Tara – Jambio

Microplastic joint survey

Report FY2020

キーポイント

静岡県下田市沖におけるマイクロプラスチック汚染モニタリング

- 2020年7月から毎月採集を行った
- 表層海水と堆積物における日本初マイクロプラスチックモニタリングプログラム
- すべての処理済みのサンプルからマイクロプラスチックが観察された

日本沿岸におけるマイクロプラスチック汚染

- 2020年秋・調査：Tara-JAMBIOマイクロプラスチック共同調査
- JAMBIOのネットワークに参加してる国立大学の協力を受け実施：
    - 岡山大学理学部附属牛窓臨海実験所
    - 広島大学大学院生物圏科学研究科附属瀬戸内圏フィールド科学教育研究センター竹原ステーション
    - 島根大学生物資源科学部附属生物資源教育研究センター　海洋生物科学部門 (隠岐臨海実験所)
    - 九州大学理学部附属天草臨海実験所
    - 香川県三豊市詫間町　粟島西浜及び粟島海洋記念館
    - 名古屋大学大学院理学研究科附属臨海実験所　菅島臨海実験所
    - 筑波大学下田臨海実験センター
- 6ヶ所の臨海実験所と、香川県三豊市詫間町粟島の西浜を拠点に調査を行った。臨海実験所では、河口から沖にわたって、67回マイクロプラスチックサンプルが採集され、日本沿岸で表層海水、堆積物とビーチが同時に採集された一番広い範囲の調査になる。
- 表層海水のサンプルのすべて（26）と抽出が終わった堆積物とビーチのサンプル（20/41）の全てからマイクロプラスチックが検出された。
- 各採集地点で環境データも採取したため、今後マイクロプラスチックのフラックスを決めるドライバーを解析できる可能性が期待される。
- 生物多様性への影響を調べるため環境DNAとプラスチスフィアーのサンプリングを行った。
- 様々な教育イベントを行い、延べ80人以上がイベントに参加した。
- TARA JAPAN と連携協定を締結している香川県三豊市の粟島では、地元のメディアを招待し、西浜のビーチでマイクロプラスチックのサンプリングを行い、粟島海洋記念館では、アウトリーチ教育イベントを行った。

8組9人の芸術家が調査に参加しその後アート作品を制作した。作品の展覧会を粟島で2021年3月21日から行う予定だったが、緊急事態宣言延長のため開始時期が延長。2021年5月から行う予定。

Key points - Observations before analysis

Monthly monitoring of microplastics in surface water and sediment in coastal waters off Shimoda, Shizuoka, Japan

- Sampling using established protocols was started in July 2020.
- First consistent monitoring of microplastic concentrations in coastal waters.
- Microplastics were found in all samples extracted.

Microplastic pollution in Japanese coastal waters: Fall 2020 Campaign

- Sampling was conducted in collaboration with six national universities: Okayama University, Hiroshima University, Shimane University, Kyushu University, Nagoya University, and Tsukuba University, and in addition beach samples were taken in Awashima, Mitoyo, Kagawa.
- Samples for surface water, sediment and beaches were taken from rivers, bays and offshore sites, for a total of 67 sampling events.
- This already represents the largest study on microplastic pollution in Japanese coastal waters and sediments.
- Microplastics were found in all samples of surface water (26), and in all of the sediment and beach samples that were extracted (20/41).
- Environment conditions were recorded for each sampling site allowing to investigate the drivers of the fluxes of plastics.
- Both eDNA and plastisphere samples were taken to study potential impacts on the local biodiversity.
- Educational events were held at each location reaching a public of more than 80 persons.
- Sampling was performed in collaboration with 9 artists, including one duo artist, art pieces will be exhibited at Awashima, in 2021, considering the situation with Covid-19 pandemic.

