# Chapter II Field Survey Regarding Floating/Sea bed Debris

## II.1. Survey method

### II.1.1 Summary of existing information

Surveys of the following 3 items were conducted.

#### (1) Recovery results of floating debris recovery ships belonging to the Ministry of Land, Infrastructure, Transport and Tourism

A questionnaire survey towards the department in control of floating debris recovery ships belonging to the Ministry of Land, Infrastructure, Transport and Tourism in general sea areas in FY 2013 was conducted regarding the main areas of operation, annual recovery amount, recovery amount according to types of debris and monthly recovery amount.

#### (2) Payment status of fishing vessel insurance

In the survey of the previous year, the number of accidents due to floating debris and entanglements[1] of the fishing vessel mutual insurance associations around the country from 2008-2010 was assessed from the fishing vessel insurance statistical chart[2]. In the survey for this year, data was collected/organized from the FY 2011 fishing vessel insurance statistical chart (issued in March 2015)[3] and the FY 2012 fishing vessel insurance statistical chart (issued in December 2015)[4].

By combining the survey result of this year with the result of last year, the status as well as chronological changes of the number of nationwide accidents due to floating debris and entanglements of the fishing vessel mutual insurance associations of each region within the 4 years from 2009-2012 were gathered.

#### (3) Other existing information

Using the survey results of floating plastics with the marine environment monitoring survey of the Ministry of Environment[5] and existing information of the

1 Entanglements of objects on propellers/ anchors/ anchor chains of vessels

2 The Fisheries Agency (2010-2013) fishing vessel insurance statistical chart

3 The Fisheries Agency (March 2014) fishing vessel insurance statistical chart

4 The Fisheries Agency (December 2010) fishing vessel insurance statistical chart

5 Ministry of Environment HP：http://www.env.go.jp/water/kaiyo/monitoring.html

monitoring survey of floating plastics of the Meteorological Agency[6], data regarding the spatial distribution and chronological changes of floating debris (plastics) around Japan were gathered.

6 Meteorological Agency HP：http://www.data.jma.go.jp/kaiyou/shindan/sougou/html_vol2/3_1_vol2.html

## II.1.2 Sea bed debris field survey method

### II.1.2.1 Recovery

Explanations regarding the survey were given to the fishery cooperatives of the prefectures of the selected areas (hereinafter referred to as "fishery cooperative"), and requests for recovering debris while operating ships were made to fishermen belonging to the fishery cooperatives using trawl nets (about 20 vessels in each area. Hereinafter referred to as "fishermen").

### II.1.2.2 Entry into field notes

Upon recovering debris, a request was made to the fishermen for providing the following information.

- "The time the nets were set" and "the time the nets were hauled"
- The location of where the nets were placed

In order to reduce workload, 20 sheets of field notes were provided to fishermen who agreed to cooperate with field note entries for recording data.

Regarding fishermen who were unable to cooperate with regular field note entries, interview regarding the above information was conducted when recovering debris.

In addition, the consignee made confirmation and took photos regarding the following at the time of collecting the debris

- Average net towing speed
- Types of trawl nets
- Width of nets
  - ◎Dragnet type 2: Spread of wing ends or beam length
  - ◎Dragnet type 3: Dredge width, tine length/numbers
  - ◎Trawl net: Spread of wing ends

### II.1.2.3 Dragnet line

The dragnet line was not specified, and survey was conducted by the fishermen's standard procedures.

### II.1.2.4 Division of recovered debris

The fishermen brought back collected debris while operating their boats in the provided bins, and were divided into the specified 4 types of bins. Debris was divided into the 4 types of "vinyl/plastics", "glass bottles", "metals", and "others".

We flexibly responded to requests from the fishery cooperatives and fishermen regarding the dividing of debris (the examiners divided or fishermen appropriately divided in a manner that was easy to store etc. when dividing debris was difficult for fishermen).

### II.1.2.5 Analysis/sorting of debris

As with the previous year, generally artificial objects were the target of analysis of sea bed debris, and natural objects such as marine plants, driftwood/shrubs were excluded as in accordance with the Ministry of Environment (2008)[7].

In accordance with the Ministry of Environment (2011)[8], sea bed debris was sorted according to the major categories (8 categories), and the individual numbers, weight, and volume were measured.

### II.1.2.6 Others

- Record of weather conditions
  - Weather conditions that may have an effect on the movement of sea bed debris such as rainfall, wind etc. were simply recorded about once a week before on the day or day before recovery.
- Assessment of expiration dates
  - Among sea bed debris, only the expiration dates of beverage cans were recorded.

### II.1.2.7 Summary of survey result

As with the previous year, the amount (individual number, weight, volume) of sea bed debris and the density (individual number, weight, volume) as well as state of sea bed debris were gathered according to survey areas (sea areas for survey).

The calculation for density was determined by covered sea area= trawling time ×speed×net mouth length, and calculated per sea unit area.

---

7 Ministry of Environment (FY 2008) Survey report regarding domestic reduction strategy model of floating/ sea bed debris

8 Ministry of Environment (FY 2011) General meeting report regarding the survey of domestic reduction strategy model of floating/ sea bed debris

### II.1.3 Floating debris field survey method

A field survey from aboard vessels (2 days at each sea areas for survey) was conducted in the selected 7 survey areas (7 sea areas for survey).

#### II.1.3.1 Observational survey

Regarding the survey for this year, the "FY 2014 field Survey of floating/sea bed debris in offshore areas" (hereinafter referred to as "offshore survey") method was used.

(1) Recording

- 1 observer each was placed on the port and starboard, and floating objects were visually observed. 1 person was in charge of recording.
- When a floating object came directly to the side of the observer, the time, type, and distance from the vessel (distance above the sea surface from the side of the vessel) were measured and recorded.

(2) Survey line, survey time

The image of the survey is displayed in diagram II.1-1.

- Generally there were 2 survey lines for 1 day, and the survey time for 1 line was about 1.5 hours.
- 1 line veered about every 0.5 hours, and vessels ran in a zigzag manner.
- Veering was roughly expected to be at 45-degree angles. * Example: North (0° )→Northeast (45° )→North (0° ).
- The ship speed was about 5 knots (approx. 9km/h/ 2.5m/s), veered every 4.5km, and ran 13.5km per 1 line.
- The actual survey line was recorded using a handy GPS device (recorded with track mode on).
- The collecting of micro plastics was conducted once.

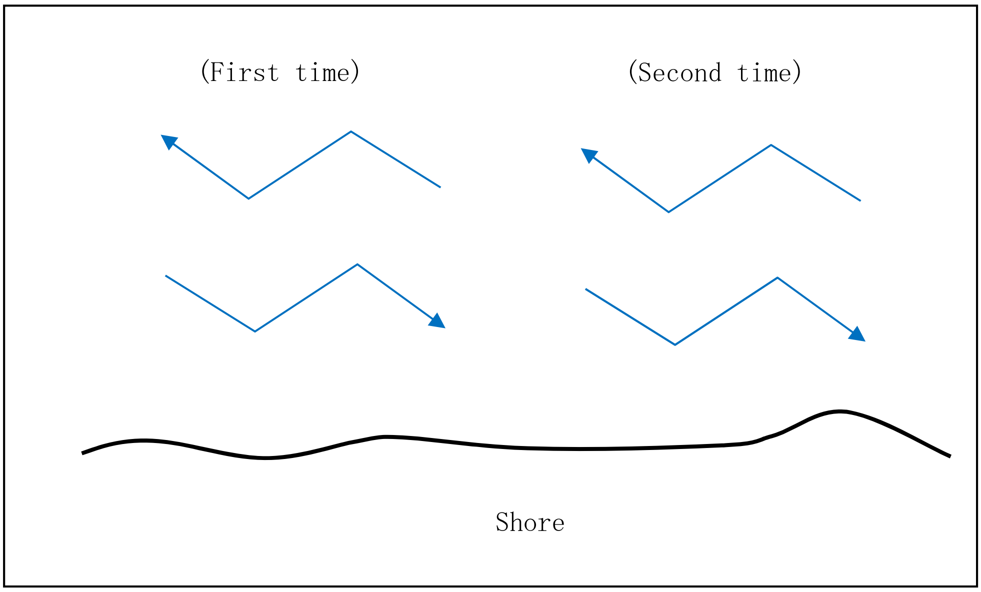



diagram II.1-1 The image of floating debris field survey

(3) Analysis/sorting of debris

The sorting in the "offshore survey" was referred to for the sorting of floating debris.

(4) Summary of survey result

Results were gathered using the "offshore survey" method.

### II.1.3.2 Micro plastics survey

The "offshore survey" method was used for micro plastics, which were difficult to visually observe.

(1) Collecting

- Debris was collected using a Neuston net with a flow meter (Meteorological Agency (JMA) Neuston net No. 5552: Diameter, 75cm edge; length 300cm; knit nip, mesh size 350$\mu$m).
- The amount of filtered water was calculated using the "offshore survey" method.
- As a general rule trawling were conducted at 2 knots for 20 minutes.

(2) Survey line

- 1 line was set for 1 survey area (sea area for survey).

(3) Analysis

- Samples were sorted with a 5mm sieve, and objects that passed through were preserved as possible micro plastics. At this time the target for analysis was over 1mm, then shifted with a 1mm sieve, and the object that remained on the sieve (1-5mm) was preserved as a sample.

- Samples were examined under a stereoscopic microscope, objects determined as plastics were sorted, and the individual numbers were recorded.

(4) Summary of survey result

The floating density (individual floating numbers per unit area) was determined from the filtered water amount and the individual numbers obtained from calculations according to survey areas (sea areas for survey).

### II.1.4 Interview towards fishermen

When conducting the field survey for floating/sea bed debris, inquiries regarding the following were conducted towards fishermen and the results were gathered.

①Actual status of bringing back floating/sea bed debris

②Details of damages due to floating/sea bed debris/(damages with propellers of fishing vessels/body of vessel, damages of fishing nets, interference with the running of vessels etc.)

③Period when damages occurred

④Location where damages occurred

⑤Degree of exigency

# II.2. Survey result

## II.2.1 Result of summary existing information

### II.2.1.1 Recovery result by floating debris recovery ships of the Ministry of Land, Infrastructure, Transport and Tourism

#### (1) Annual recovery amount

The position status of floating debris recovery ships in standard sea areas by the Ministry of Land, Infrastructure, Transport and Tourism are displayed in diagram II.2-1.

Cleaning sea area and base port of marine environmental improvement operations


| Responsible sea area | Base port | Jurisdiction | Cleaning area(km²) | Vessel name |
|---|---|---|---|---|
| Tokyo Bay | Yokohama | Kanto Regional Development Bureau | 850 | Beikurin |
| Ise Bay | Nagoya | Chubu Regional Development Bureau | 1,800 | Hakuryu |
| Setonaikai | Kobe<br>Higashiharima | Kinki Regional Development Bureau | 3,000 | Dr.Kaiyo<br>Crean Harima |
| | Wakayama-Shimotsu | Chugoku Regional Development Bureau | 1,500 | Umiwakamaru |
| | Kure | Shikoku Regional Development Bureau | 2,400 | Ondo2000 |
| | Sakaide | Shikoku Regional Development Bureau | 2,500 | Bisan |
| | Matsuyama | Shikoku Regional Development Bureau | 2,800 | Ishizuti |
| | Komatsushima | Shikoku Regional Development Bureau | 1,400 | Mizuki |
| | Kitakyusyu | Kyusyu Regional Development Bureau | 3,500 | Ganryu |
| Ariake Sea/ Yatsusiro Sea | Kumamoto | Kyusyu Regional Development Bureau | 3,728 | Kaiki |
| | Yatsushiro | Kyusyu Regional Development Bureau | | Kaiko |
| Total | | | 23,478 | |

Diagram II.2-1 The position status of floating debris recovery ships

The annual recovery amount of FY 2013 is displayed in chart II.2-1. Harima Sea/Osaka Bay had the most with 1,436.0m$^3$, and the least was Tokyo Bay with approximately 125.8m$^3$.

Chart II.2-1 Annual recovery amount of floating debris recovery ships

<table>
<tr><td colspan="2">Responsible sea area</td><td>Tokyo Bay</td><td>Ise Bay</td><td colspan="2">Setonaikai</td></tr>
<tr><td colspan="2">Jurisdiction</td><td>Kanto Regional Development Bureau</td><td>Chubu Regional Development Bureau</td><td colspan="2">Kinki Regional Development Bureau</td></tr>
<tr><td colspan="2">Vessel name</td><td>①Beikurin</td><td>②Hakuryu</td><td>③Dr.Kaiyo/ Crean Harima</td><td>④ Umiwakamaru</td></tr>
<tr><td colspan="2">Base port</td><td>Yokohama</td><td>Nagoya</td><td>Kobe/ Higashiharima</td><td>Wakayama-Shimotsu</td></tr>
<tr><td colspan="2">Main operating sea areas</td><td>Tokyo Bay</td><td>Ise Bay</td><td>Osaka Bay/ Harima Sea</td><td>Kii Channel/ the Southern Osaka Bay</td></tr>
<tr><td rowspan="5">Annual recovery amount</td><td>FY2009</td><td>192.8m³</td><td>24.725 t</td><td colspan="2">2,454.7m³</td></tr>
<tr><td>FY2010</td><td>182.6m³</td><td>31.682 t</td><td colspan="2">3,109.9m³</td></tr>
<tr><td>FY2011</td><td>239.3m³</td><td>24.912 t</td><td colspan="2">3,641.9m³<br>(**368 m³ out of this was from amount of the team dispatched to the Tohoku region)</td></tr>
<tr><td>FY2012</td><td>139.4m³</td><td>36.418 t<br>(260.7m³)</td><td>2,102.4m³</td><td>1,888.0m³</td></tr>
<tr><td>FY2013</td><td>125.8m³</td><td>371.1m³</td><td>1,436.0m³</td><td>1,126.0m³</td></tr>
</table>

<table>
<tr><td colspan="2">Responsible sea area</td><td colspan="4">Setonaikai</td></tr>
<tr><td colspan="2">Jurisdiction</td><td>Chugoku Regional Development Bureau</td><td colspan="3">Shikoku Regional Development Bureau</td></tr>
<tr><td colspan="2">Vessel name</td><td>⑤Ondo2000</td><td>⑥Bisan</td><td>⑦Ishizuti</td><td>⑧Mizuki</td></tr>
<tr><td colspan="2">Base port</td><td>Kure</td><td>Sakaide</td><td>Matsuyama</td><td>Komatsushima</td></tr>
<tr><td colspan="2">Main operating sea areas</td><td>Hiroshima Bay Aki Sea</td><td colspan="3">Setonaikai</td></tr>
<tr><td rowspan="5">Annual recovery amount</td><td>FY2009</td><td>1,069m³</td><td colspan="3">2,197.94m³</td></tr>
<tr><td>FY2010</td><td>1,264m³</td><td colspan="3">2,469.75m³</td></tr>
<tr><td>FY2011</td><td>1,660m³</td><td colspan="3">3,247.75m³</td></tr>
<tr><td>FY2012</td><td>1,529m³</td><td colspan="3">1,542.29m³</td></tr>
<tr><td>FY2013</td><td>1,410m³</td><td>724.6m³</td><td>750.00m³</td><td>367.35m³</td></tr>
</table>

| Responsible sea area | | Setonaikai | Ariake Sea/Yatsusiro Sea | |
|---|---|---|---|---|
| Jurisdiction | | Kyusyu Regional Development Bureau | Kyusyu Regional Development Bureau | |
| Vessel name | | Ganryu | Kaiki | Kaiko |
| Base port | | Kitakyusyu | Kumamoto | Yatsushiro |
| Main operating sea areas | | Suo Sea | Ariake Sea | Yatsushiro Sea |
| Annual recovery amount | FY2009 | 434.8$m^3$ | 601.55$m^3$ | |
| | FY2010 | 322.0$m^3$ | 635.47$m^3$ | |
| | FY2011 | 577.6$m^3$ | 1,030.18$m^3$ | |
| | FY2012 | 1,209.3$m^3$ | 1,064.50$m^3$ | 1,545.65$m^3$ |
| | FY2013 | 1,094.5$m^3$ | 1,107.40$m^3$ | |

(2) The ratio of recovered amount according to types of debris and recovery amount according to month

In order to assess the differences according to sea areas, the ratio of the recovered amount according to types of debris in main operating sea areas for FY 2013 was gathered in diagram II.2-2. However, Ise Bay was not a target for analysis as its sorting of debris types was particular.

The overall ratio of glass bottles/cans and others were small.

Types of debris with large ratios varied according to operating sea areas.

