Investigation of Microplastic Contamination in the Rivers of Hiroshima and the Development of Contamination Indices

W201910

Hiroshima Prefectural Hiroshima Kokutaiji High School

1 .Introduction

In recent years, there has been an increase in the awareness of the environmental issue, of microplastics (hereafter referred to as MP) in the ocean. Still, awareness of MP pollution in the freshwater environment seems to be low. According to the "Public Opinion Poll on Environmental Problems" conducted by the Cabinet Office 84.0% of respondents were aware that "plastic waste was thrown away in oceans and beaches". Still, only 59.4% were aware of plastic waste thrown away in rivers, towns, and farmlands". Therefore, to evaluate MP pollution in various freshwater environments, we decided to investigate MP pollution in familiar rivers in Hiroshima and create pollution indices using organisms.

2 ． What are Microplastics (MP)

Plastics which have been fragmented into smaller pieces of less than 5 mm due to physical stimuli such as ultraviolet rays and waves.

3 . Objectives

①Investigate MP pollution levels in the rivers of Hiroshima.
②Identify the feeding habits which are suitable for contamination indicators in freshwater environments.
③Identify the organisms with the most suitable feeding habits for pollution indicators.

4 ． Investigation

We investigated three rivers in Hiroshima.

Survey point
(the rivers in Hiroshima city)
①Kyobashi river
②Motoyasu river
③Kyuota river

【Results】

MP was confirmed in all rivers surveyed.

|	Kyobashi river	Motoyasu river	Kyuota river
Water flow(L)	1130	3100	3400
Total MP	18	5	31
MP（Fertilizer）	6	0	0
MP（Red）	0	0	2
MP（Green）	6	5	24
MP（Blue）	4	0	5
MP（Colorless）	2	0	0
MP（the number of pieces/㎥）	15	1.6	6.1
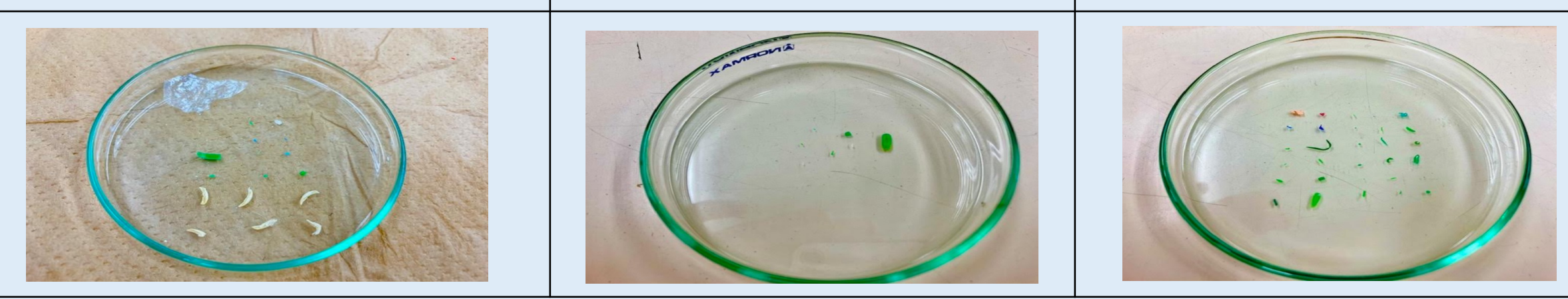
5. Experiment ①

