water	surface		five major rivers	2017-2019	KIOST	number, size, color, shape, polymer type
			water column		five major rivers	2017-2019	KIOST	number, size, color, shape, polymer type
Russia	Inshore	seawater	surface	The initial assessment of microplastic concentration	16 sites	2014-2015	Maritime State University	density, settling speed
			surface	A preliminary work for microplastic distribution and concentration assessment	1 site in 2015; 16 sites in 2016; 16 sites in 2017; 37 sites in 2018 and 2019	2015-2019	Pacific Geographical Institute, FEB RAS	number, density, size, shape, polymer type
			surface	Micro and nanoplastic contamination in the microalgae and zooplankton	1 site	2016-2019	National Scientific Center for Marine Biology, FEB RAS	number, density, size, chemical
		sediment		Microplastic contamination in bottom sediments	7 sites	2015	Project MicroplAstics Research in the BaLtic marine Environment (MARBLE)	number, density, size, chemical
	Beach	sediment		Microplastic contamination of two beaches in Sevastopol city	2 sites	2016-2019	A.O. Kovalevsky Institute of Marine Biological Research, RAS (IMBR RAS)	number, density, size
	River	river water	surface	A preliminary work for microplastic distribution and concentration assessment	8 sites in 2017; 10 sites in 2018 and 2019	2017-2019	Pacific Geographical Institute, FEB RAS	number, density, size, shape, polymer type