I. Project Goals

Quantification of microplastic pollution in Japan coastal waters: input and fluxes

Plastic pollution comes from the land with a large part of it flowing through the rivers as it was recently shown by the Tara Microplastic mission in Europe. Studies available in Japan showed the presence of microplastic in most rivers sampled (Kataoka et al., 2019) and high concentration in coastal waters (Isobe et al., 2014). However no studies in Japan tried to link these two and assess the flux from rivers towards the open ocean. In this regard, the sampling for the proposed project will be conducted along a transect from river mouths towards the open ocean. Quantification of microplastic pollution in marine sediment

Most studies on the occurrence of microplastic focus on the surface waters and very few investigated the presence of microplastic in marine sediment with only two studies in Japan to our knowledge (Matsuguma et al., 2017; Sagawa et al., 2018). Nevertheless microplastic were observed in most studies investigating their presence in marine sediment (Yao et al., 2019) but very few investigated at the same time the surface and sediment microplastic abundances. However the downward fluxes from surface water to the sea bottom is a requirement for our understanding of the input of microplastic to the open ocean. During the Tara – Jambio joint survey, both surface water and sediment are sampled for the quantification of microplastics. Benthic organisms sampled are also taken to assess the ingestion rates of microplastic in the natural community.

The plastisphere in Japanese coastal waters and marine sediment

Microplastics in the oceans get rapidly colonised by various microorganisms. This ecosystem has been recently described as the “plastisphere” (Zettler et al., 2013). Although still limited, a number of studies showed a various community of microorganisms attached to microplastics including virus, bacteria and protists. These fouled microplastic were also found to be more biotoxic than pristine plastic (Wagner et al., 2014) and could alter the physiology and survival of marine organisms or even pose a threat for human health (Lu et al., 2019). Finally, microplastic have been found to travel long distances across oceans (Galgani et al., 2015) and could therefore act as a raft for pathogens (Goldstein et al., 2014; Viršek et al., 2017) or invasive microorganisms (Reisser et al., 2014). It is therefore of utmost importance to document the microbial communities attached to microplastic in order to assess their potential effects on marine ecosystems and human health. During the Tara-Jambio project the microbial communities attached to the microplastics sampled, the plastisphere, are analysed using next generation sequencing targeting prokaryotes and protists. Moreover to assess the difference and potential impact on local biodiversity, environmental DNA is investigated at the sampling locations.

Increase the awareness of the young and general public on the plastic problematic

Governments around the world have taken plastic pollution as a serious threat and it has resulted in an agreement taken by countries of the G20 to reduce plastic pollution. This was certainly due to an increase in media coverage and general public awareness. However education on the threats caused by plastic pollution as well as the solutions for the reduction in plastic usage is still lacking. Moreover plastic pollution can serve as an avenue to outreach concerning other threats to the marine

environment such as climate change, ocean acidification, overfishing, etc. Thus, we organise outreach events targeting children and the general public. Finally, following the lead of previous Tara Océan Foundation projects, we actively collaborate with artists, to explore new avenues of communication.

These aims were divided in four topics:

- Education: Increase awareness on plastic pollution and other threats that oceans are facing
- Topic 1: To assess plastic pollution in Japanese, including both surface and sediment
- Topic 2: To assess "plastisphere" community in japanese coastal waters
- Topic 3: Effects of microplastic on meiofauna under natural conditions

All the data obtained during the project will be uploaded on Zenodo under the Tara Jambio project page: https://zenodo.org/communities/tarajambiomicroplastic/. The data will be freely accessible to anyone following the principle of “open science”.

II. Research Activities in FY2020

1. Fall Campaign - Sampling strategy

Plastic concentration in surface water, sediment and sandy beaches was investigated in six locations in West Japan over 3 to 4 days (Table 2) and in addition the plastic pollution in the sand of a beach in Awashima, Mitoyo City, Kagawa was investigated. At each location, sampling was performed in front of the station, close to an estuary, within the bay where the river outflow and offshore. A total of 67 samples were collected for microscopic analysis, 12 eDNA samples, 6 plastisphere samples were collected and 46 CTD casts and environmental parameters measurements were taken.