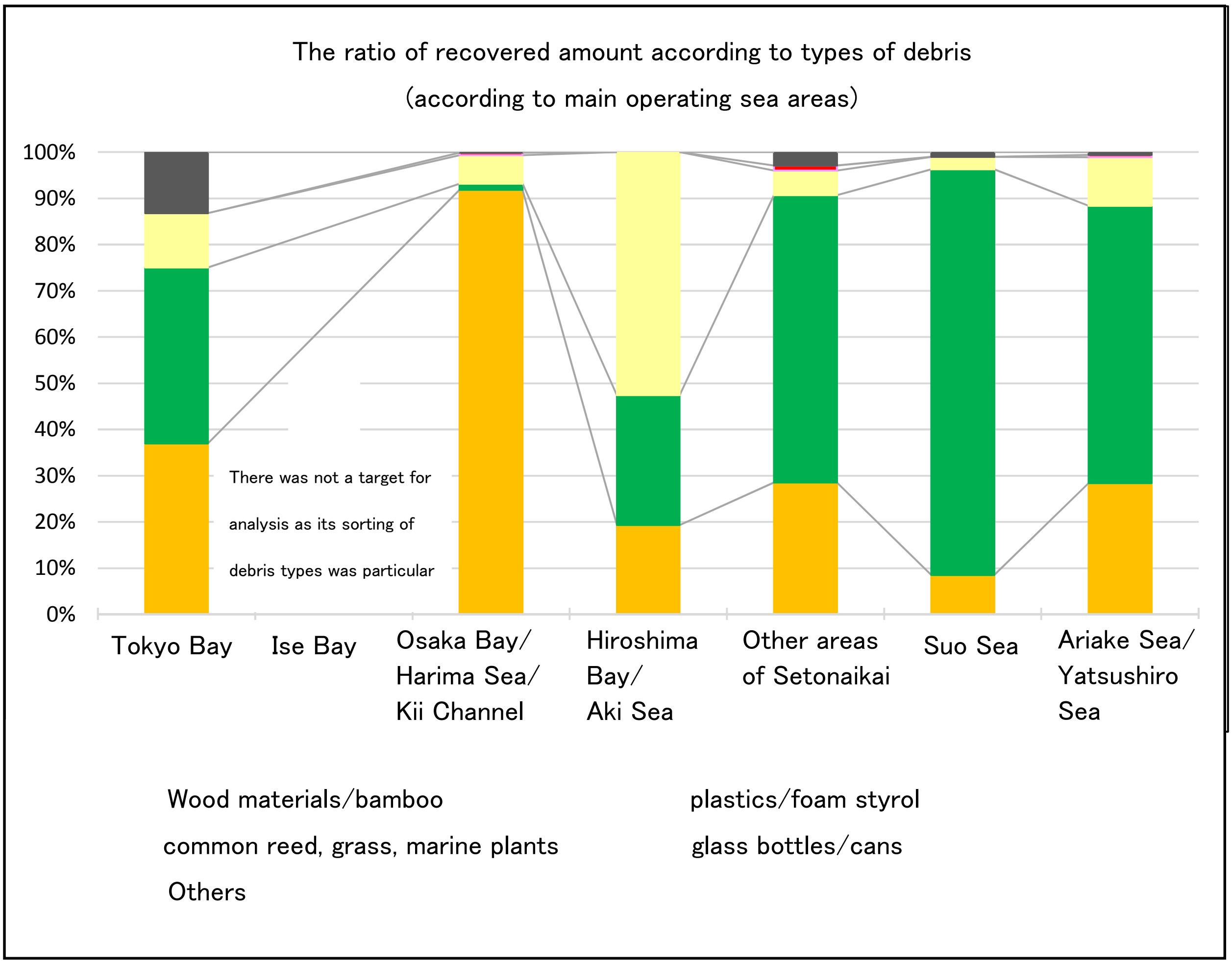
The ratio of wood materials/bamboo, common reed, grass, marine plants were large and about the same in Tokyo Bay, however this was due to the fact that there were many common reed, grass, wood pieces, wood materials, and driftwood.

The ratio of wood materials/bamboo in Osaka Bay/Harima Sea/Kii Channel was extremely large, however this was due to the fact that there were many driftwood and wood materials.

The ratio of plastics/foam styrol was extremely large in Hiroshima Bay/Aki Sea.

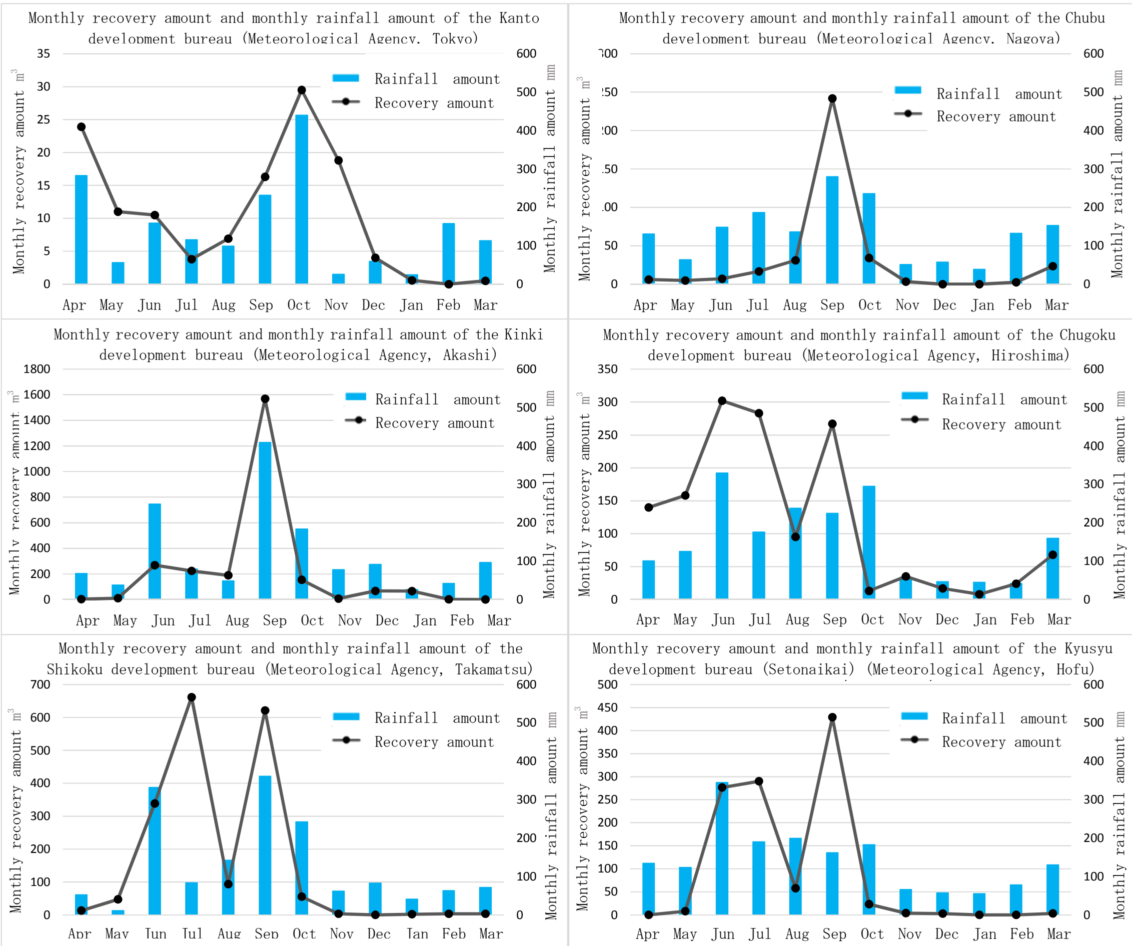
The ratio of common reed, grass, marine plants were large in the Suo Sea/Ariake Sea/Tachibana Bay and other areas of the Setonaikai. However this was due to the fact that there were many marine plants in other areas of the Setonaikai, and many common reed/grass in the Suo Sea, Ariake Sea/Yatsuhirokai Sea/Tachibana Bay.

Diagram II.2-2 Ratio of Recovered amount according to types of debris (according to regional development bureau)



In order to understand the effects of inundation due to rainfall, a comparison of the monthly recovery amount and monthly rainfall amount for FY 2013 was made (diagram II.2-3). The monthly total rainfall amount of the Meteorological Agency observatory located near the center of the operating area was used for the monthly rainfall amount.

Apart from a few exceptions, the peak monthly recovery amount and peak monthly rainfall amount were consistent. From this result it could be assumed that the amount of floating debris increases due to inundation caused by rainfall, thus leading to the increase in recovery amount.



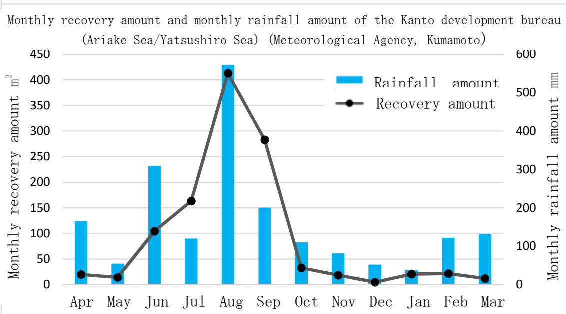




Diagram II.2-3
Relation of the monthly recovery amount and monthly rainfall amount (FY2013)

### II.2.1.2 Payment status of fishing vessel insurance

The fishing vessel insurance statistical chart for the past 4 years was collected/organized, and the ratio of accidents due to floating objects and entanglements reported at the fishing vessel mutual insurance associations in each area were gathered in diagram II.2-4.

The ratio of accidents for 2012 were greater in the order of Kitami fishing vessel mutual insurance association, Rumoi fishing vessel mutual insurance association, and Wakayama prefecture fishing vessel mutual insurance association. The ratio also seemed to be large in Donan fishing vessel mutual insurance association, Fukuoka prefecture fishing vessel mutual insurance association, nationwide/Osaka fishing vessel mutual insurance association, and Hokkaido. Also, areas with higher ratios of accidents for FY 2012 had high ratios from 2009-2011, although their orders varied.

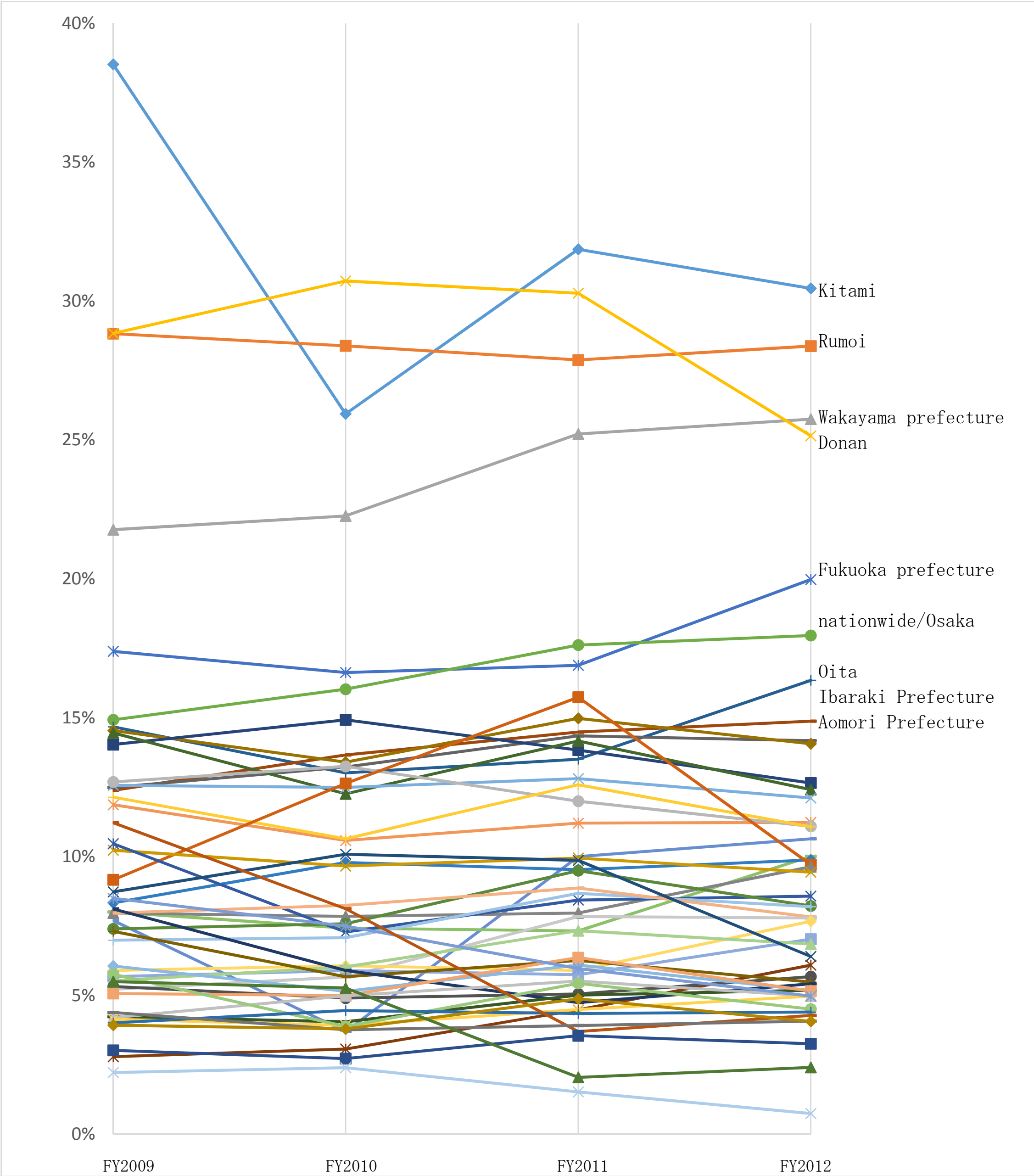



Diagram II.2-4 The ratio of accidents due to floating objects and entanglements for the past 4 years

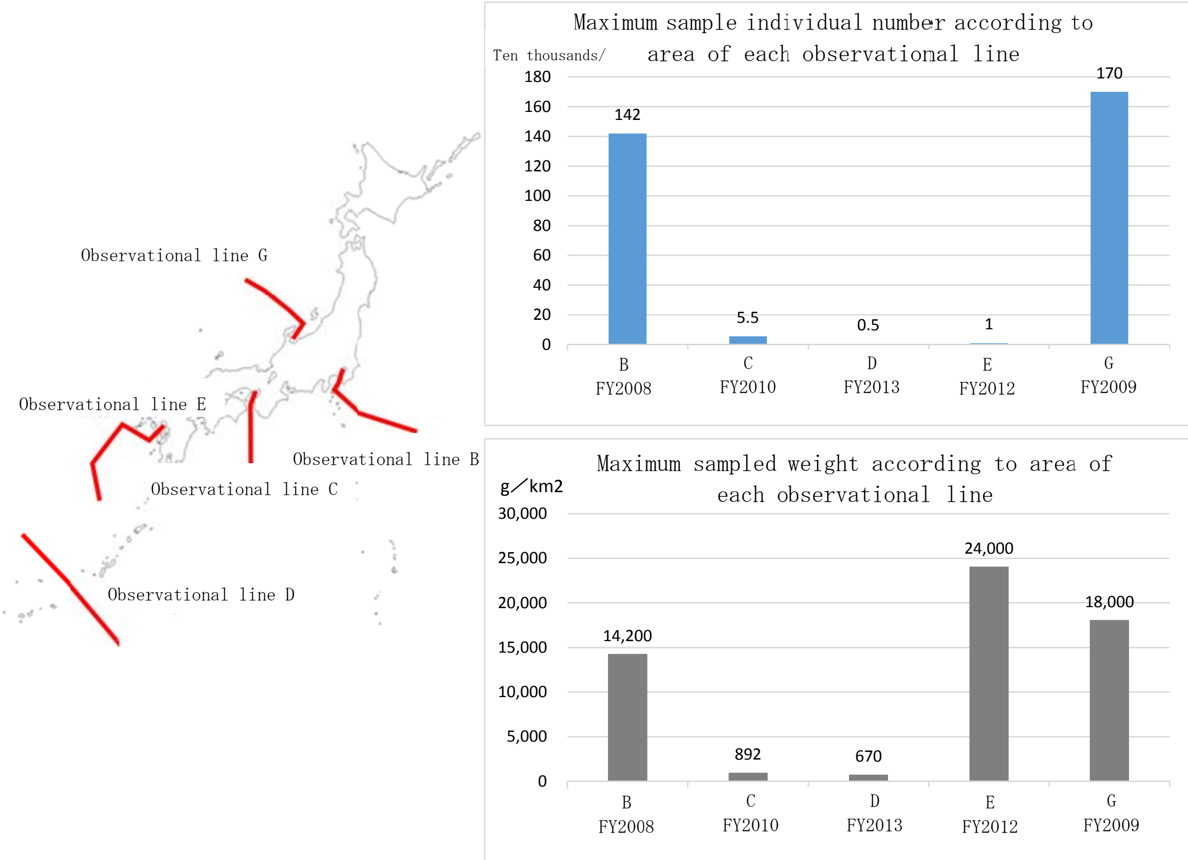
### II.2.1.3 Other existing information

As a survey regarding other floating debris, the spatial distribution as well as chronological changes of floating debris (plastics) around Japan was recorded using existing information of the marine environmental monitoring survey of the Ministry of Environment and the monitoring survey of floating plastics of the Meteorological Agency.

#### (1) Marine environmental monitoring survey

The Ministry of Environment conducts a marine environmental monitoring survey for studying the effects of pollution generated from land areas on marine environments and the effects of pollution due to wastes disposed of at sea. This survey also examines the pollution caused by plastics, and conducts a sampling survey of floating plastics using nets. From the results of 2004-2006, it has become clear that plastics are distributed not only along coast areas, but also in offshore areas. There is also a large inconsistency with space and time, showing observation points with large distribution amounts in specific areas or according to the survey year.

In order to understand the differences according to areas, the 5 observational lines with numeric data from 2008-2013 were set as targets, and the maximum individual sample numbers according to area and the maximum sampled weight was compared below.




Source: Ministry of Environment HP

Observational lines B and G had the largest maximum individual sample number according to area. With observational line B, the maximum number was at B-1 closest to the shore with a large ratio of thin plastics, with the possibility of effects due to daily life wastes. With observational line G, the maximum number was at G-5, which was relatively distant from the shore, with a large ratio of foam styrene and the possibility of effects due to fishery related wastes.

The figures with observational line E, G, and B were high regarding the maximum sample weight according to area. However this is thought to be due to relatively heavy wastes such as permanent markers, strings of sandbags, vinyl bags etc.

### (2) Monitoring survey of floating plastics of the Meteorological Agency

As a part of marine environmental survey, the Meteorological Agency conducts an observational survey of floating plastics. According to this, there are few floating plastics in sea areas between 5 and 20 degrees north latitude, however many floating plastics are discovered in overall sea areas nearby Japan. There is especially a large amount of floating plastics spanning from east to west in the area of 30-35 degrees north latitude that includes the Kuroshio extension, with about 10 floating plastics per 100km.

