

## 1. Introduction

We are conducting research on Microplastics (MPs), which has become an international issue. So far, we have conducted coastal surveys and fish feeding surveys in Hiroshima Bay. From the results, we thought that there might be a positive correlation between the MP intake of organisms and the MP density in seawater. From this, we thought that it would be possible to create an index that can mutually estimate the MP intake and MP density in seawater. If such an index can be completed, anyone can easily investigate the MP density in seawater. It is also possible that scientists around the world will use this index to speed up MP research worldwide.

## 2. What are Microplastics

Microplastics are plastics that are 5mm or less due to physical influences such as ultraviolet rays and ocean waves. There is a possibility of adverse effects such as dissolution of harmful chemical substances attached to plastic components and surfaces, and accidental ingestion by living organisms.

## 3. Purpose

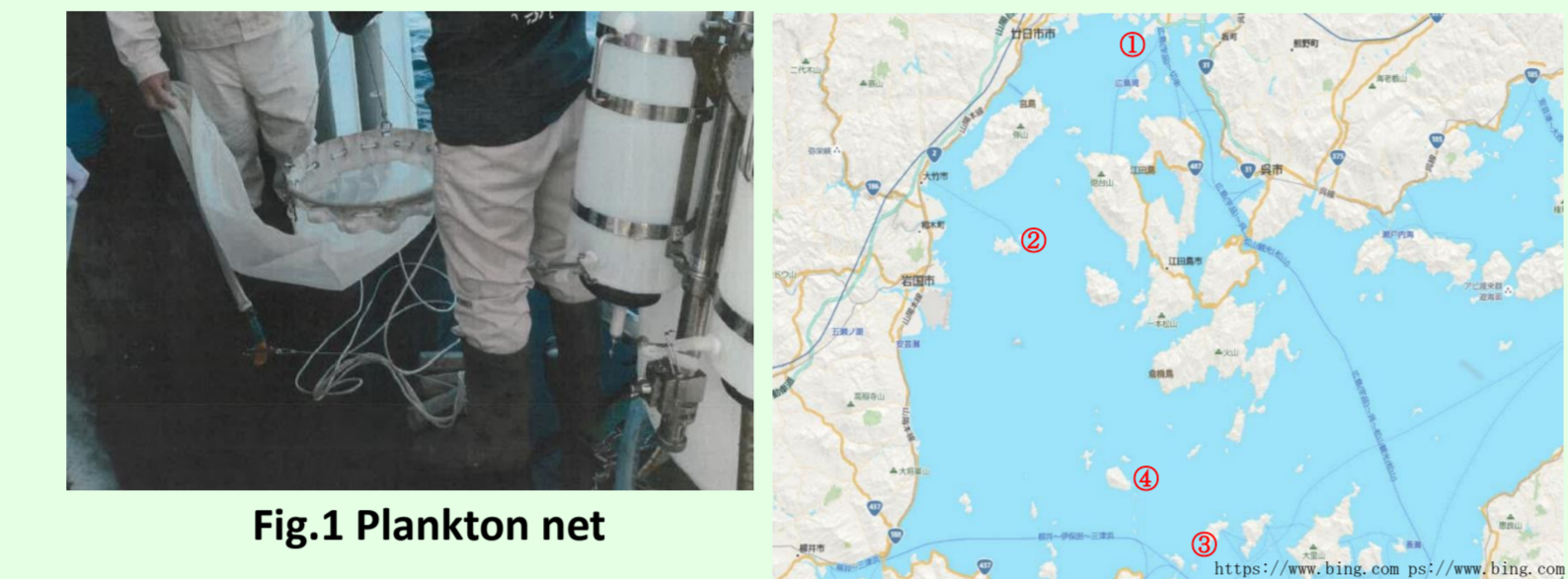
- (I) To investigate the MP density in Hiroshima Bay and the MP feeding status of fish.
- (II) To clarify the relationship between the MPs density in seawater and the number of MPs eaten by crabs and oysters.