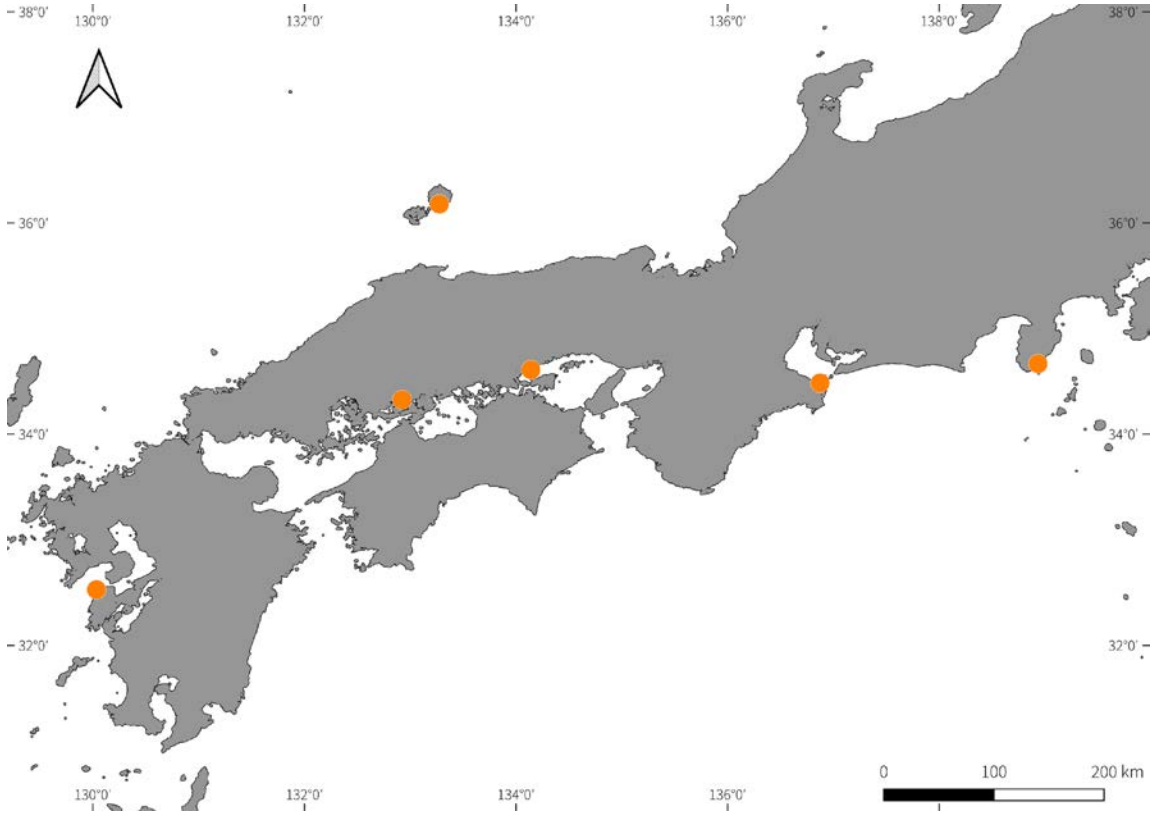

Figure 1: Maps showing the locations surveyed during the 2020 Tara Jambio Campaign.

Table 2: List of the locations sampled and dates

Sampling Location	Date
岡山大学理学部附属牛窓臨海実験所 Okayama University, Ushimado Marine Institute	2020-10-12
広島大学大学院生物圏科学研究科附属瀬戸内圏フィールド科学教育研究センター竹原ステーション Hiroshima University, Takehara station	2020-10-15
島根大学生物資源科学部附属生物資源教育研究センター 海洋生物科学部門 (隠岐臨海実験所) Shimane University, Oki Marine Station	2020-10-19
九州大学理学部附属天草臨海実験所 Kyushu University, Amakusa Marine Station	2020-10-26
Awashima（海洋記念館）香川県三豊市詫間　粟島　TARA OCEAN JAPAN 常設展 Awashima Tara Océan Japan Exhibition	2020-10-30
名古屋大学大学院理学研究科附属臨海実験所＜菅島臨海実験所 Nagoya University, Sugashima Marine Station	2020-11-02
筑波大学下田臨海実験センター University of Tsukuba, Shimoda Marine Research Center	2020-11-19