Also, after the peak from 1988 to 1990, the amount of floating plastics in sea areas near Japan are showing a downward trend. In 1988 a plastic discharge regulation measure for ships was specified due to the Marpol Treaty annex V, and the Marine Pollution Prevention Law was also revised, having an effect on this sea area. However since the 2000s there has been an increasing trend, and particularly in 2011 the discovered amount became almost the same as the peak in 1990 (16 per 100km area). On the other hand, there was no clear increase or decrease trend in the 137-degree east longitude line, and years with over 10 objects per 100km seem to be sporadic.

The discovered amount according to sea area/types observed by the Meteorological Agency in FY 2012 is displayed. Most artificial floating pollutants found in oceanic waters are petrochemicals, and among them the ratio of Styrofoam are the highest in every sea area. There are also many fishing equipments thought to have been disposed of or lost. Among pollutants discovered along coast areas, the ratio of foam styrol is high, followed by pieces of rigid plastics, pieces of plastic sheets/bags, cigarette butts/filters.

Source: Meteorological Agency HP
http://www.data.jma.go.jp/kaiyou/shindan/sougou/html_vol2/3_1_vol2.html

### II.2.2 Sea bed debris field survey result

#### II.2.2.1 Sea area for survey

Initially the sea area for survey was expected to include 30 areas along the coast of the Setonaikai covering 11 prefectures. However we were unable to receive cooperation from the fishery cooperatives of 2 sea areas at the advanced planning stage, and so the survey was planned for 28 sea areas.

Out of the 28 sea areas for survey, we were unable to receive a clear response regarding cooperation from the fishery cooperative for a certain period of time, and therefore were unable to conduct a survey. Regarding another sea area for survey, we had received a response regarding cooperation from the fishery cooperative, however the belonging fishermen were unable to comply (the fishery cooperative requested the fishermen for cooperation with recovering debris, however the belonging fishermen did not bring back debris for survey), and for this reason the survey was not conducted. For the above reasons, the survey was eventually conducted in 26 sea areas.

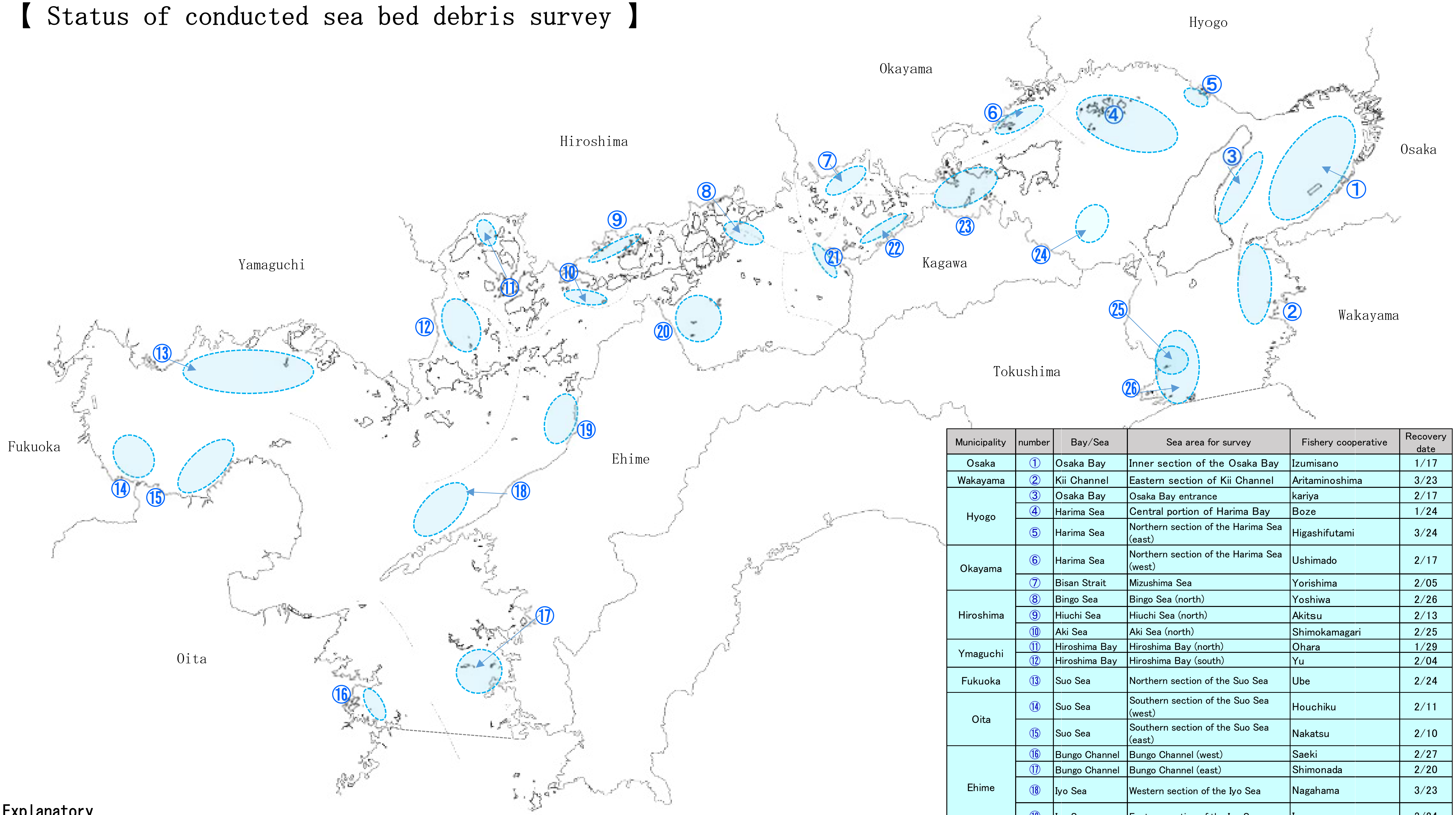
The status of the conducted survey is displayed in chart II.2-2 and diagram II.2-5.

Chart II.2-2 Status of conducted sea bed debris survey

FY2015

| Municipality | number | Bay/Sea | Sea area for survey | Fishery cooperative | Recovery date |
|---|---|---|---|---|---|
| Osaka | ① | Osaka Bay | Inner section of the Osaka Bay | Izumisano | 1/17 |
| Wakayama | ② | Kii Channel | Eastern section of the Kii Channe | Aritaminoshima | 3/23 |
| Hyogo | ③ | Osaka Bay | Osaka Bay entrance | kariya | 2/17 |
| | ④ | Harima Sea | Central portion of Harima Bay | Boze | 1/24 |
| | ⑤ | Harima Sea | Northern section of the Harima Sea (east) | Higashifutami | 3/24 |
| Okayama | ⑥ | Harima Sea | Northern section of the Harima Sea (west) | Ushimado | 2/17 |
| | ⑦ | Bisan Strait | Mizushima Sea | Yorishima | 2/05 |
| Hiroshima | ⑧ | Bingo Sea | Bingo Sea (north) | Yoshiwa | 2/26 |
| | ⑨ | Hiuchi Sea | Hiuchi Sea (north) | Akitsu | 2/13 |
| | ⑩ | Aki Sea | Aki Sea (north) | Shimokamagari | 2/25 |
| Ymaguchi | ⑪ | Hiroshima Bay | Hiroshima Bay (north) | Ohara | 1/29 |
| | ⑫ | Hiroshima Bay | Hiroshima Bay (south) | Yu | 2/04 |
| Fukuoka | ⑬ | Suo Sea | Northern section of the Suo Sea | Ube | 2/24 |
| Oita | ⑭ | Suo Sea | Southern section of the Suo Sea (west) | Houchiku | 2/11 |
| | ⑮ | Suo Sea | Southern section of the Suo Sea (east) | Nakatsu | 2/10 |
| Ehime | ⑯ | Bungo Channel | Bungo Channel (west) | Saeki | 2/27 |
| | ⑰ | Bungo Channel | Bungo Channel (east) | Shimonada | 2/20 |
| | ⑱ | Iyo Sea | Western section of the Iyo Sea | Nagahama | 3/23 |
| | ⑲ | Iyo Sea | Eastern section of the Iyo Sea | Iyo | 3/24 |
| Kagawa | ⑳ | Hiuchi Sea | Hiuchi Sea (south) | Sakurai | 3/11 |
| | ㉑ | Bingo Sea | Bingo Sea (south) | Nishitakuma | 2/18 |
| | ㉒ | Bisan Strait | Bisan Strait (west) | Marugame | 2/19 |
| | ㉓ | Bisan Strait | Bisan Strait (east) | TakamatsushiSetouchi | 3/12 |
| | ㉔ | Harima Sea | Southern section of the Harima Sea | Tosan | 1/21 |
| Tokushima | ㉕ | Kii Channel | Western section of the Kii Channel (Ⅰ) | Tokushima | 2/27 |
| | ㉖ | Kii Channel | Western section of the Kii Channel (Ⅱ) | Tachibana | 2/11 |

# 【 Status of conducted sea bed debris survey 】




**Explanatory**

Outline of ship operation range when recovering debris from operating record of trawler ship or interview

Diagram II.2-2 Status of conducted sea bed debris

| Municipality | number | Bay/Sea | Sea area for survey | Fishery cooperative | Recovery date |
|---|---|---|---|---|---|
| Osaka | ① | Osaka Bay | Inner section of the Osaka Bay | Izumisano | 1/17 |
| Wakayama | ② | Kii Channel | Eastern section of Kii Channel | Aritaminoshima | 3/23 |
| Hyogo | ③ | Osaka Bay | Osaka Bay entrance | kariya | 2/17 |
| | ④ | Harima Sea | Central portion of Harima Bay | Boze | 1/24 |
| | ⑤ | Harima Sea | Northern section of the Harima Sea (east) | Higashifutami | 3/24 |
| Okayama | ⑥ | Harima Sea | Northern section of the Harima Sea (west) | Ushimado | 2/17 |
| | ⑦ | Bisan Strait | Mizushima Sea | Yorishima | 2/05 |
| Hiroshima | ⑧ | Bingo Sea | Bingo Sea (north) | Yoshiwa | 2/26 |
| | ⑨ | Hiuchi Sea | Hiuchi Sea (north) | Akitsu | 2/13 |
| | ⑩ | Aki Sea | Aki Sea (north) | Shimokamagari | 2/25 |
| Ymaguchi | ⑪ | Hiroshima Bay | Hiroshima Bay (north) | Ohara | 1/29 |
| | ⑫ | Hiroshima Bay | Hiroshima Bay (south) | Yu | 2/04 |
| Fukuoka | ⑬ | Suo Sea | Northern section of the Suo Sea | Ube | 2/24 |
| Oita | ⑭ | Suo Sea | Southern section of the Suo Sea (west) | Houchiku | 2/11 |
| | ⑮ | Suo Sea | Southern section of the Suo Sea (east) | Nakatsu | 2/10 |
| Ehime | ⑯ | Bungo Channel | Bungo Channel (west) | Saeki | 2/27 |
| | ⑰ | Bungo Channel | Bungo Channel (east) | Shimonada | 2/20 |
| | ⑱ | Iyo Sea | Western section of the Iyo Sea | Nagahama | 3/23 |
| | ⑲ | Iyo Sea | Eastern section of the Iyo Sea | Iyo | 3/24 |
| Kagawa | ⑳ | Hiuchi Sea | Hiuchi Sea (south) | Sakurai | 3/11 |
| | ㉑ | Bingo Sea | Bingo Sea (south) | Nishitakuma | 2/18 |
| | ㉒ | Bisan Strait | Bisan Strait (west) | Marugame | 2/19 |
| | ㉓ | Bisan Strait | Bisan Strait (east) | TakamatsushiSetouchi | 3/12 |
| | ㉔ | Harima Sea | Southern section of the Harima Sea | Tosan | 1/21 |
| Tokushima | ㉕ | Kii Channel | Western section of the Kii Channel (Ⅰ) | Tokushima | 2/27 |
| | ㉖ | Kii Channel | Western section of the Kii Channel (Ⅱ) | Tachibana | 2/11 |

## II.2.2.2 Field survey result

### (1) Outline

Outline of sea bed debris survey result is displayed in chart II.2-3.

### Chart II.2-3 Outline of sea bed debris survey result

| Sea area for survey | Survey period | Fishery cooperative | Participating no. of fishing vessels | Types of trawl | Total no. of trawler vessels | Total no. of times of trawls | Trawling speed (km/hr) | Total trawling time(km) | Total trawling distance (km) |
|---|---|---|---|---|---|---|---|---|---|
| Inner section of the Osaka Bay | 1/16 | Izumisano | 20 | Dragnet type 3 | 20 | 60 | 8.3 | 60.0 | 500.0 |
| Eastern section of the Kii Channel | 1/14～2/27 | Aritaminoshima | 1 | Dragnet type 1 | 20 | 20 | 2.8 | 32.8 | 92.0 |
| Osaka Bay entrance | 1/21～2/4 | kariya | 2 | Dragnet type 2 | 16 | 155 | 3.6 | 185.2 | 660.9 |
| Central portion of Harima Bay | 1/18～1/23 | Boze | 20 | Dragnet type 3 | 20 | 60 | 6.9 | 60.0 | 416.7 |
| Northern section of the Harima Sea (east) | 1/26～3/5 | Higashifutami | 1 | Dragnet type 1 | 3 | 20 | 1.4 | 16.5 | 22.4 |
| Northern section of the Harima Sea (west) | 1/14～2/12 | Ushimado | 3 | Dragnet type 3 | 20 | 128 | 6.9 | 107.9 | 749.4 |
| Mizushima Sea | 1/7～2/1 | Yorishima | 2 | Dragnet type 3 | 20 | 76 | 6.5 | 57.0 | 369.5 |
| Bingo Sea (north) | 1/14～2/19 | Yoshiwa | 2 | Dragnet type 3 | 21 | 84 | 3.7 | 160.0 | 592.6 |
| Hiuchi Sea (north) | 1/14～2/6 | Akitsu | 6 | Dragnet type 3 | 20 | 120 | 7.4 | 80.0 | 592.0 |
| Aki Sea (north) | 2/12～2/21 | Shimokamagari | 6 | Dragnet type 3 | 20 | 70 | 8.3 | 70.0 | 583.4 |
| Hiroshima Bay (north) | 12/21～1/16 | Ohara | 1 | Dragnet type 3 | 20 | 20 | 2.3 | 30.0 | 68.5 |
| Hiroshima Bay (south) | 1/25～2/2 | Yu | 4 | Dragnet type 3 | 20 | 20 | 7.9 | 155.5 | 1229.2 |
| Northern section of the Suo Sea | 2/12～2/16 | Ube | 21 | Dragnet type 3 | 20 | 250 | 6.5 | 167.5 | 1085.7 |
| Southern section of the Suo Sea (west) | 2/4 | Houchiku | 20 | Dragnet type 3 | 20 | 130 | 8.3 | 97.5 | 812.6 |
| Southern section of the Suo Sea (east) | 1/14～2/5 | Nakatsu | 2 | Dragnet type 3 | 20 | 200 | 8.3 | 150.0 | 1250.1 |
| Bungo Channel (west) | 2/6～2/23 | Saeki | 1 | Dragnet type 2 | 20 | 40 | 2.6 | 140.0 | 358.4 |
| Bungo Channel (east) | 1/4～2/5 | Shimonada | 2 | Dragnet type 2 | 14 | 44 | 4.6 | 198.4 | 918.6 |
| Western section of the Iyo Sea | 2/16～3/21 | Nagahama | 2 | Dragnet type 2 | 20 | 90 | 4.6 | 90.0 | 416.7 |
| Eastern section of the Iyo Sea | 2/16～3/13 | Iyo | 2 | Dragnet type 2 | 20 | 20 | 3.7 | 40.0 | 148.2 |
| Hiuchi Sea (south) | 2/19～3/6 | Sakurai | 12 | Dragnet type 3 | 20 | 150 | 7.4 | 124.5 | 922.3 |
| Bingo Sea (south) | 2/6～2/16 | Nishitakuma | 5 | Dragnet type 3 | 20 | 130 | 15.7 | 75.4 | 1186.9 |
| Bisan Strait (west) | 1/16～1/28 | Marugame | 9 | Dragnet type 2 | 22 | 104 | 3.7 | 197.6 | 731.9 |
| Bisan Strait (east) | 2/12～3/6 | TakamatsushiS | 9 | Dragnet type 2 | 17 | 72 | 3.7 | 136.8 | 506.7 |
| Southern section of the Harima Sea | 1/6～1/17 | Tosan | 10 | Dragnet type 2 | 20 | 90 | 6.9 | 74.7 | 518.8 |
| Western section of the Kii Channel (Ⅰ) | 1/5～2/26 | Tokushima | 1 | Dragnet type 3 | 20 | 180 | 6.5 | 216.0 | 1400.1 |
| Western section of the Kii Channel (Ⅱ) | 1/14～2/2 | Tachibana | 3 | Dragnet type 1 | 20 | 86 | 3.7 | 146.2 | 541.5 |