## 4. Investigation (I)

(I) MP survey in seawater on research vessel

<Survey date> 2020/9/28 2020/10 / 5-6  
<Survey point>

- ① Ninoshima island ② Atadajima island
  - ③ Nasakejima island ④ Hashirajima island
- Drag Plankton net (Diameter 45 cm) vertically at each of the points (20-35 m) and measure MPs density in seawater.



**Table.1 MPs density (numbers/L)**

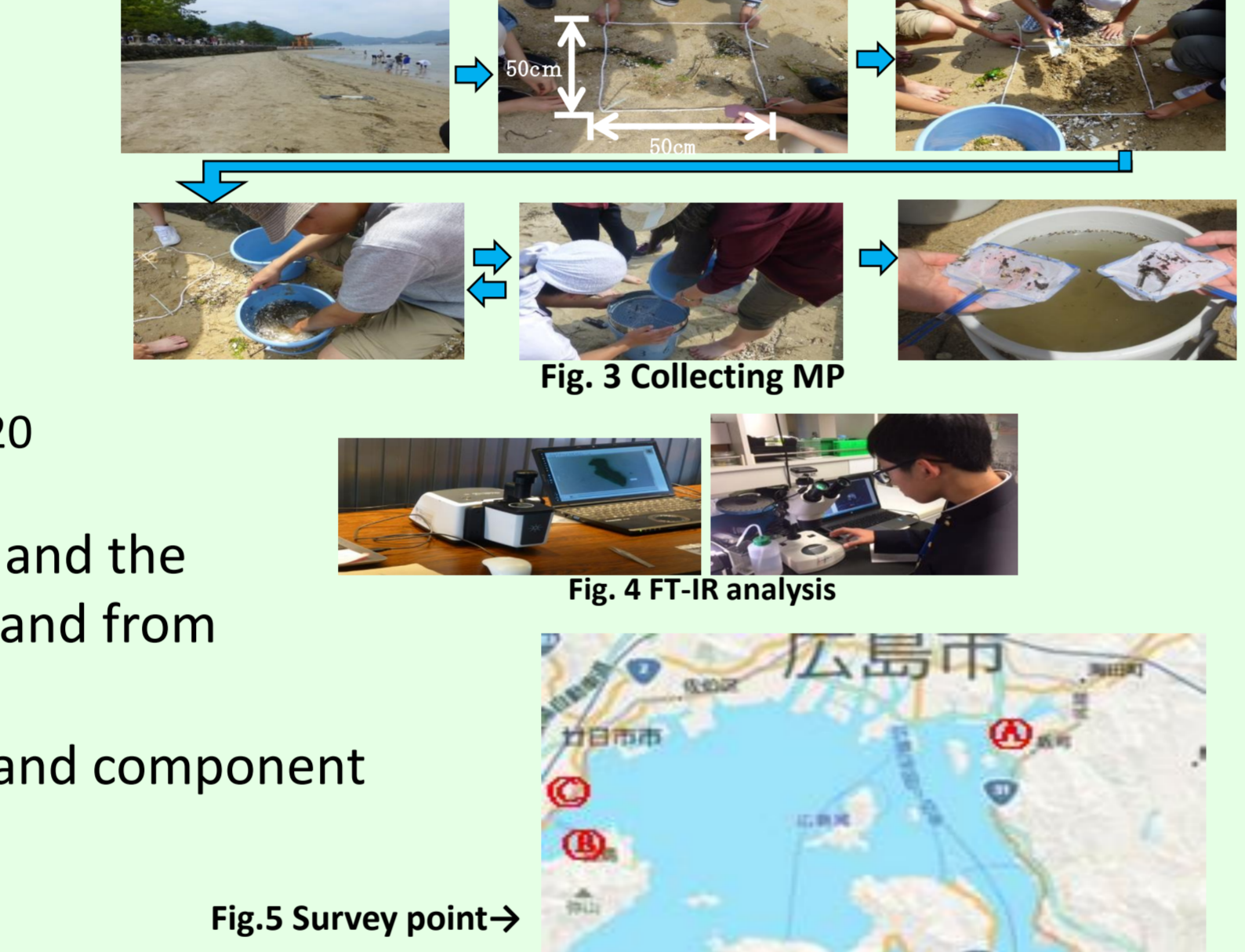
Island	Ninoshima island	Atadajima island	Nasakejima island	Hashirajima island
Density	6.20	0.304	1.01	0.589