【Hypothesis】

Past research suggests that filter-feeders are suitable pollution indicators for MP in marine environments. Therefore, filtration feeders are also suitable indicators in freshwater environments.
We used freshwater snails（filter feeders, detritivores and grazers） and Semisulcospiras(detritivores and grazers).
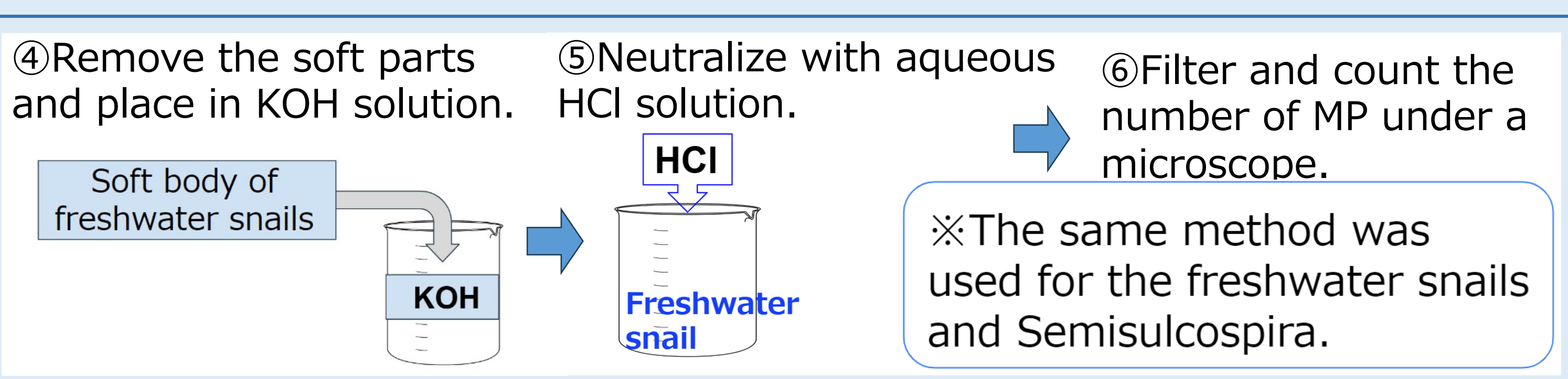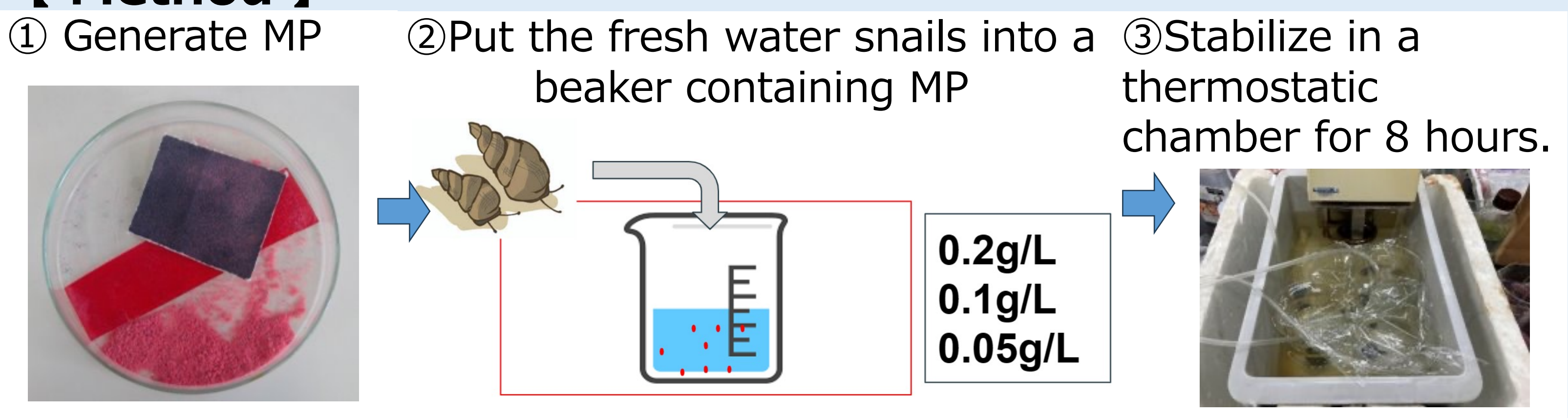↓ Relationship of feeding habits