| Sea area for survey | Net mouth width(m) | Total covered area($km^2$) | Individual no. of recovered debris | Recovered debris weight(kg) | Recovered debris volume(L) | Large objects | Types of large objects | Individual no. of large objects | Weight of large objects(kg) | Volume of large objects(L) | Special notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inner section of the Osaka Bay | 3.48 | 1.74 | 2224 | 188.1 | 800.9 | – | – | – | – | – | – |
| Eastern section of the Kii Channel | 2.70 | 0.25 | 211 | 39.8 | 351.8 | – | – | – | – | – | – |
| Osaka Bay entrance | 3.00 | 1.98 | 927 | 202.1 | 599.8 | Present | Metals | 1 | 124 | 59.4 | Foundations |
| Central portion of Harima Bay | 2.70 | 1.13 | 808 | 109.4 | 1479.9 | – | – | – | – | – | – |
| Northern section of the Harima Sea (east) | 18.20 | 0.41 | 4 | 7.4 | 22.2 | – | – | – | – | – | – |
| Northern section of the Harima Sea (west) | 3.65 | 2.74 | 1332 | 195.1 | 1533.4 | – | – | – | – | – | – |
| Mizushima Sea | 2.60 | 0.96 | 2720 | 297.8 | 1343.5 | Present | Metals | 1 | 95 | 21.4 | Wire |
| Bingo Sea (north) | 2.98 | 1.77 | 2664 | 152.6 | 2844.1 | – | – | – | – | – | – |
| Hiuchi Sea (north) | 3.40 | 2.01 | 1358 | 1659.8 | 3615.0 | Present | Metals | 1 | 1551 | 2646 | Wire |
| Aki Sea (north) | 4.85 | 2.83 | 3386 | 162.3 | 2078.7 | – | – | – | – | – | – |
| Hiroshima Bay (north) | 4.70 | 0.32 | 507 | 129.3 | 965.3 | – | – | – | – | – | – |
| Hiroshima Bay (south) | 3.82 | 4.70 | 2124 | 216.7 | 3322.2 | – | – | – | – | – | – |
| Northern section of the Suo Sea | 4.84 | 5.25 | 600 | 85.0 | 883.3 | – | – | – | – | – | – |
| Southern section of the Suo Sea (west) | 4.20 | 3.41 | 1661 | 84.9 | 744.4 | – | – | – | – | – | – |
| Southern section of the Suo Sea (east) | 2.45 | 3.06 | 2166 | 164.4 | 1718.4 | – | – | – | – | – | – |
| Bungo Channel (west) | 12.00 | 4.30 | 853 | 92.9 | 840.3 | – | – | – | – | – | – |
| Bungo Channel (east) | 17.00 | 15.62 | 648 | 71.4 | 391.5 | – | – | – | – | – | – |
| Western section of the Iyo Sea | 3.50 | 1.46 | 31 | 0.2 | 9.0 | – | – | – | – | – | – |
| Eastern section of the Iyo Sea | 16.00 | 2.37 | 1790 | 76.8 | 836.5 | – | – | – | – | – | – |
| Hiuchi Sea (south) | 2.98 | 2.75 | 3751 | 221.4 | 1570.1 | – | – | – | – | – | – |
| Bingo Sea (south) | 3.00 | 3.56 | 1879 | 172.7 | 1154.4 | – | – | – | – | – | – |
| Bisan Strait (west) | 16.10 | 11.78 | 563 | 31.3 | 571.5 | – | – | – | – | – | – |
| Bisan Strait (east) | 20.00 | 10.13 | 610 | 46.2 | 681.5 | – | – | – | – | – | – |
| Southern section of the Harima Sea | 2.70 | 1.40 | 2030 | 68.1 | 637.4 | – | – | – | – | – | – |
| Western section of the Kii Channel (Ⅰ) | 2.58 | 3.61 | 478 | 79.6 | 855.5 | – | – | – | – | – | – |
| Western section of the Kii Channel (Ⅱ) | 12.00 | 6.50 | 178 | 61.5 | 463.6 | – | – | – | – | – | – |

### (2) Individual numbers

The individual numbers list of sea bed debris according to sea area of survey and type is displayed in diagram II.2-6.

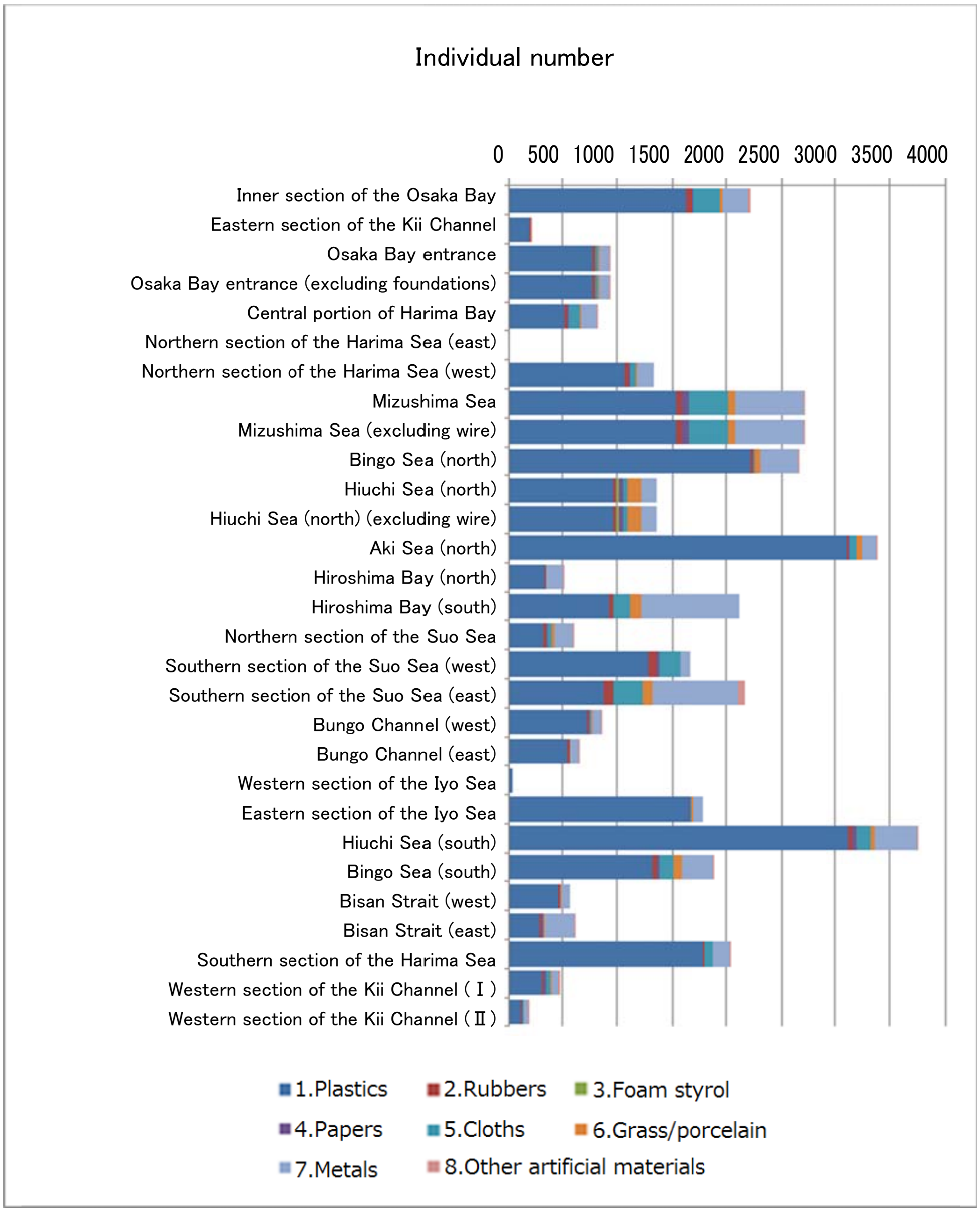
Extremely heavy individual objects (details are recorded in the weight section) were confirmed in the Osaka Bay entrance, Mizushima Sea, and Hiuchi Sea (north), and so a calculation excluding those objects as a singular value was also conducted, and is displayed together.

According to sea area of survey, the Hiuchi Sea (south) had the most number of objects with 3,751, followed by the Aki Sea (north) with 3,386, and the Mizushima Sea with 2,720. The area with the least was the northern section of Harima Sea (east) that had 4, followed by the western section of the Iyo Sea with 31, and the western section of the Kii Channel (II) with 178.

According to types, plastics were the highest in all sea areas of survey apart from the northern section of the Harima Sea (east) where the numbers of individual objects were extremely low (only rubbers including tires were confirmed). The next highest types of objects were metals and cloths.

With extremely heavy objects (details are mentioned in the weight section), there was only 1 each in sea areas of survey where they were confirmed.

Diagram II.2-6 Sea bed debris survey result (individual number)



### (3) Weight

The weight list of sea bed debris according to sea area of survey and type is displayed in diagram II.2-7.

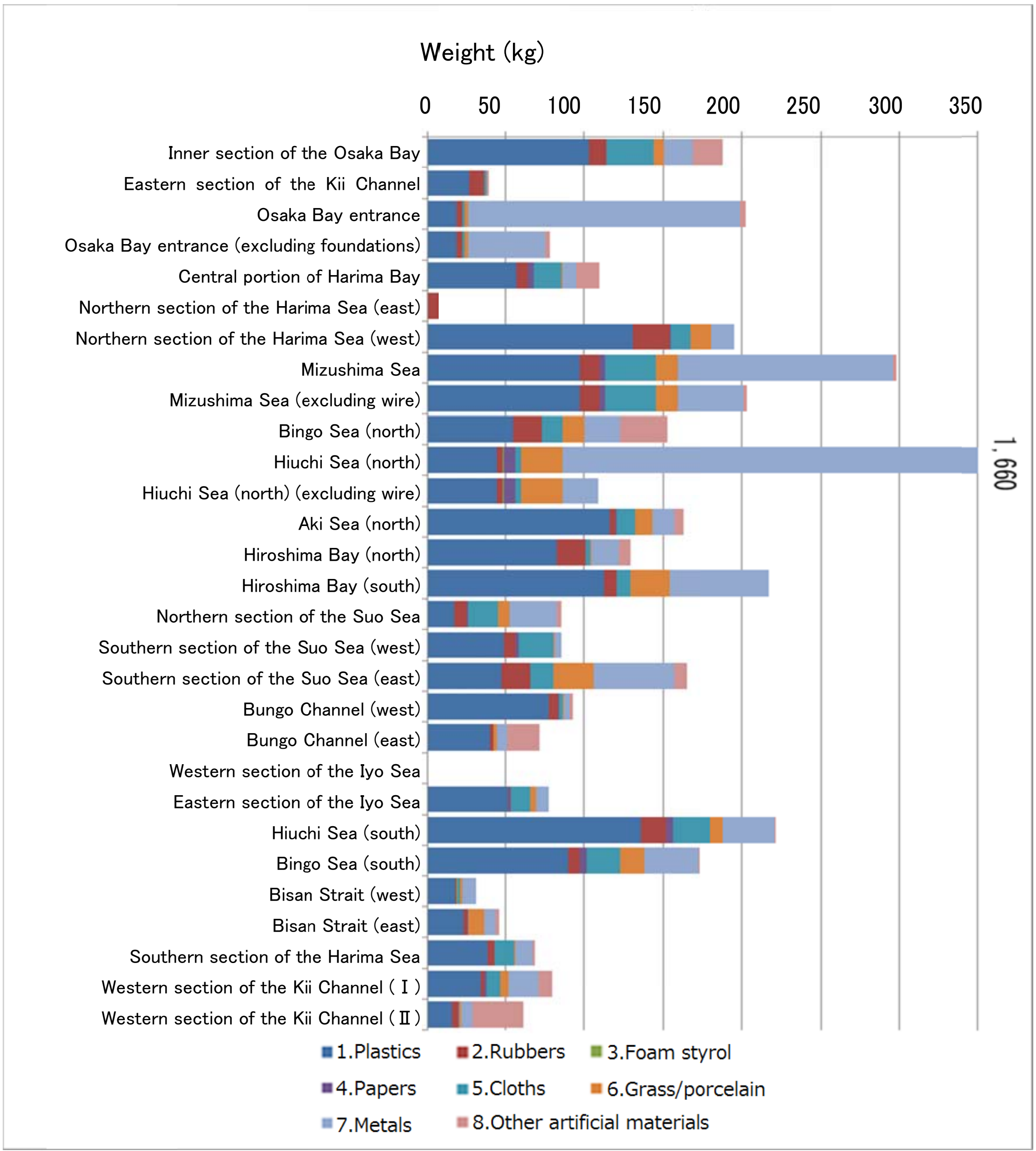
According to sea area of survey, the figure for the Hiuchi Sea (north) was the highest at 1659.8kg, followed by the Mizushima Sea at 297.8kg, and the Hiuchi Sea (south) at 221.4kg. The area with the least was the western section of the Iyo Sea with 0.2kg, followed by the northern section of the Harima Sea (east) with 7.4kg, and the Bisan Strait (west) with 31.3kg.

The particularly heaviest object was in the Hiuchi Sea (north) at 1,551kg, and a 95kg wire was confirmed in the Mizushima Sea. There was also a 124kg steel foundation at the entrance of the Osaka Bay.

When calculating by excluding these particularly heavy objects as a singular data, order according to heaviest weight was the Hiuchi Sea (south) with 221.4kg, the Hiroshima Bay (south) with 216.7kg, and the Mizushima Sea (excluding the wire) with 202.8kg.

According to types, the amount of plastics was highest in most sea areas of survey. In the Mizushima Sea and Hiuchi Sea (north) mentioned above, the ratio of metals was highest when including singular data. However with the result excluding the singular data, the ratio of plastics was highest similarly with other sea areas of survey.

Diagram II.2-7　Sea bed debris survey result (Weight(kg))



## (4) Volume

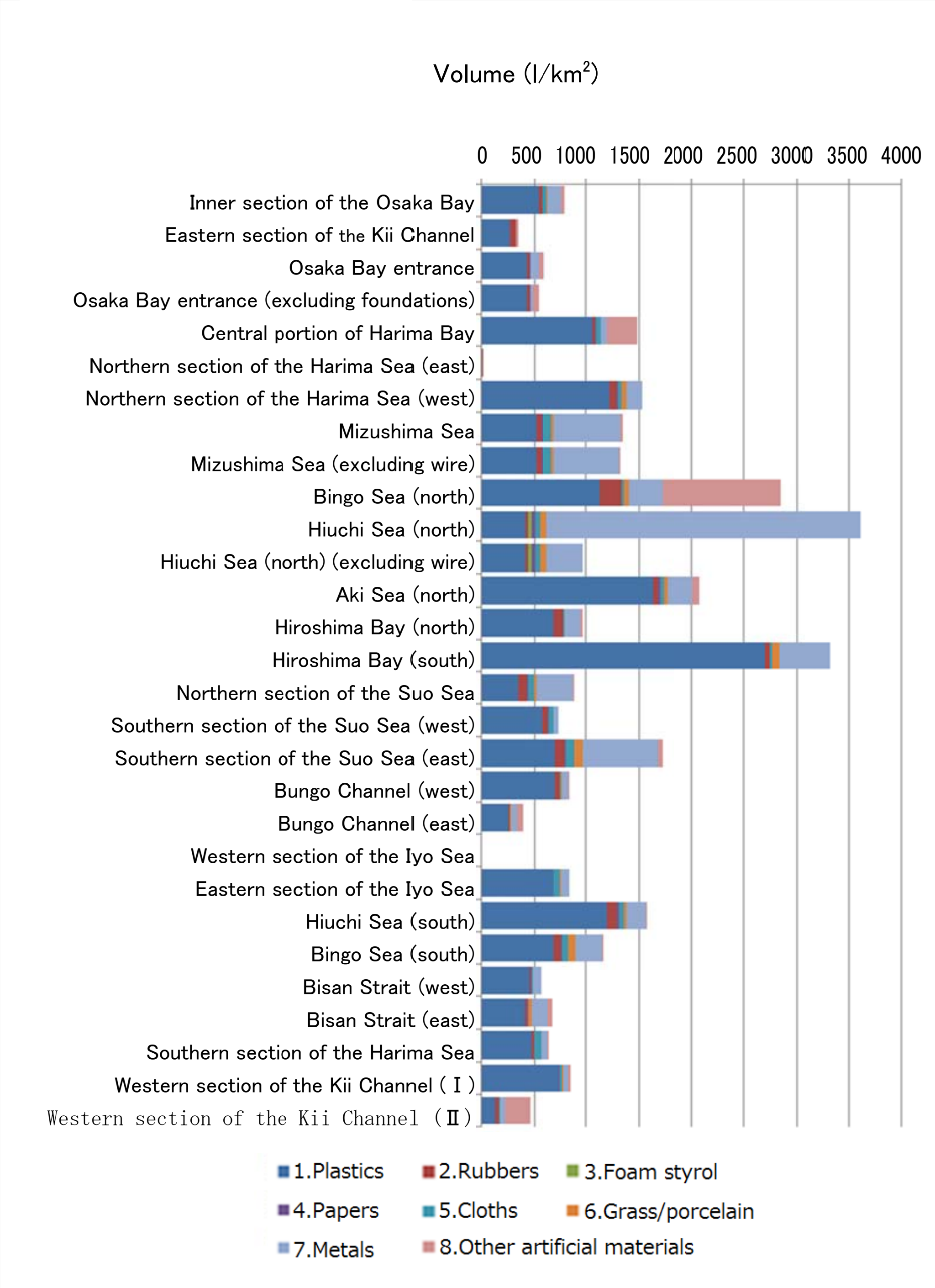
The volume list of sea bed debris according to sea area of survey and types is displayed in diagram II.2-8.

According to sea areas of survey, the figure of the Hiuchi Sea (north) was the largest with 3,615.0L, followed by the Hiroshima Bay (south) at 3,322.2L, and the Bingo Sea (north) with 2,844.1L. The result of the Hiuchi Sea (north) was affected by the wire, just as with the according to weight. The area with the lowest figure was the western section of the Iyo Sea at 9.0L, followed by the northern section of the Harima Sea (east) with 22.2L, and the eastern section of the Kii Channel with 351.8L.

With the calculation excluding singular data, the Hiroshima Bay (south), the Bingo Sea (north) followed by the Aki Sea (north) was the largest with 2,078.7L.

According to types, plastics were the highest in most sea areas of survey similarly with according to weight. However in the Mizushima Sea where 18L drums were confirmed, the ratio of metals was highest even with excluding singular data.

Diagram II.2-8 Sea bed debris survey result (Volume ($L/km^2$))



## (5) Density

The density per unit area ($km^2$) was calculated from the survey result (individual number, weight, volume).