## 5. Investigation (II)

(II) Quadrat survey at the coast of Hiroshima Bay

<Survey point and survey date>  
 Ⓐ Heiseigahama beach 2015/6/30  
 Ⓑ Miyajimamaigann beach 2016/8/4, 2017/5/21, 2018/5/20  
 Ⓒ Sennennaigann beach 2019/8/4

- ① The collected sediment was placed in seawater and the difference in density was used to separate the sand from other materials
- ② Classify collected materials by color and shape and component analysis using FT-IR to identify MPs.



**Table.2 Point Ⓐ 2015/6/30**

	Point a	Point b	Point c
Number of plastics	571	8	170

**Table.3 Point Ⓑ 2016/8/4**

	Point a	Point b	Point c
All(numbers)	1110	994	133
Foamed plastic(numbers)	1082	974	126
Hard plastic(numbers)	28	20	7

**Table.4 Point Ⓒ 2017/5/21**

	Point a	Point b	Point c	Point d	Point e	Point f
All(numbers)	245	340	244	3065	1471	474
Foamed plastic(numbers)	245	330	236	3040	1467	466
Hard plastic(numbers)	0	10	8	25	4	8
Dry weight (mg)	10	110	70	470	320	30

**Table.5 Point Ⓒ 2018/5/20**

	Point a	Point b	Point c	Point d	Point e
All(numbers)	941	1037	704	835	565
Foamed plastic(numbers)	895	985	608	760	524
Hard plastic(numbers)	46	52	96	75	41

### 【Discussion I】

- ▶ Ⓐ The amount of hard plastics (blue, black, green) and foam plastics is high. Since there are many rafts in the sea, it is thought that the MP may be caused by the decay of the parts used in the rafts and the styrofoam used for the floats.
- ▶ Ⓑ The number of plastics was greater than in previous years, and most of them were foamed plastics. It is possible that not only the deterioration of the raft, but also the different weather conditions may be the cause.
- ▶ Ⓒ The survey point is a tidal flat that is under the sea at high tide. The reason for the low MPs despite the relatively high amount of debris in the surrounding area may be due to the fact that they were washed out into the seawater at high tide.