Freshwater snail   Semisulcospira
Filter feeder
Detritivorous Grazer
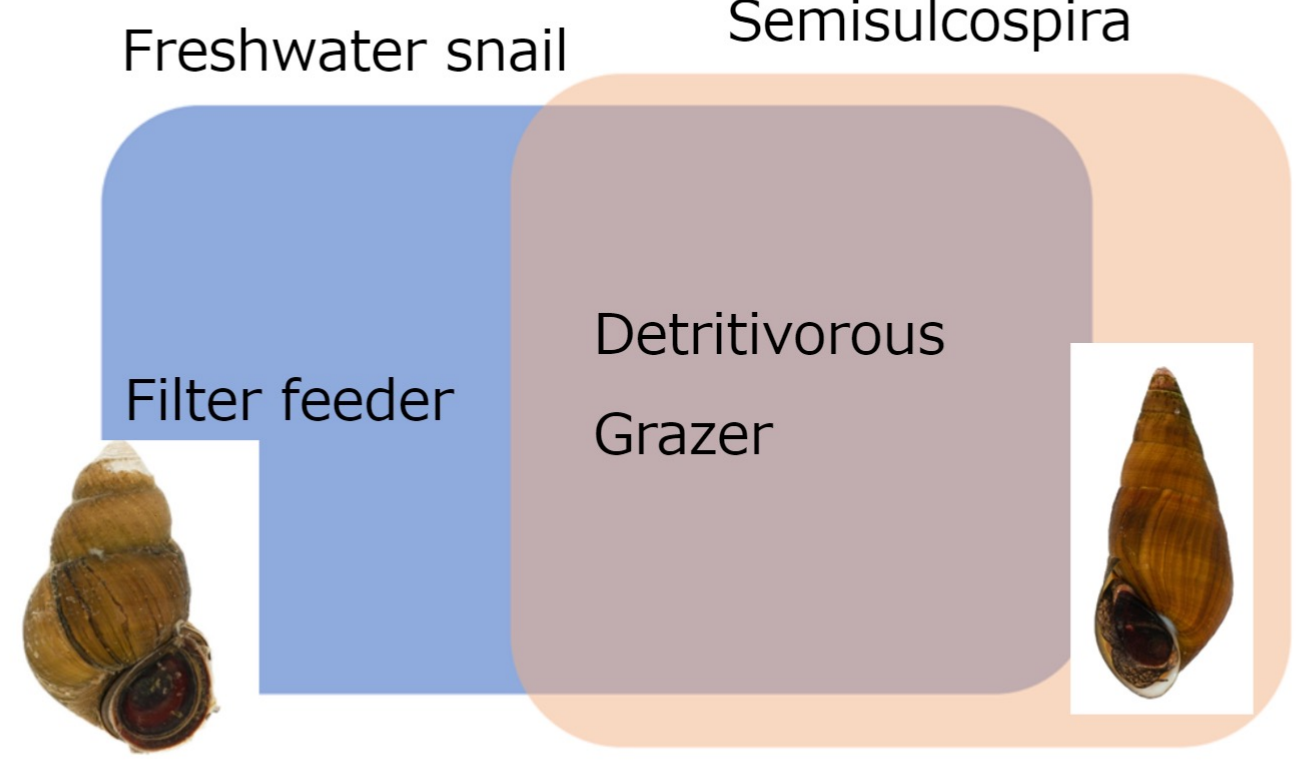
Freshwater snails and Semisulcospira inhabit rivers, lakes, and ponds in various parts of Japan.
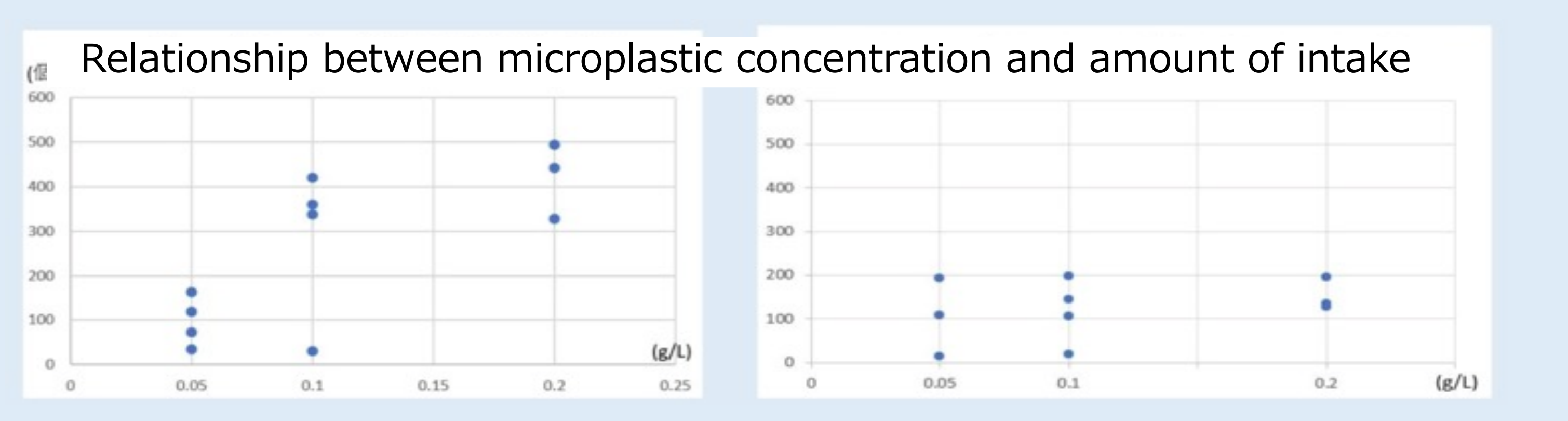
Filter feeding
Food suspended in water is strained out in the body, and ingested.