The singular data of the entrance of the Osaka Bay, Mizushima Sea, and Hiuchi Sea (north) was excluded for calculation.

### 1) Density (individual number)

The density of individual numbers is displayed in diagram II.2-9.

According to sea area of survey, the Mizushima Sea was the highest with 2,830/$km^2$, followed by the Hiroshima Bay (north) with 1,575/$km^2$, and the Bingo Sea (north) at 1,508/$km^2$. The lowest was the northern section of the Harima Sea (east) with 10/$km^2$, followed by the western section of the Iyo Sea with 21/$km^2$, and the western section of the Kii Channel (II) with 27/$km^2$.

### 2) Density (weight)

The density of weight is displayed in diagram II.2-10.

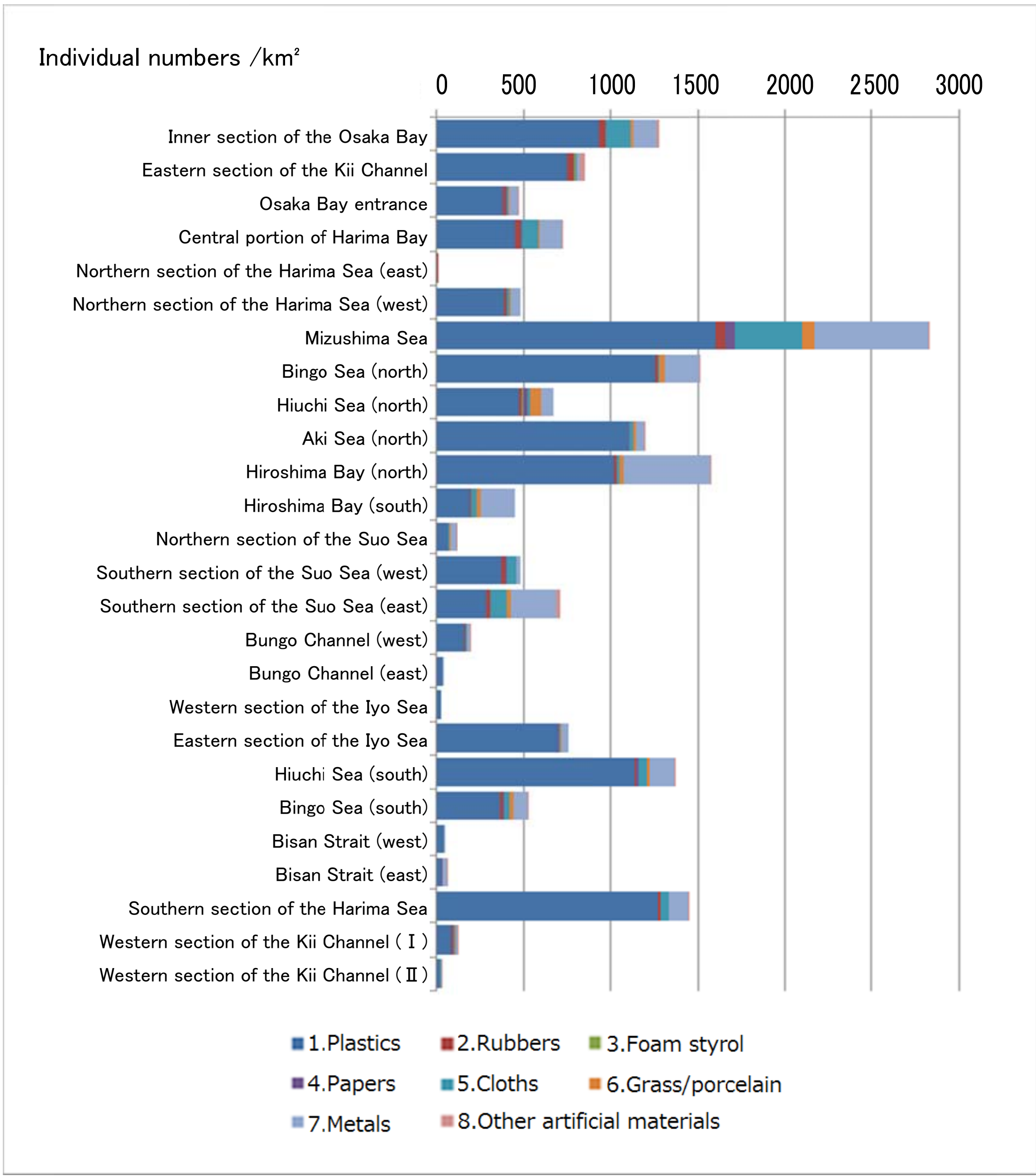
According to sea area of survey, the Hiroshima Bay (north) was the highest at 401.6kg/$km^2$, followed by the Mizushima Sea at 211.1kg/$km^2$, and the eastern section of the Kii Channel with 160.1kg/ $km^2$. The lowest was the western section of the Iyo Sea with 0.1kg/$km^2$, followed by the Bisan Strait (west) with 2.7kg/$km^2$, and the Bisan Strait (east) with 2.7kg/$km^2$ along with the Bungo Channel (east) with 4.6kg/$km^2$.

### 3) Density (volume)

The density of the volume is displayed in diagram II.2-11.

According to sea areas of survey, the Hiroshima Bay (north) was the highest at 2,998.2L/$km^2$, followed by the Bingo Sea (north) at 1,610.4L/$km^2$, and the eastern section of the Kii Channel with 1,416.2L/$km^2$. The lowest was the western section of the Iyo Sea at 6.2L/$km^2$, followed by the Bungo Channel (east) with 25.1L/$km^2$, and the Bisan Strait (west) with 48.5L/$km^2$.

Diagram II.2-9 Density of individual numbers according to type




(Individual number /km²)

Diagram II.2-10 Density of weight according to type

(kg/km²)

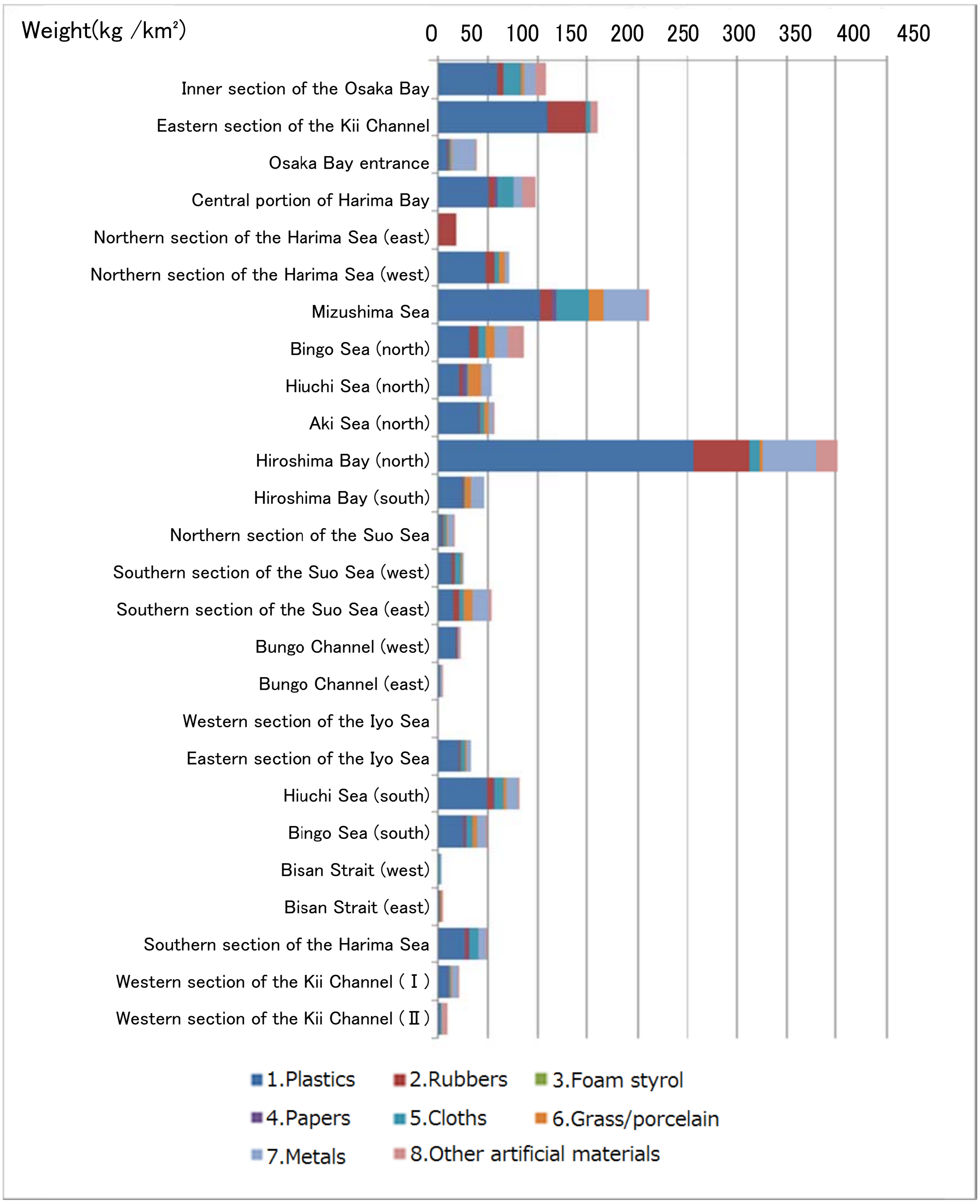
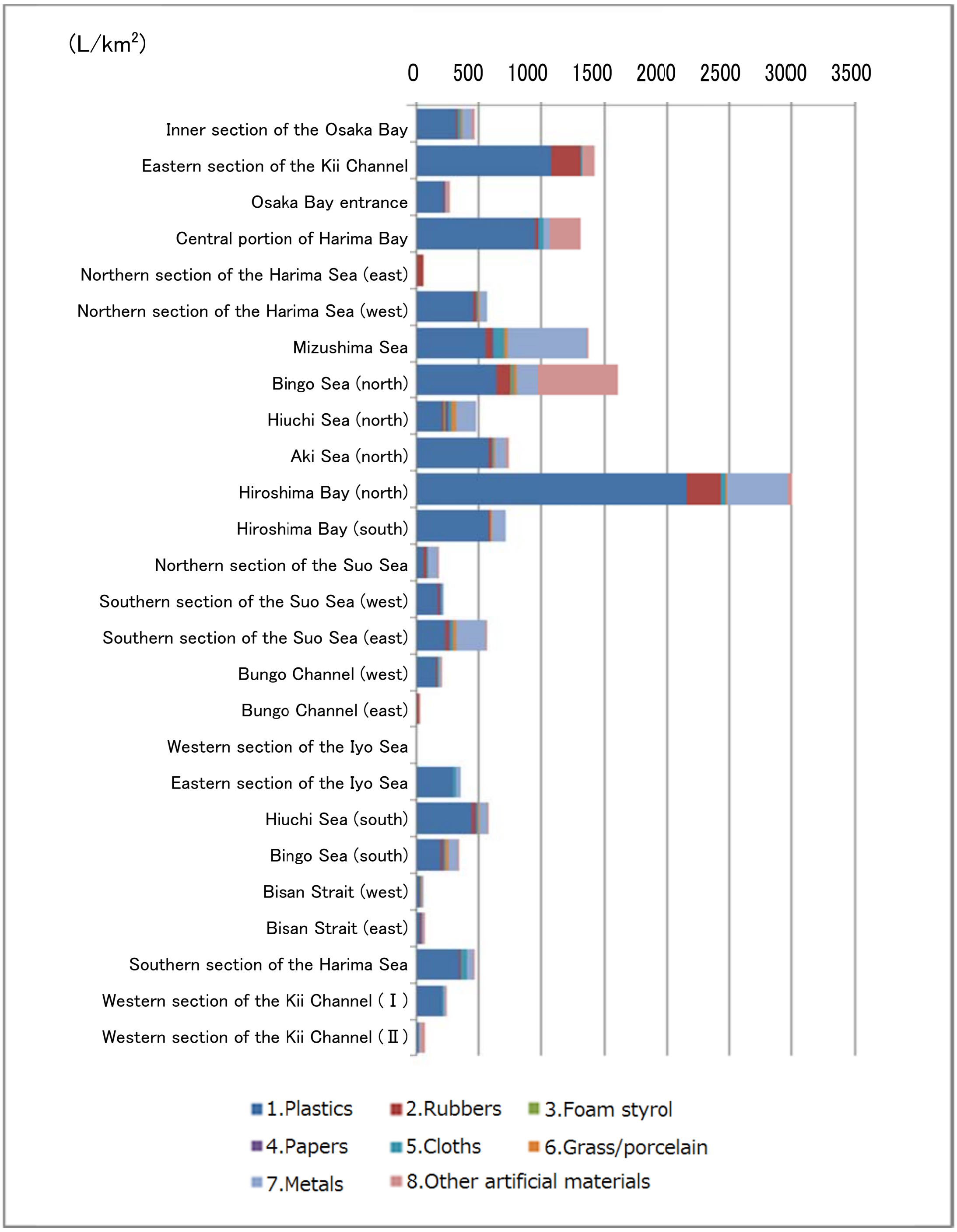


Diagram II.2-11 Density of volume according to type

(L/km²)



### (6) Expiration date of beverage cans

The expiration dates of beverage cans among sea bed debris were read and recorded. The results are displayed in diagram II.2-12.

The total number of beverage cans with identifiable expiration dates according to sea areas of survey was highest in the Hiroshima Bay (south) with 679, followed by the southern section of the Suo Sea (east) with 606, and the Mizushima Sea with 363. The expiration dates of recovered beverage cans in the eastern section of the Kii Channel were illegible, while beverage cans were not recovered in the northern section of the Harima Sea (east) and western section of the Iyo Sea.

According to the year, beverage cans with expiration dates in 2015 were the highest, showing a decreasing trend as the year became older. For this reason the recovery amount for older than 2009 was calculated for 5-10 years.

The beverage can with the oldest expiration date was that of 1983, recovered in Saiki.

Diagram II.2-12.A Expiration date of beverage cans according to sea area of survey

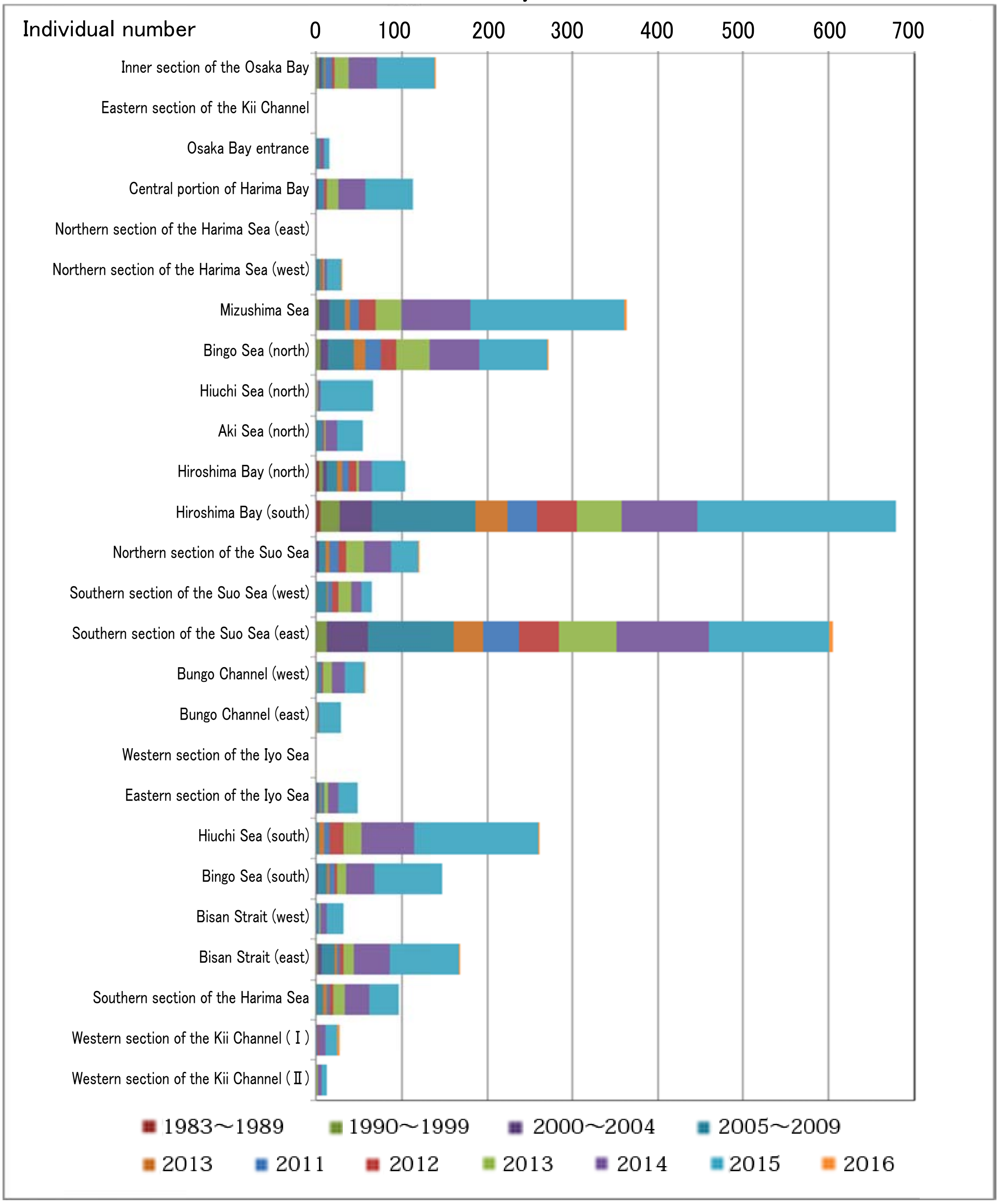
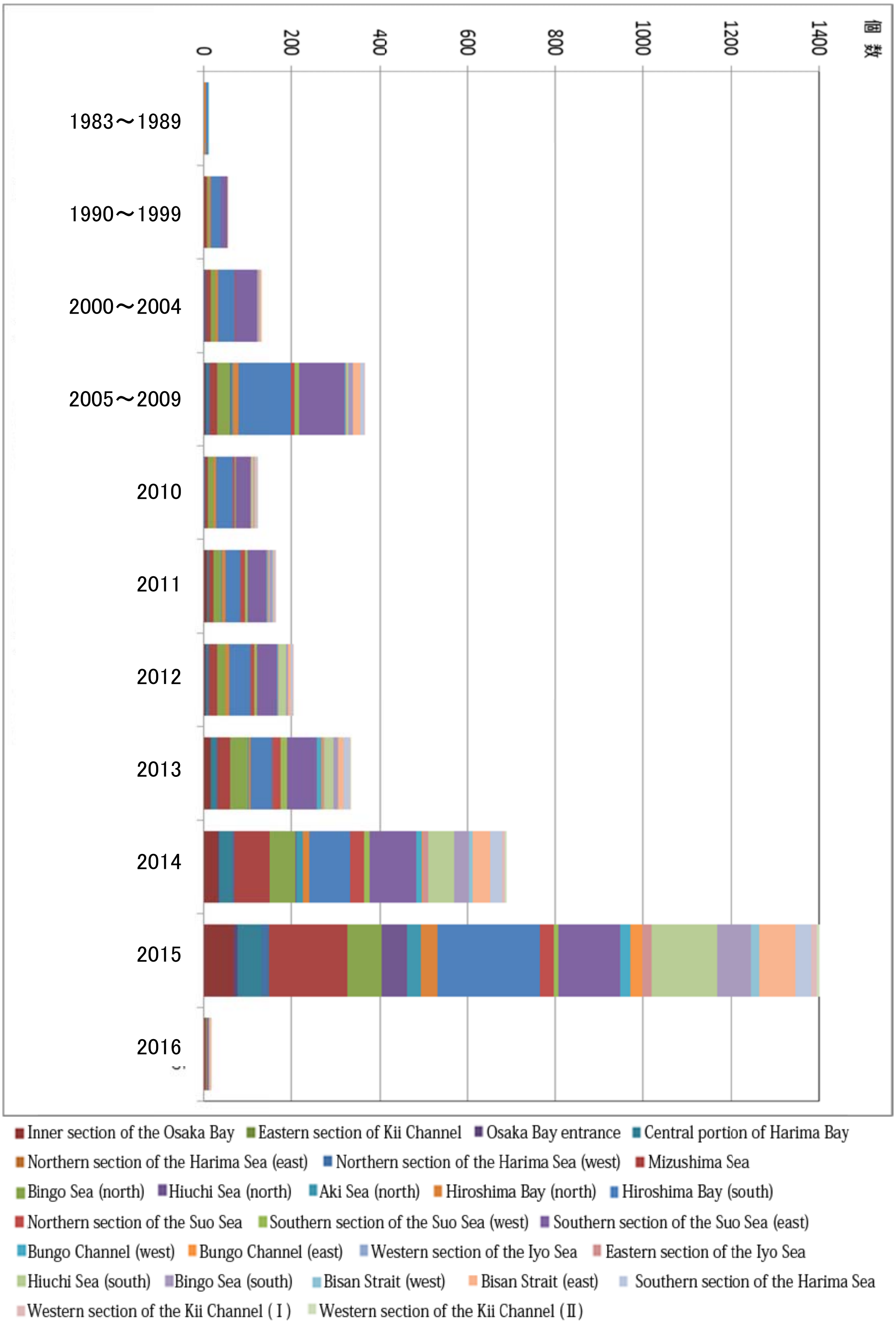