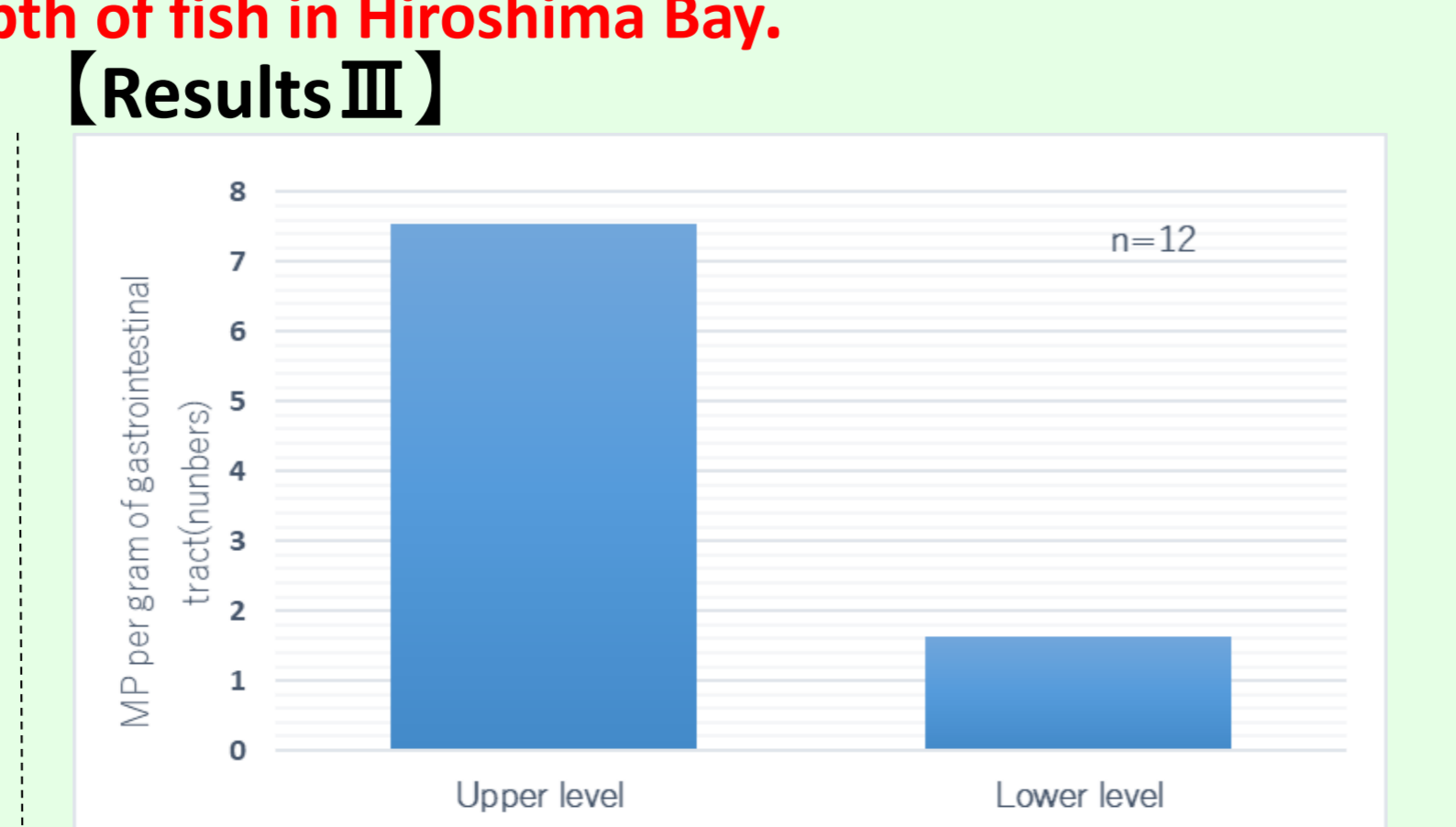
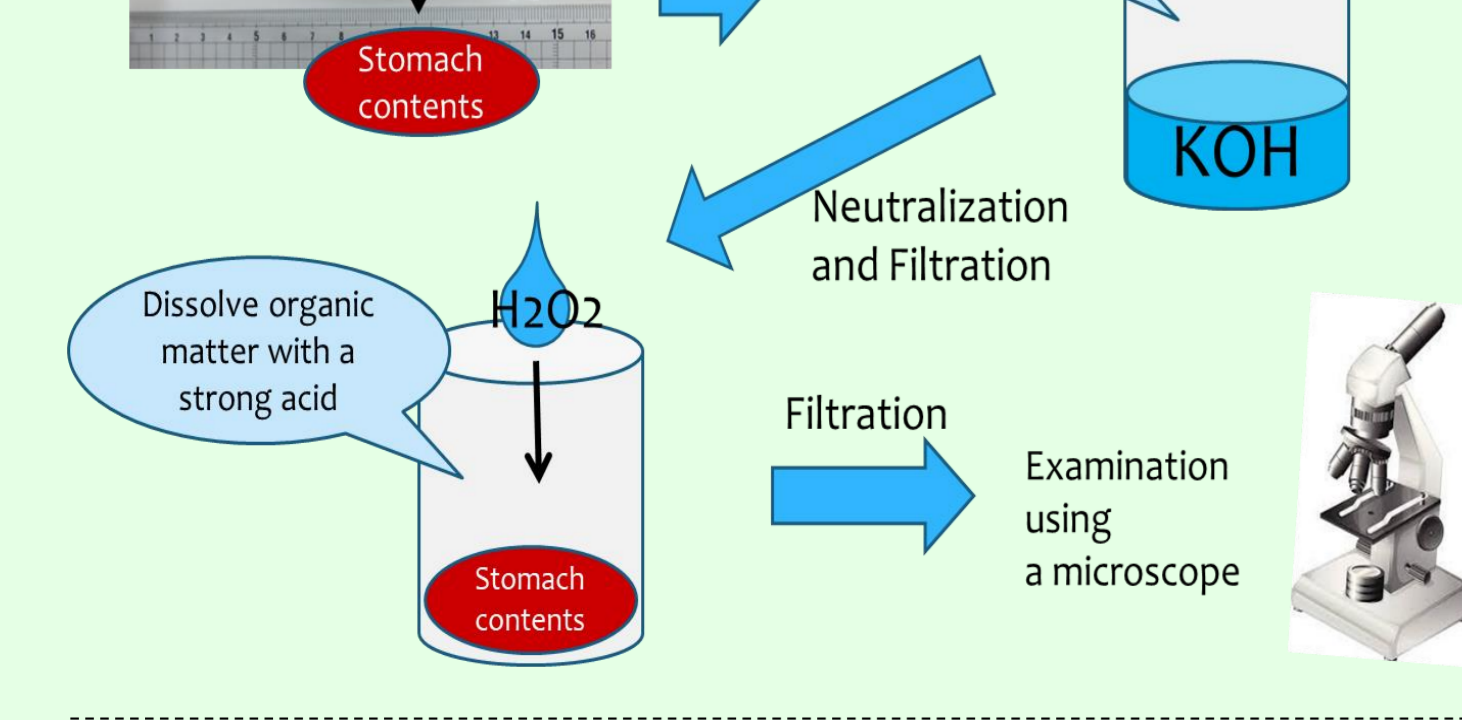
**Table.6 Point Ⓒ 2019/8/4**