【 Method 】

① Generate MP
②Put the fresh water snails into a beaker containing MP
③Stabilize in a thermostatic chamber for 8 hours.

0.2g/L
0.1g/L
0.05g/L

④Remove the soft parts and place in KOH solution.
⑤Neutralize with aqueous HCl solution.
⑥Filter and count the number of MP under a microscope.

Soft body of freshwater snails
KOH
HCl
Freshwater snail

※The same method was used for the freshwater snails and Semisulcospira.

【Results】

Significance was checked using a t-test.
Freshwater snails   Semisulcospiras
r=0.75   r=0.29

Relationship between microplastic concentration and amount of intake

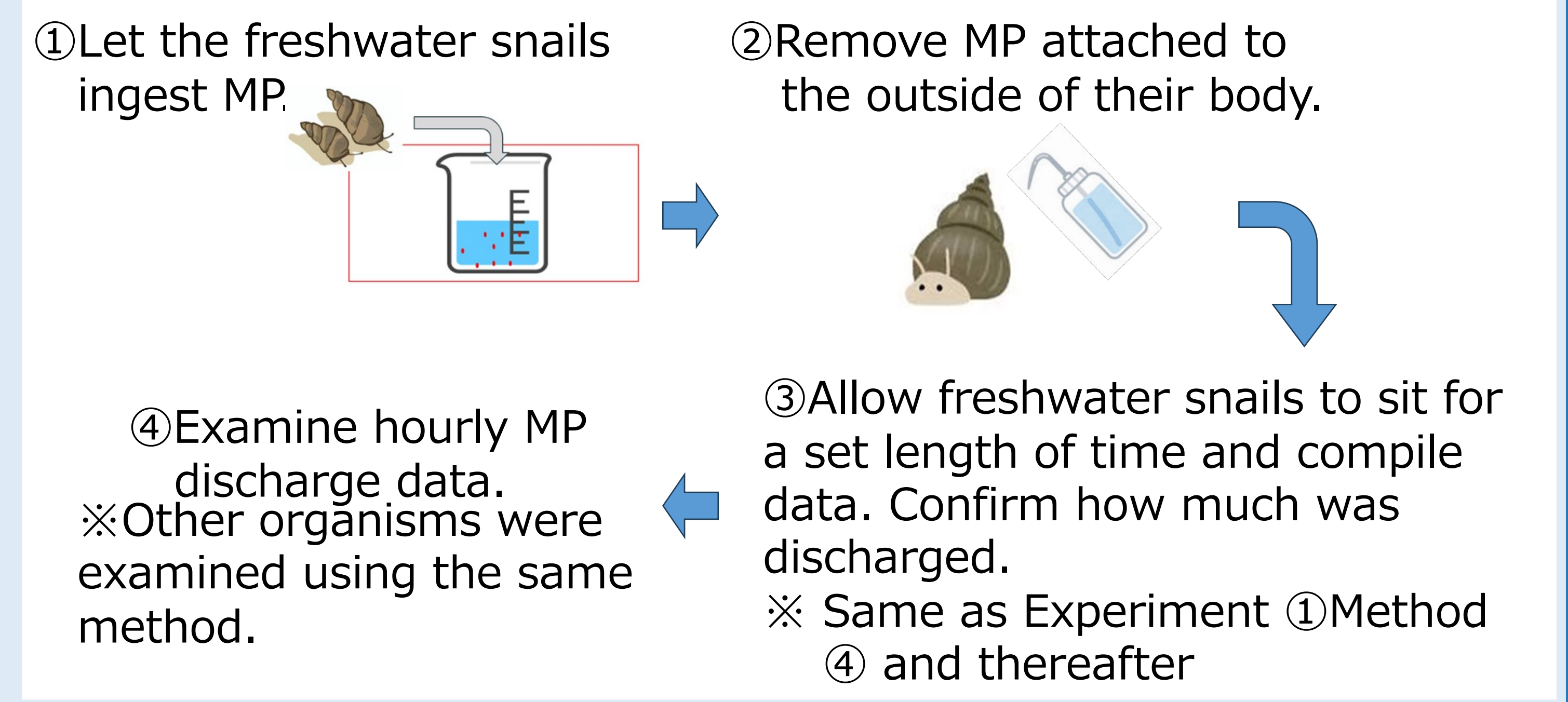Significance was confirmed in freshwater snails, but not in semisulcospira.