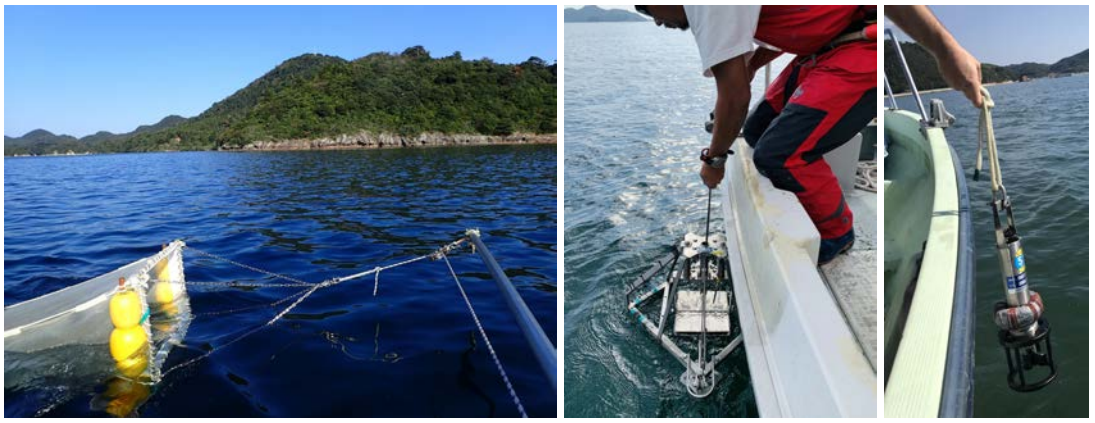

Figure 2: Left: Sampling of surface water microplastics using Neuston net (Oki, Shimane). Middle: Sampling of microplastic in sediment (Ushimado, Okayama). Right: measurements of environmental parameters using CTD (Ushimado, Okayama).

2. Preliminary results

Surface water

All surface water samples (25), were processed until extraction of the microplastics. The determination of the number of plastic and weight is now underway. All samples processed showed the presence of microplastics fragments. Different types of plastic fragments were observed: particles, fibers and films. All samples are checked under white light and UV light (epifluorescence) under the microscope. The pick up of plastic for future determination of polymer and documentation of the size and type of plastic under the microscope takes from one day to one week per sample depending on the number of fragments. A large number of polystyrene fragments were collected.

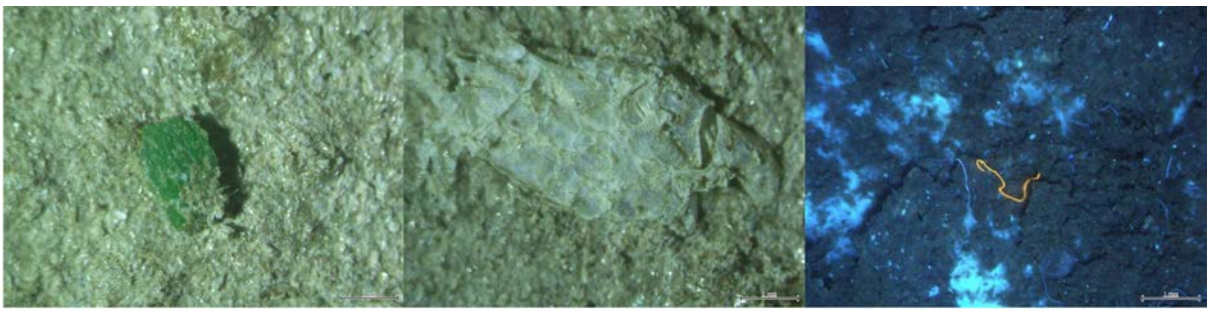

Figure 4: Example of microplastic sampled in Sugashima, Mie. From left to right: plastic particle, plastic film and different polymer types of microfibers under UV light.

Sediment and beach samples

Microplastic of 22 out of the 42 sediment and beach samples were extracted. Count, documentation and pickup is now underway. Similar to surface water, all three (particles, sheet and fiber) were observed. Again similar to surface water, a large number of polystyrene fragments were collected. As numerous discarded fishing gear made of polystyrene were found on all beaches sampled, it is possible that a large portion of the polystyrene microplastic samples come from fishing gears.