	Numbers	Weight
All	2	0.8
Foamed plastic	0	0
Hard plastic	2	0.8

## 6. Investigation (III)

(III) Correlation survey of MP intake, habitat depth of fish in Hiroshima Bay.

【Methods III】



And the upper level fish took in more MPs than the lower level fish.

### 【Discussion II】

- ▶ Anchovy is likely to ingest MPs, so correlation with the amount of MPs in seawater is likely.
- ▶ We thought that it is difficult to recreate the situation of anchovy in the natural world because anchovy is a migratory fish and its ingestion is influenced by a wide migratory road and its habitat.

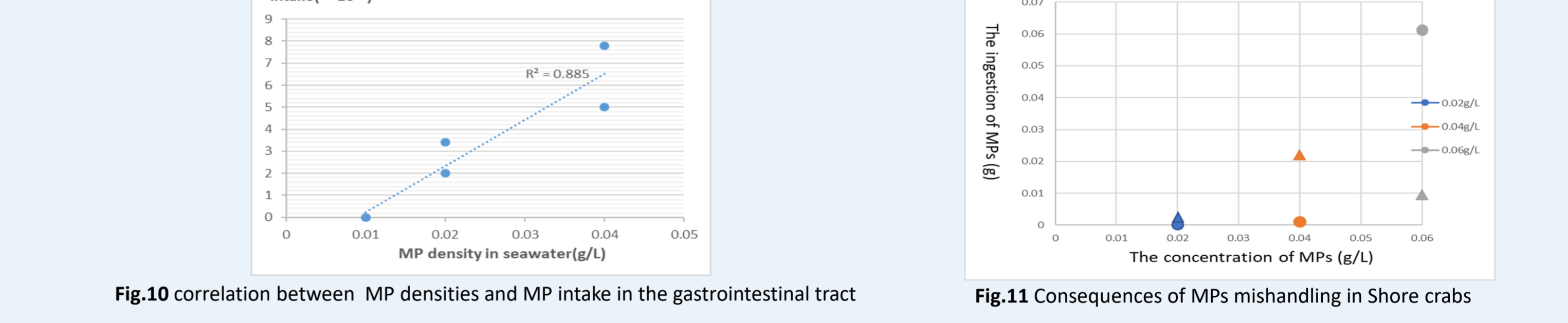
## 7. Experiment (I)

【Methods IV】

- ① Collecting Japanese shore crab (*Hemigrapsus penicillus*) (Fig.8) and shore crab (*Helice tridens*) (Fig.9) from Oota river and Motoyasu river.
- ② Prepare water tanks with different MP densities and put crabs in and let stand for a certain period of time.
- ③ 【Method α】 ✕ using electronic balance to weigh MPs



【Results IV】



### 【Discussion III】

- ▶ A positive correlation was found between MP densities and MP intake in the gastrointestinal tract of Japanese shore crabs, which is likely to be suitable for MP index generation.
- ▶ It has been confirmed that shore crab swallow MPs by mistake. However, a positive correlation was not found between MP densities and MP intake in the gastrointestinal tract, and therefore, shore crabs are likely not suitable for the creation of a pollution environment index.