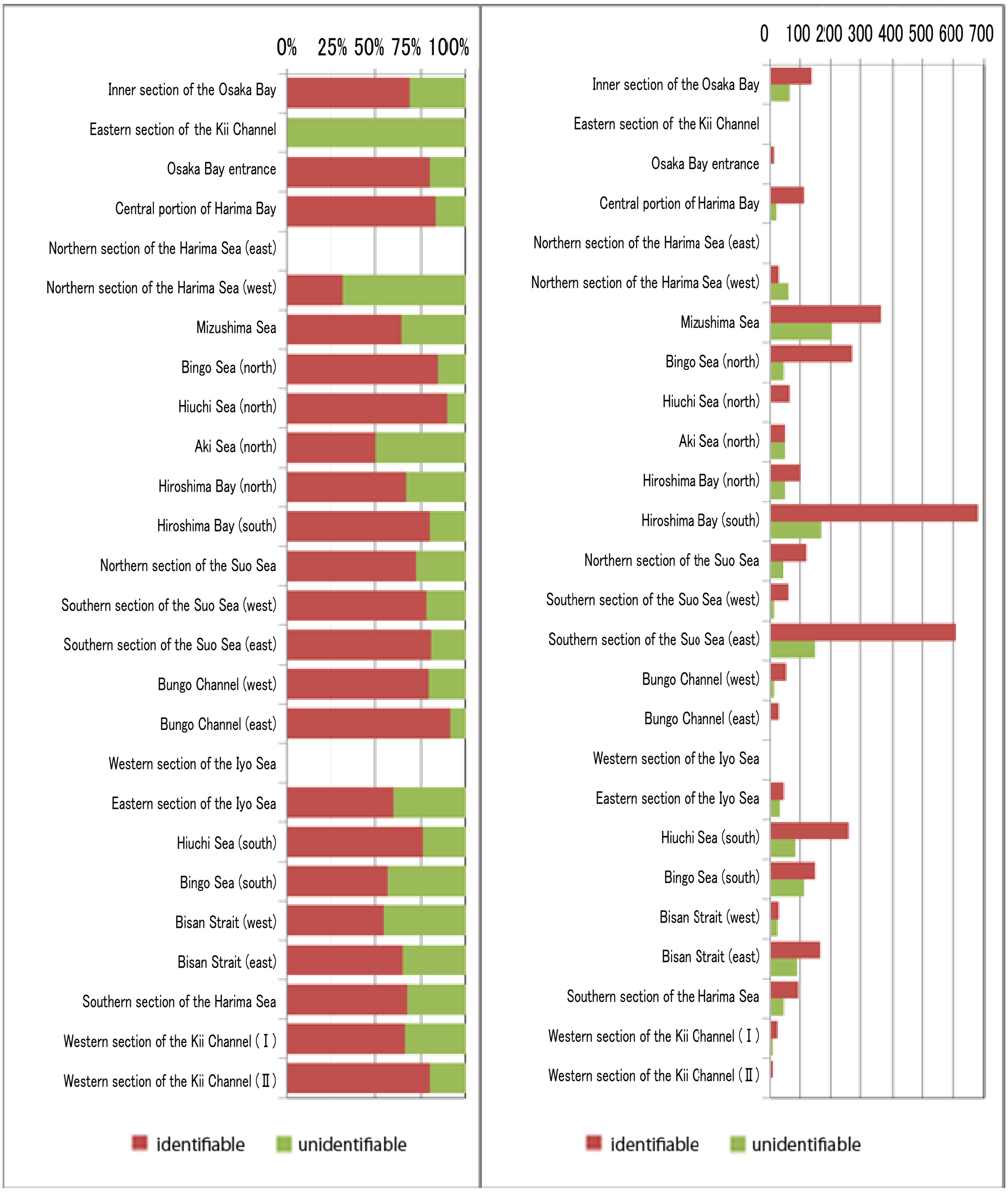
Diagram II.2-12.B Expiration date of beverage cans according to year



The numbers of beverage cans with identifiable/unidentifiable expiration dates are displayed in diagram II.2-13.

Apart from the eastern section of the Kii Channel and the northern section of the Harima Sea (west), the ratio of beverage cans with identifiable expiration dates were the highest in each sea area of survey.

Diagram II.2-13 Number of beverage cans with identifiable/unidentifiable expiration dates are displayed



Regarding the recovered cans of the eastern section of the Iyo Sea, the material of the cans (steel or aluminum) was confirmed. The results are displayed in diagram II.2-14.

The ratio of aluminum cans was highest with both the total number and according to expiration year.

Regarding aluminum cans, those with expiration years older than 2012 were also confirmed, however these were not confirmed with steel cans. The following reasons can be considered for this.

(1) <u>Corrosion is faster with steel cans</u>

Regarding the survival rate of beverage cans, the 6-year survey result from 1995-2000 in Tokyo Bay by *Kuriyama and co. estimates aluminum cans to be 0.47/year and steel cans to be 0.38/year. Based on these figures, the survival rate of aluminum and steel cans (decrease due to corrosion) varies more as the year becomes older. From this reason, it can be said that steel cans decrease at a rate that is 10 percent faster than aluminum cans.

<u>(2) There were less steel cans to begin with</u>

When looking at cans with recent expiration dates in 2015 that have relatively little effect from corrosion in this survey result, the ratio of aluminum and steel cans of the recovered beverage cans are about 2:1. Due to this it can be understood that the amount of sea bed steel cans was about half of aluminum cans to begin with.

From these reasons, it can be considered that steel cans with expiration dates older than 2012 were not confirmed, mainly due to the fact that the survival rate of steel cans are lower than aluminum cans (corrode faster). In addition, the fact that there are less steel cans than aluminum cans makes the identification of steel cans difficult.

＊Yuji Kuriyama, Tadashi Tokai, Kanji Tabata, Haruyuki Kanehiro (2003) Analysis according to year regarding the composition/distribution of sea bed debris of Tokyo Bay  Nippon Gekkan Suisanshi  65(5), 770-781

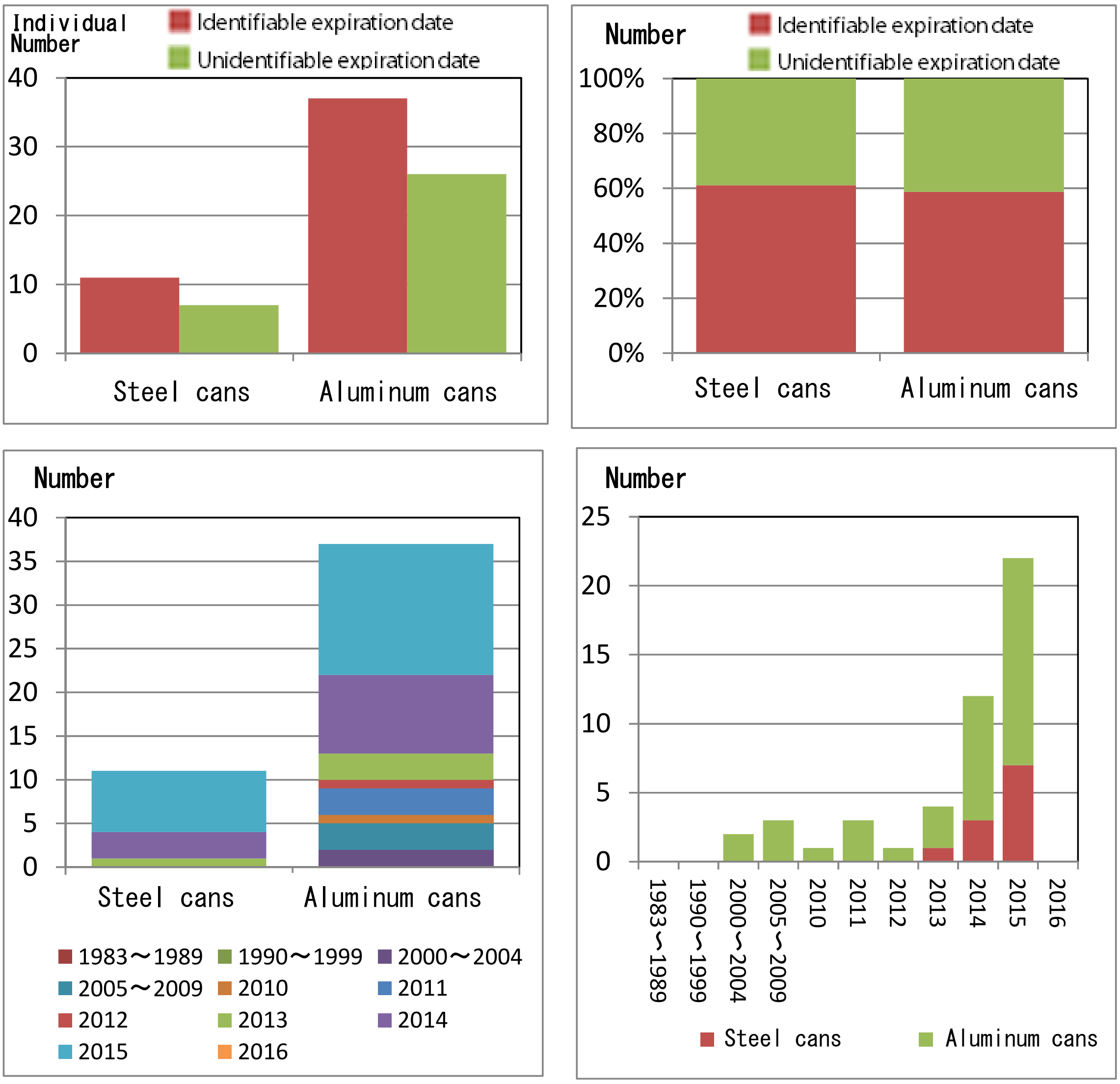



Diagram II.2-14 Regarding the differences of steel and aluminum cans (eastern section of the Iyo Sea)

## II.2.3 Floating debris field survey result

### II.2.3.1 Sea area for survey

Initially the plan was to conduct surveys at 10 sea areas expected to have large amounts of floating debris along the coast of the Setonaikai covering 11 prefectures. However surveys were conducted at 7 sea areas due to climate issues. The status of surveys is displayed in chart II.2-4 and diagram II.2-15.

The floating debris survey was initially planned as 1 vessel/2 days, however this was changed to 2 vessels/1 day due to frequent delays caused by climate conditions.

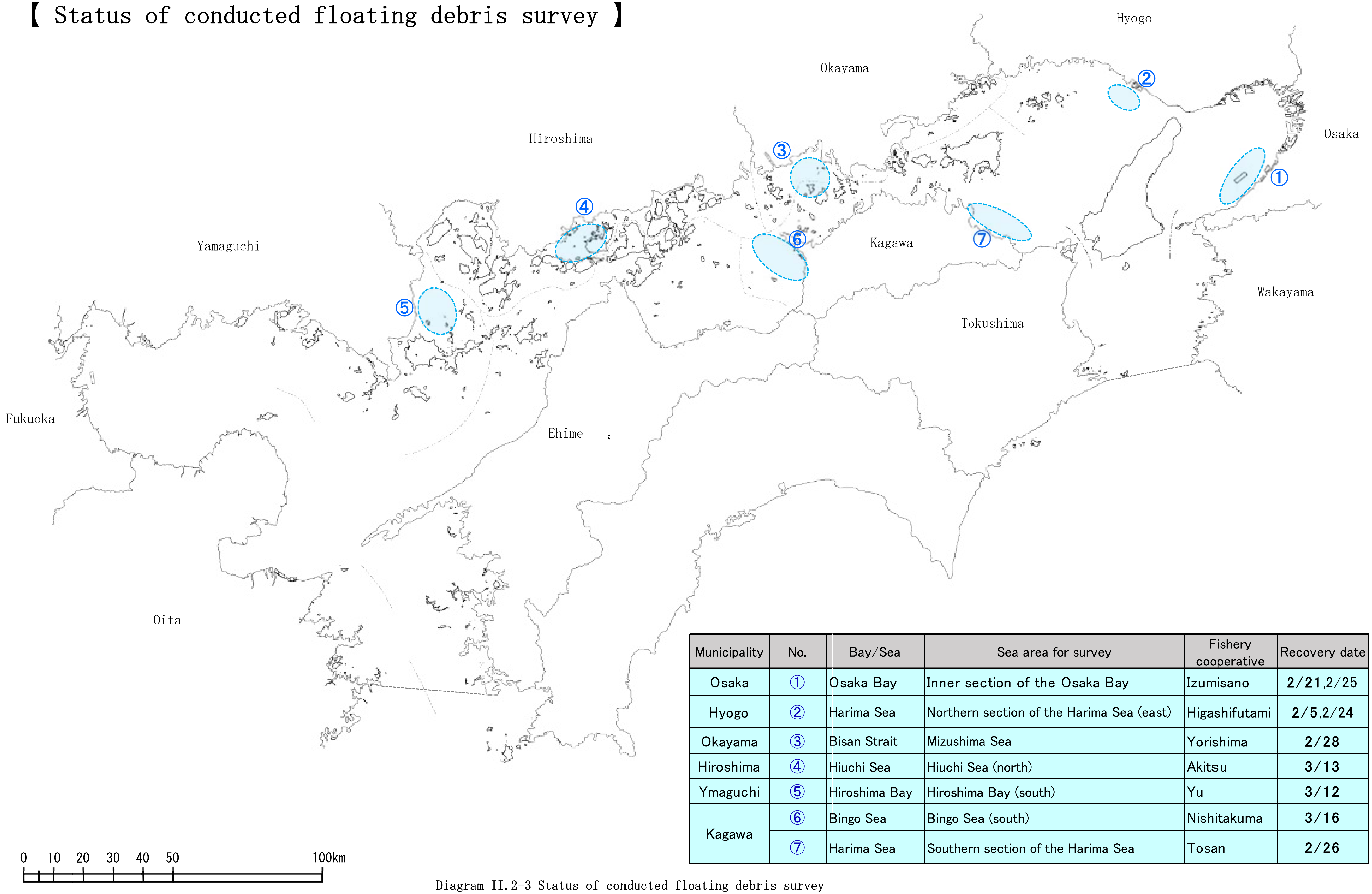
Chart II.2-4 Status of floating debris survey

2015

| Municipality | No. | Bay/Sea | Sea area for survey | Fishery cooperative | Recovery date |
|---|---|---|---|---|---|
| Osaka | ① | Osaka Bay | Inner section of the Osaka Bay | Izumisano | **2/21**,2/25 |
| Hyogo | ② | Harima Sea | Northern section of the Harima Sea (east) | Higashifutami | **2/5**,2/24 |
| Okayama | ③ | Bisan Strait | Mizushima Sea | Yorishima | **2/28** |
| Hiroshima | ④ | Hiuchi Sea | Hiuchi Sea (north) | Akitsu | **3/13** |
| Ymaguchi | ⑤ | Hiroshima Bay | Hiroshima Bay (south) | Yu | **3/12** |
| Kagawa | ⑥ | Bingo Sea | Bingo Sea (south) | Nishitakuma | **3/16** |
| | ⑦ | Harima Sea | Southern section of the Harima Sea | Tosan | **2/26** |

＊ Large characters are dates of micro plastic survey

# 【 Status of conducted floating debris survey 】




| Municipality | No. | Bay/Sea | Sea area for survey | Fishery cooperative | Recovery date |
|---|---|---|---|---|---|
| Osaka | ① | Osaka Bay | Inner section of the Osaka Bay | Izumisano | 2/21,2/25 |
| Hyogo | ② | Harima Sea | Northern section of the Harima Sea (east) | Higashifutami | 2/5,2/24 |
| Okayama | ③ | Bisan Strait | Mizushima Sea | Yorishima | 2/28 |
| Hiroshima | ④ | Hiuchi Sea | Hiuchi Sea (north) | Akitsu | 3/13 |
| Ymaguchi | ⑤ | Hiroshima Bay | Hiroshima Bay (south) | Yu | 3/12 |
| Kagawa | ⑥ | Bingo Sea | Bingo Sea (south) | Nishitakuma | 3/16 |
|  | ⑦ | Harima Sea | Southern section of the Harima Sea | Tosan | 2/26 |

Diagram II.2-3 Status of conducted floating debris survey

## II.2.3.2 Observational survey

### (1) Survey result

The results regarding the observational survey of floating debris are gathered in diagram II.2-16 to diagram II.2-19.