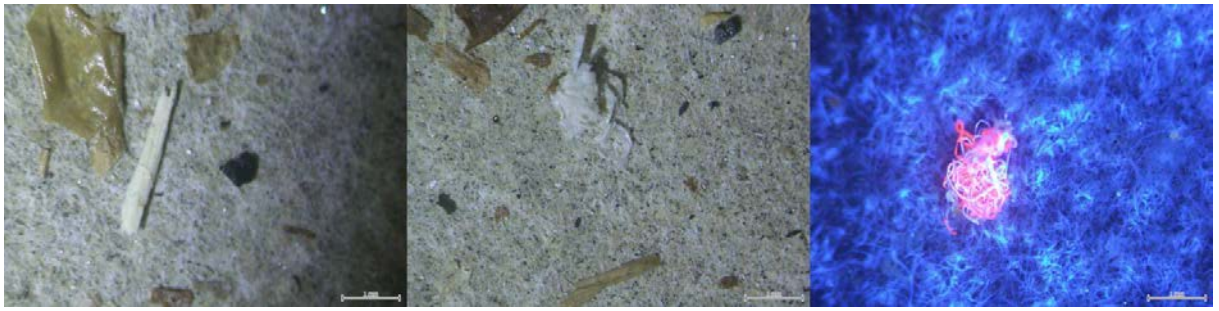

Figure 5: Example of microplastic sampled in Sugashima, Mie. From left to right: plastic particles, plastic film and different polymer types of microfibers under UV light.

Figure 6: Plastic pollution on the beach, polystyrene made fishing gears, polystyrene fragments and plastic fragments used in ostreiculture.

3. Collaboration with artists

During the Fall campaign, an artist or a group of artists joined the sampling. In total, 9 artists joined including musician, poem writer, ceramic artists, etc. The artists participated in the sampling, samples treatment and educational events. An exhibition of the art pieces produced following the sampling campaign is planned to start in April at the Tara Center in Awashima, Mitoyo city, Kagawa Prefecture and the pieces will be exhibited at different venues.

Figure 7: From left to right: Moka TAKEDA and Kanae KAMIKAWA in Amakusa sampling microplastics on the beach, Prof Hibino and Yuya KANAZAWA collecting neuston net samples in Amakusa and Aiko KIYONAKA filtering for environmental DNA in Ushimado.

4. Outreach event

Two events with children were organised during the campaign. Children participated in microplastic sampling in surface water (Neuston net) or on the beach. Outdoor seminars were also given using panels showing the activities of the Tara Océan foundation and threats to the marine environment including plastic pollution.

Figure 8: Left: High school students sorting microplastic from neuston net sample in Oki Island, Shimane. Right: Lecture given on the beach to high school students from Reihoku High School (Amakusa).

Several events for the general public were held during the campaign. These events ranged from beach cleaning, microplastic sampling demonstration, panel exhibitions and seminars

Figure 9: (Left to Right) Demonstration of microplastics on the beach in Takehara and panel exhibition in Takehara and Oki Island.

Figure 10: (Left to Right) Beach cleaning in Takehara, Amakusa and Oki Island

Figure 11: Panel exhibition in Awashima, Kagawa, and images of the panels used.

II. Plan for 2021

Sampling around Eastern Japan will be performed at the following locations during three campaign:

- 東北大学女川臨海実験所 (Tohoku Univ. Onagawa) (July-August)
- 東北大学大学院生命科 学研究科附属浅虫海洋生物学教育研究センター
- (Tohoku Univ. Asamushi) (July-August)
- 北海道大学北方生物圏フィールド科学センター水圏ステーション
- (Hokkaido Univ. Akkeshi) (July-August)
- 金沢大学能登臨海実験所 (Kanazawa Univ.) (September-October)
- 新潟大学佐渡臨海実験所 (Niigata Univ.) (September-October)

Outreach activities will be organised during the different sampling events. The type of events will be determined according covid-19 spread.

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