## 8. Experiment (II)

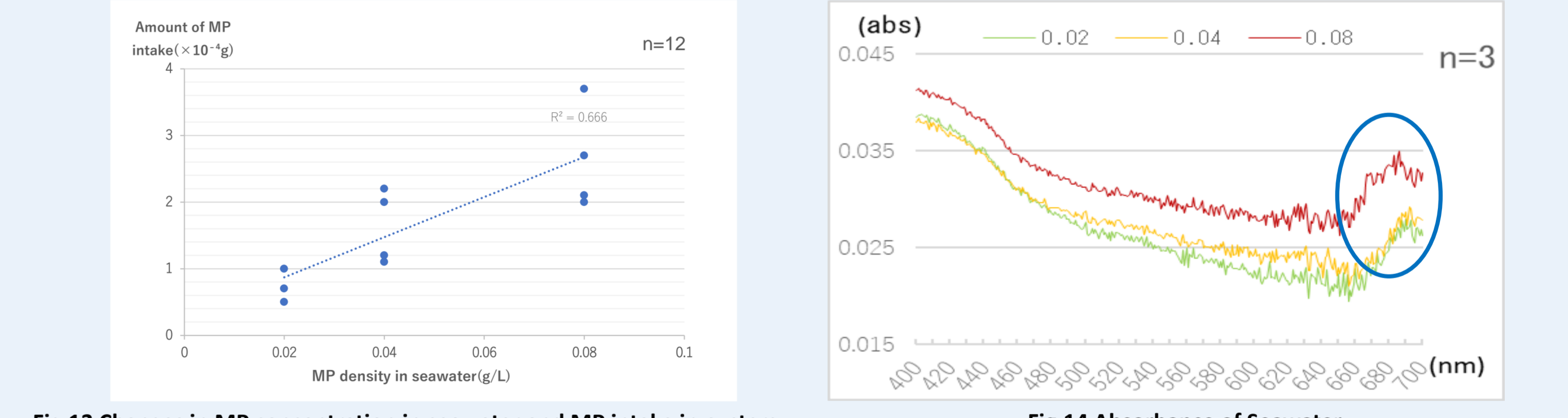
【Methods V】

- ① Collecting oysters (*Crassostrea gigas*) from Hiroshima Bay.
- ② 【Method α】 ✕ using electronic balance to weigh MPs.
- ③ Remove the seawater from the bottle and put it on an absorber

**Table.7 Amount of MP**

Bottle	Chlorella (mL)	MP (g/L)
1	0.1	0.02
2	0.1	0.04
3	0.1	0.08

【Results V】



### 【Discussion IV】

▶ Figure 13 shows that there is a positive correlation between the MP densities in seawater and the number of MPs ingested by oysters.

## 9. Project

Our work is not limited to scientific research; we also run projects, such as Guru Guru Project, that involve local people to solve the problems. In this project, we conduct beach cleanups with local people and present research results to raise awareness. We have continued our exchange with Fukushima Prefectural Futaba Mirai Gakuen High School and participation in the "High School Students' Forum on the Environment of the Seto Inland Sea" organized by Hyogo Prefectural Amagasaki Oda High School, as well as interaction with high school students from other prefectures to address environmental issues.



## 10. Future Research

We would like to continue to conduct surveys and research to create an index that is easy to use around the world and which can contribute to the resolution of the MP problem, which is a global problem. We would also like to contribute to the fundamental solution of the problem through Guru Guru Project and other activities in cooperation with local communities and governments.

## 11. Reference

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