◎Discovered individual numbers (3 types)

When looking at the individual number of discovered debris according to types, artificial materials were the majority in all sea areas of survey. When looking at the individual number of debris according to sea areas, the Bingo Sea (south) had the most, followed by the inner section of the Osaka Bay, while the Hiroshima Bay (south) had extremely few. The reason for the extremely low number in the Hiroshima Bay (south) is thought to be due to relatively strong winds and rough sea conditions compared to other sea areas during the survey, which made it difficult to discover floating objects.

◎Discovered individual numbers (according to artificial materials)

When looking at the individual discovered number of artificial materials, plastic films were the highest in all sea areas. Apart from the Hiroshima Bay (south) with extremely low numbers of discovered individual numbers, 30-60 percent of the discovered materials in all sea areas of survey were plastic films. With other types of materials, foam styrol (inner section of Osaka Bay, Hiuchi Sea (north), Bingo Sea (south)) and other petrochemicals[9] (inner section of Osaka Bay, Hiuchi Sea (north)) had high numbers.

◎Size (all items)

The sizes of discovered debris were mostly small in all sea areas of survey, with size SS (less than 20cm) and size S (larger than 20cm-less than 50cm) were over 80 percent. Large size L (larger than 100cm-less than 200cm) debris was found in the inner section of Osaka Bay, northern section of the Harima Sea (east), the Bingo Sea (south), and the southern section of the Harima Sea.

◎Discovered distance (all items)

50-70 percent of discovered distance of debris was less than 10cm in most sea areas of survey, however the ratio of debris discovered in a location over 30cm away from the survey vessel was larger in the Mizushima Sea.

The reason for the high ratio of long discovered distance in the Mizushima Sea is thought to be due to the lowest wave scale among other sea areas during the survey period with calm sea conditions.

9 "Other petrochemicals": Petrochemicals apart from fishing tools, foam styrol, plastic films, and plastic bottles.

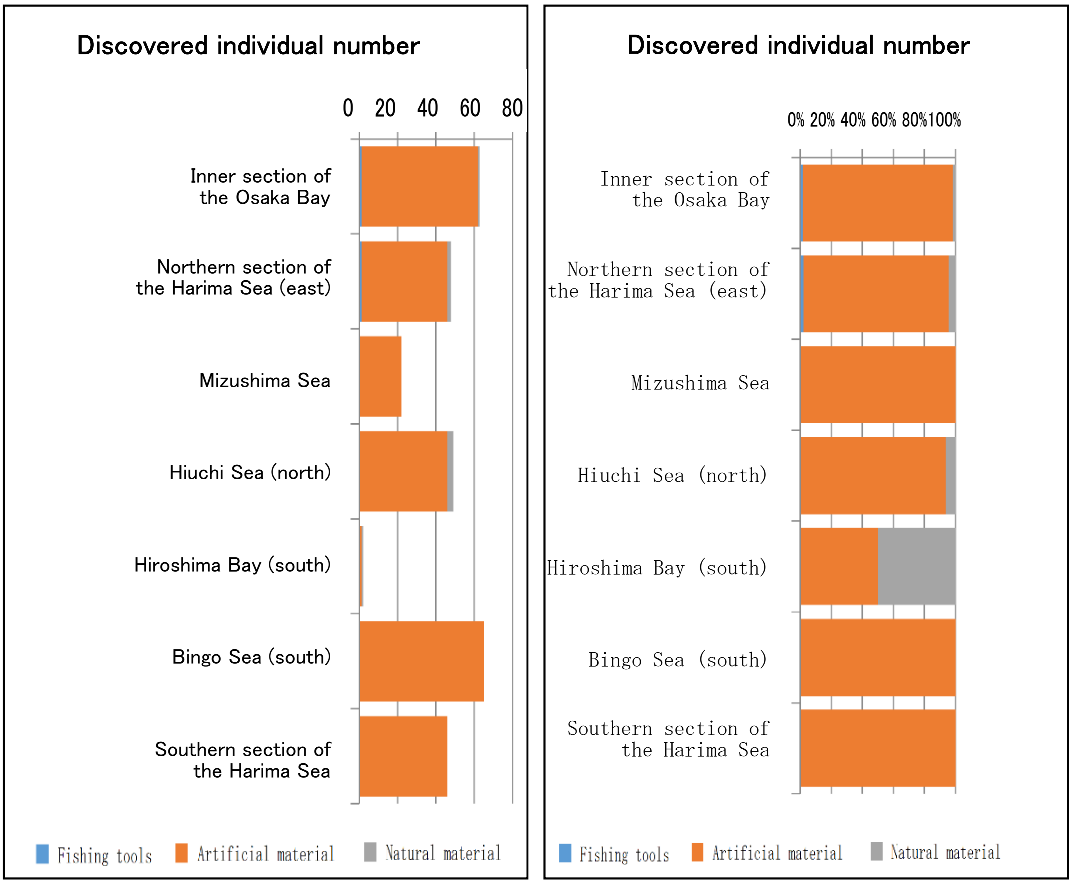



Diagram II.2-16 Floating debris survey Discovered individual numbers (3 types)

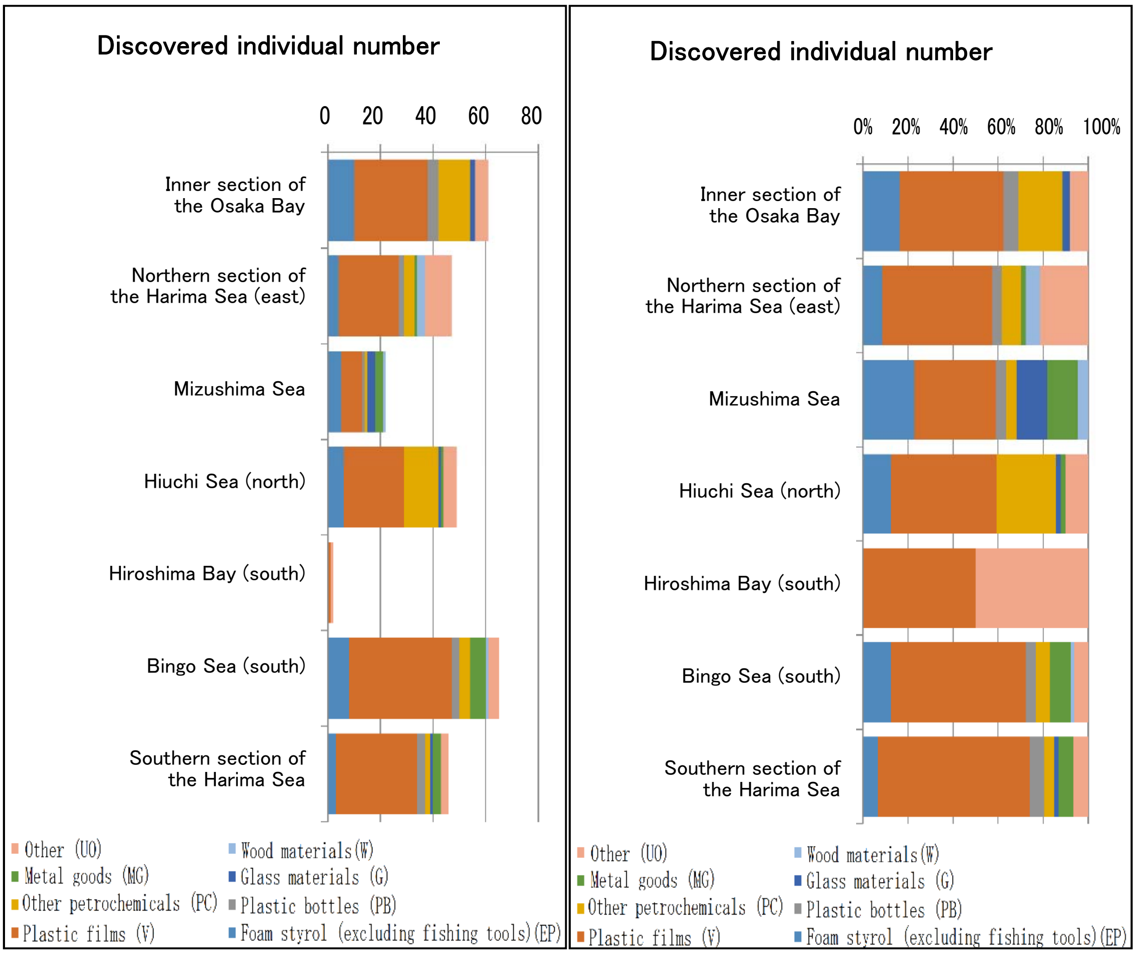
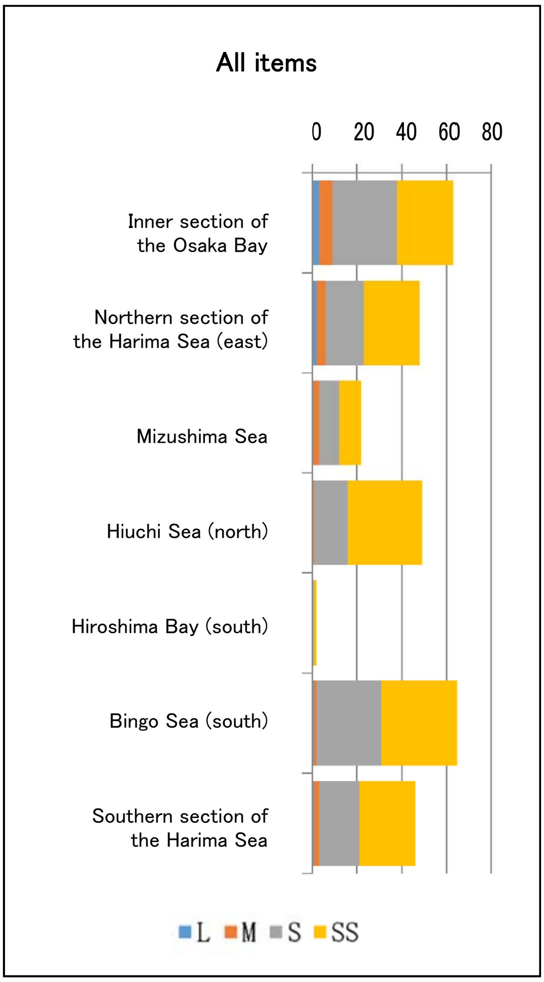
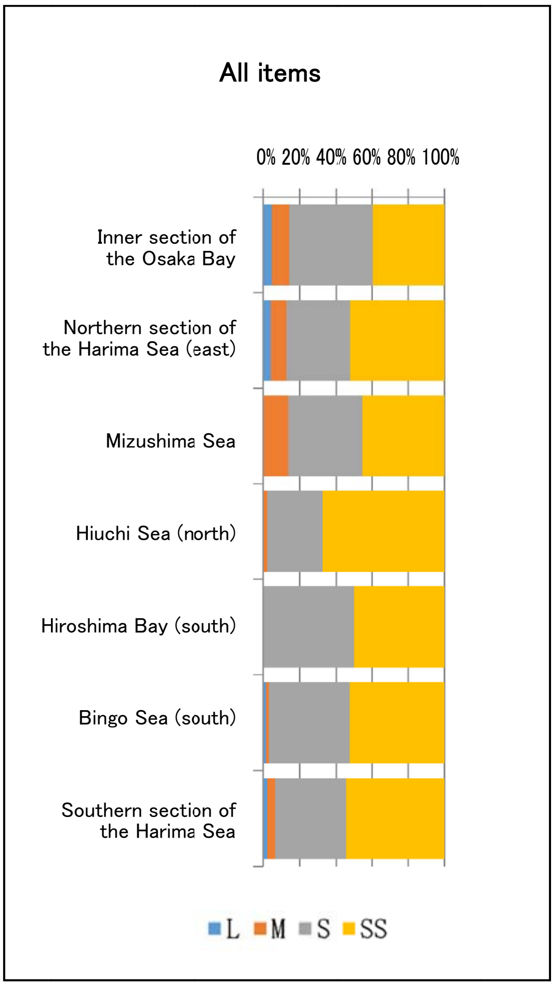



Diagram II.2-17 Floating debris survey Discovered numbers

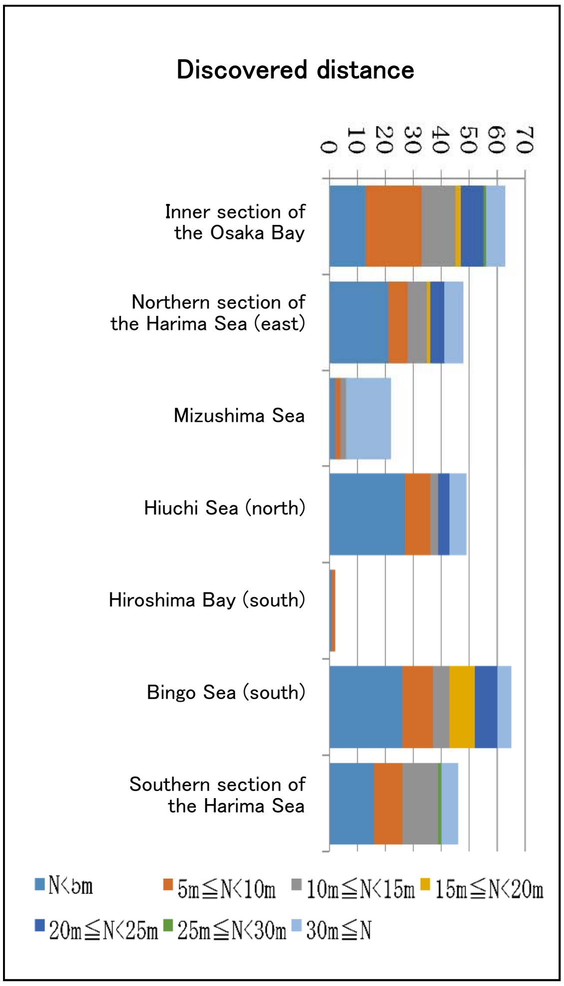
(According to artificial materials)




L：200cm>N≧100cm、M：100cm>N≧50cm、 S：50cm>N≧20cm、 S S：20cm>N

Diagram II.2-18 Floating debris survey Size (all items)



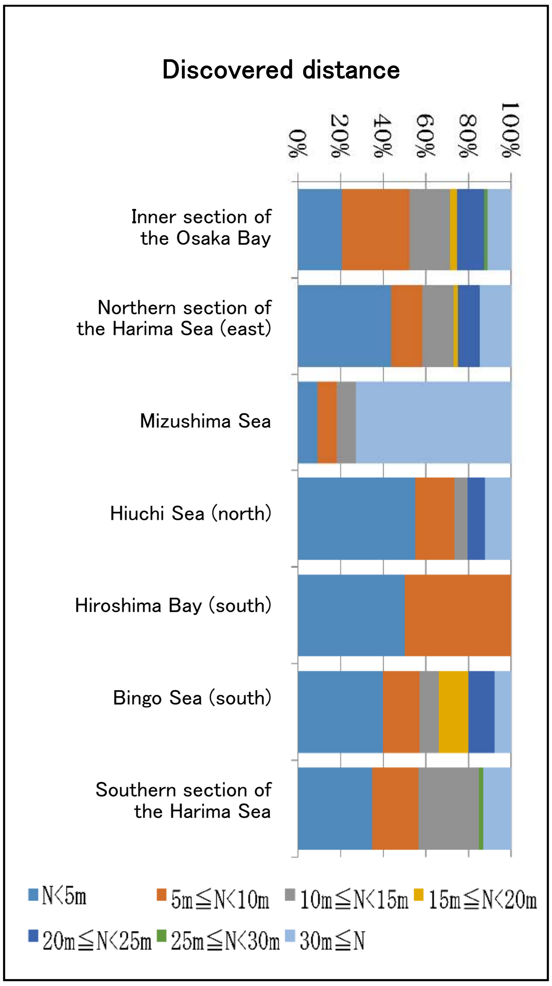




Diagram II.2-19 Floating debris survey Discovered distance (all items)

### (2) Estimation of semi effective sweep width

The analysis regarding the observational survey result of floating debris was conducted through estimating the density of floating debris using the semi effective sweep width introduced by Professor Tadashi Tokai of the Tokyo University of Marine Science and Technology. Since the number of samples with 1 sea area of survey would be insufficient, the data of all 7 sea areas of survey were gathered and analyzed. According to items even with using all data of the 7 sea areas of survey, the discovered individual number that could be used for estimation of the semi effective sweep width was low. For this reason a histogram was created for the top 3 materials with relatively high discovered individual numbers, which were plastic films (V), foam styrol (EP), and other petrochemicals (PC). At the same time, the semi estimated sweep width, which was provided by Professor Tokai, was estimated by calculating the discovered function using an Excel worksheet.

#### 1) Plastic film (V)

The discovered status of plastic films and the semi effective sweep width is displayed below. The discovered function with the lowest AIC (Akaike information criterion) was the hazard-rate function, and the semi effective sweep width was estimated as 14m.

#### 2) Foam styrol (EP)

The discovered status of foam styrol and the estimation result of the semi effective sweep width are displayed below. The discovered function with the lowest AIC (Akaike information criterion) was the exponential function, and the semi effective sweep width was estimated as 23m.

#### 3) Other petrochemicals (PC)

The discovered status of other petrochemicals and the estimation result of the semi effective sweep width are displayed below. The discovered function with the lowest AIC (Akaike information criterion) was the exponential function, and the semi effective sweep width was estimated as 18m.

### (3) Density of floating debris (observational)

The density of floating debris according to sea areas of survey was determined from the semi effective sweep width, survey line distance, and discovered individual number.

The calculation results are displayed in chart II.2-5, diagram II.2-20.

When comparing the 3 items, the overall density of plastic films was the highest.

The Bingo Sea (south) had the highest density of plastic films with 27/km$^2$, and the lowest was the Hiroshima Bay (south) with 0.6/km$^2$, followed by the Mizushima Sea with 5/km$^2$.

The inner section of the Osaka Bay had the highest density of foam styrol with 3.6/km$^2$, and the lowest was the Hiroshima Bay (south) with 0/km$^2$, followed by the southern section of the Harima Sea with 1/km$^2$. When comparing with plastic films the variance between sea areas of survey was small.

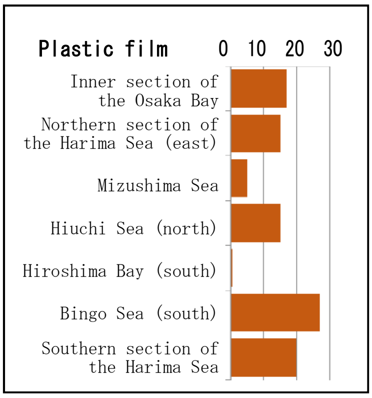
The Hiuchi Sea (north) had the highest density of other petrochemicals with 6.6/km$^2$, and lowest was Yuu of Hiroshima Bay (south) with 0/km$^2$, followed by the southern section of the Harima Sea with 1/km$^2$.

Chart II.2-5 Density of floating debris

■Plastic film (V)

| Semi effective sweep width | 14m |
|---|---|

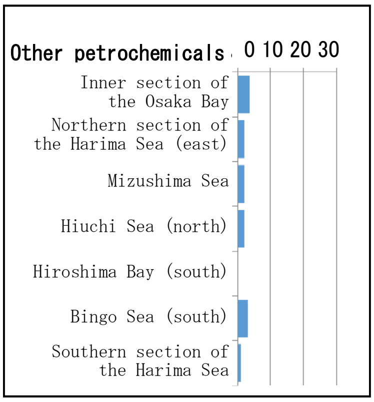
| No. | Sea area for survey | Fishery cooperative | Total survey line distance (km) | Discovered number (Number) | Density (Number/km$^2$) |
|---|---|---|---|---|---|
| ① | Inner section of the Osaka Bay | Izumisano | 60.29 | 28 | 17 |
| ② | Northern section of the Harima Sea (east) | Higashifutami | 55.35 | 23 | 15 |
| ③ | Mizushima Sea | Yorishima | 54.06 | 8 | 5 |
| ④ | Hiuchi Sea (north) | Akitsu | 54.36 | 23 | 15 |
| ⑤ | Hiroshima Bay (south) | Yu | 57.61 | 1 | 0.6 |
| ⑥ | Bingo Sea (south) | Nishitakuma | 51.18 | 39 | 27 |
| ⑦ | Southern section of the Harima Sea | Tosan | 55.33 | 31 | 20 |




■Foam styrol (EP)

| Semi effective sweep width | 23m |
|---|---|

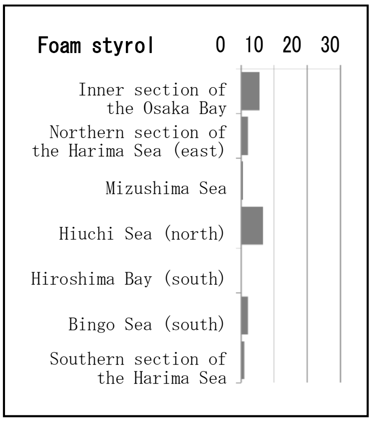
| No. | Sea area for survey | Fishery cooperative | Total survey line distance (km) | Discovered number (Number) | Density (Number/km$^2$) |
|---|---|---|---|---|---|
| ① | Inner section of the Osaka Bay | Izumisano | 60.29 | 10 | 3.6 |
| ② | Northern section of the Harima Sea (east) | Higashifutami | 55.35 | 4 | 2 |
| ③ | Mizushima Sea | Yorishima | 54.06 | 5 | 2 |
| ④ | Hiuchi Sea (north) | Akitsu | 54.36 | 6 | 2 |
| ⑤ | Hiroshima Bay (south) | Yu | 57.61 | 0 | 0 |
| ⑥ | Bingo Sea (south) | Nishitakuma | 51.18 | 8 | 3 |
| ⑦ | Southern section of the Harima Sea | Tosan | 55.33 | 3 | 1 |




■Other petrochemicals (PC)

| Semi effective sweep width | 18m |
|---|---|

| No. | Sea area for survey | Fishery cooperative | Total survey line distance (km) | Discovered number (Number) | Density (Number/km$^2$) |
|---|---|---|---|---|---|
| ① | Inner section of the Osaka Bay | Izumisano | 60.29 | 12 | 5.5 |
| ② | Northern section of the Harima Sea (east) | Higashifutami | 55.35 | 4 | 2 |
| ③ | Mizushima Sea | Yorishima | 54.06 | 1 | 0.5 |
| ④ | Hiuchi Sea (north) | Akitsu | 54.36 | 13 | 6.6 |
| ⑤ | Hiroshima Bay (south) | Yu | 57.61 | 0 | 0 |
| ⑥ | Bingo Sea (south) | Nishitakuma | 51.18 | 4 | 2 |
| ⑦ | Southern section of the Harima Sea | Tosan | 55.33 | 2 | 1 |




エラー！参照元が見つかりません。 Density of floating debris

### II.2.3.3 Micro plastics survey

#### (1) Survey result

The collected samples using neuston nets at with the field survey were separated with a 5mm sieve, and objects that passed through the sieve were preserved as possible micro plastics. Furthermore, this time the target for analysis was set to larger than 1mm, and so objects were sifted using a 1mm sieve and objects that remained in the sieve (1-5mm) were sampled. The samples were examined using a stereoscopic microscope. Objects determined as plastics were sorted and the individual numbers were recorded.

Plastics were confirmed in 5 out of the 7 sea areas of survey (inner section of the Osaka Bay, northern section of the Harima Sea (east), the Hiroshima Bay (south), the Bingo Sea (south), southern section of the Harima Sea). Most of their forms were granular, however there were also films, sheets, (northern section of the Harima Sea (east), southern section of the Harima Sea), strings (inner section of the Osaka Bay, northern section of the Bingo Sea (Kainan)), others (floating objects with plastic parts: inner section of the Osaka Bay, sponge-type floating objects: the Bingo Sea (south)).

With other materials, foam styrols were confirmed in 6 sea areas of survey (northern section of Harima Sea (east), Mizushima Sea, Hiuchi Sea (north), the Hiroshima Bay (south), the Bingo Sea (south), southern section of the Harima Sea), while cloths and fabrics were confirmed in the inner section of the Osaka Bay, northern section of the Harima Sea (east), and the Hiuchi Sea (north). Also metals were confirmed in the inner section of the Osaka Bay.

From the above results and the filtered water amount determined from the number of rotations of the flow meter, the density of floating micro plastics (individual number/$m^3$) was calculated. Metals were excluded from the data for calculations. The results are displayed in chart II.2-6, diagram II.2-21 and diagram II.2-22.

The Hiuchi Sea (north) had the highest floating density with 0.098/$m^3$, and the lowest was the Mizushima Sea with 0.003/$m^3$.

Chart II.2-6 Density of floating micro plastics

(individual number/$m^3$)

| Sea area for survey | Fishery cooperative | Collected number | Amount of filtered water | Density |
|---|---|---|---|---|
| | | Number | $m^3$ | Number/$m^3$ |
| Inner section of the Osaka Bay | Izumisano | 7 | 205.313 | 0.034 |
| Northern section of the Harima Sea (east) | Higashifutami | 16 | 437.109 | 0.037 |
| Mizushima Sea | Yorishima | 1 | 362.813 | 0.003 |
| Hiuchi Sea (north) | Akitsu | 27 | 276.563 | 0.098 |
| Hiroshima Bay (south) | Yu | 3 | 370.313 | 0.008 |
| Bingo Sea (south) | Nishitakuma | 12 | 338.438 | 0.035 |
| Southern section of the Harima Sea | Tosan | 19 | 426.094 | 0.045 |

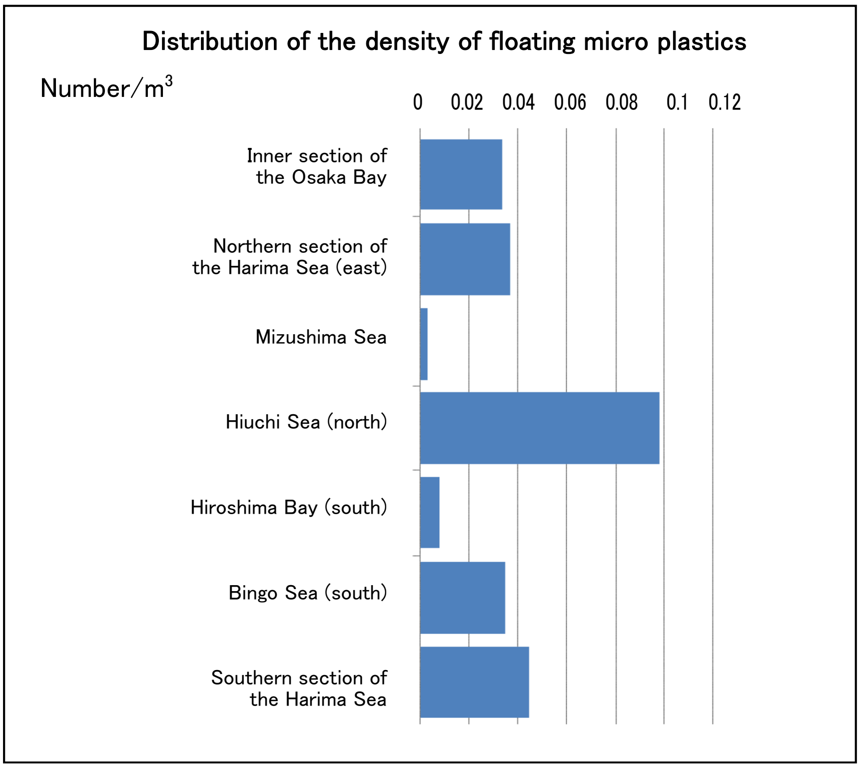



Diagram II.2-21 The density of floating micro plastics

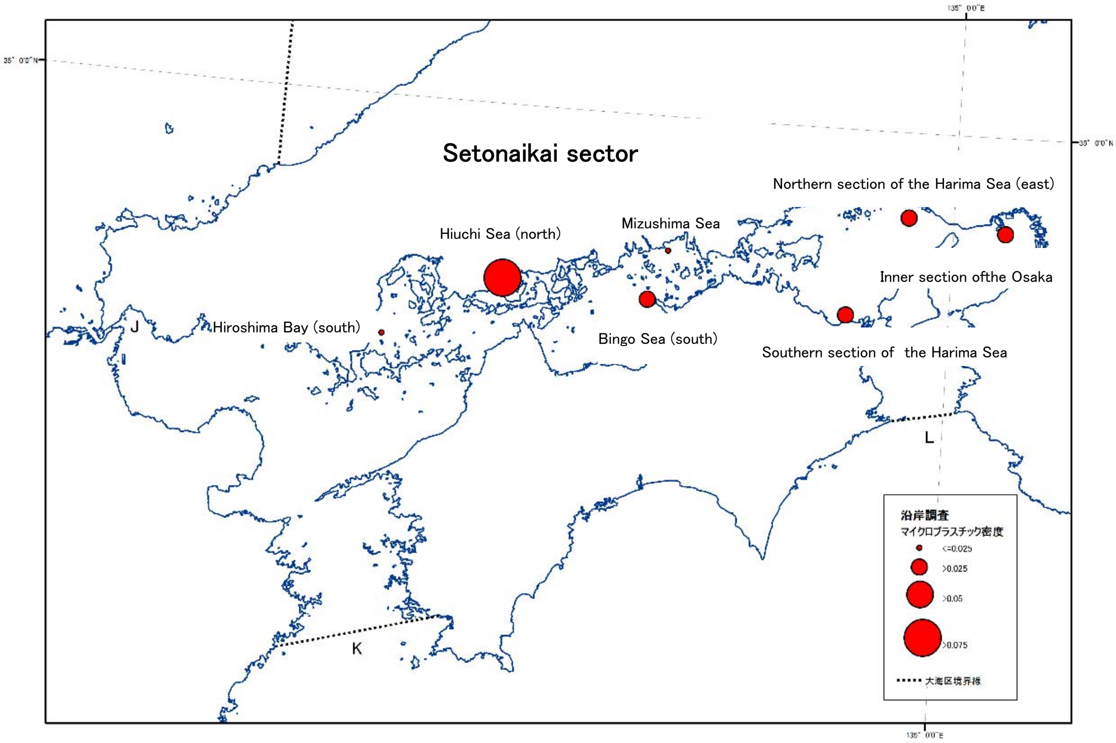



Diagram II.2-22 Distribution of the density of floating micro plastics

### II.2.4 Results of interview towards fishermen

Results regarding interviews towards fishermen during the field survey of floating/sea bed debris are gathered below.

The interviews were mainly conducted when visiting fishery cooperatives for dividing debris found during sea bed debris surveys (conducted at 26 fishery cooperatives). Interviews were conducted with 1-2 fishermen of each fishery cooperative or staff of the fishery cooperatives.

① Status of bringing back floating/sea bed debris

◎The summary of the recovery status of debris through by-catch when operating vessels are shown below.

- The Ministry of Land, Infrastructure, Transport and Tourism and the local government has placed debris recovery boxes, and encourages the fishermen at each fishery cooperative to recover debris.
- Recovered debris is brought back by fishermen, and independently disposed of. At this time the recovered debris is divided, and are also disposed of when the municipalities recover the debris. There are also some municipalities that handle the disposal of debris by themselves.

◎In some fishery cooperatives the following efforts are made for the recovery of debris.

- The fishermen of the fishery cooperatives work together for cleaning (recovering debris) fishing grounds once a year.
- There are both fishery cooperatives that target sea bed debris (recovering debris through trawling) and fishery cooperatives that recover floating debris.
- Encourages debris recovery by placing waste boxes in various sections of fishing ports.

② Details of damages caused by floating/sea bed debris

- Fishing nets are damaged when driftwood (natural), wires, and 18 liter drums get caught in trawls.
- Difficulty with lifting and recovering trawls due to driftwood (natural) or heavy household electronics get caught in trawls.
- Screws are damaged when coming into contact with driftwood (natural).
- Floating vinyl bags or ropes get caught in screws (entanglement), and sometimes hinders the operation of vessels.

③ Periods when damages occur

- With both floating/sea bed debris, plastic bottles and vinyl bags increase from spring to summer.
- Floating debris increases after inundation caused by typhoons or heavy rain.
- Regarding the types of floating debris at the time of inundation, artificial debris (vinyl bags, plastic bottles) increase, however the majority is natural driftwood, dead branches/grass. This phenomenon is particularly evident in sea areas nearby large rivers.
- Sea bed debris is often confirmed in areas where trawling using dragnet type 2 recently became permitted and debris seems to accumulate when trawling is suspended for a certain amount of time.
- Sea bed also seems to increase after inundation.

④ Locations where damages occur

- Floating debris mostly gathers nearby junctions where currents meet, then move, and so the positions are not consistent.
- Sea bed debris often accumulates in areas where the geography rises. Vessels are operated in a way to avoid areas where debris has accumulated.
- Large debris such as wires seems to be often confirmed nearby offshore ship courses.
- When sea gravel was collected in the past, wires were often confirmed as sea bed debris.
- Depending on the direction of the wind, floating debris enters fishing ports after inundation, and so fishing vessels cannot be operated at times (this seems to occur once every few years in most fishery cooperatives).

⑤ Degree of urgency

- When large amounts of floating debris (natural) enter ports, the municipality (usually the prefecture) conducts debris recovery.
- When the majority of debris that has entered the ports is dead grass caused by grass cutting in nearby riverbeds, the manager of the riverbed has been contacted.