【Discussion】

These results indicate that freshwater snails, which are filter-feeding organisms, are more suitable as pollution indicators than semisulcospira. The results suggest that filter-feeding organisms are suitable as pollution indicators.
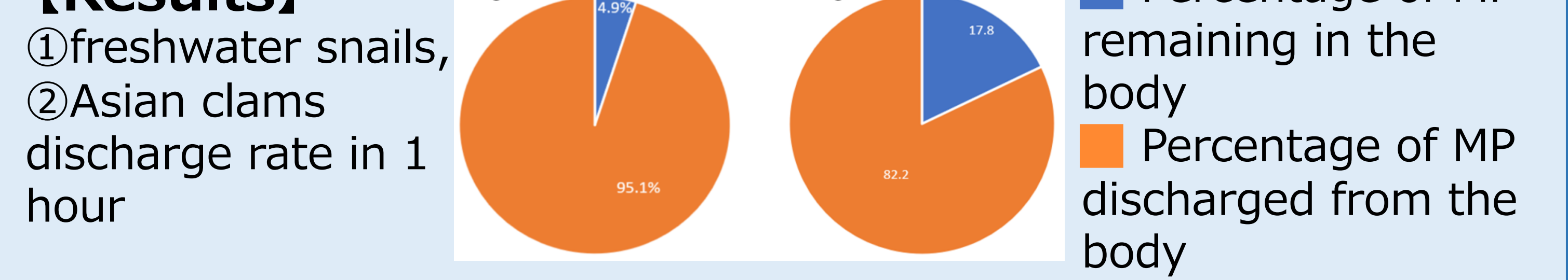
6.Experiment ②

【Hypothesis】

The following experiments were conducted to demonstrate Objective ③. Results II showed that filter-feeding organisms are suitable pollution indicators. Based on this, the extent to which freshwater filtration-feeding organisms such as freshwater snails and Asian clams ingest MP was investigated to determine which organisms are most suitable as pollution indicators.

【Method】

①Let the freshwater snails ingest MP.
②Remove MP attached to the outside of their body.
③Allow freshwater snails to sit for a set length of time and compile data. Confirm how much was discharged.
※ Same as Experiment ①Method ④ and thereafter
④Examine hourly MP discharge data.
※Other organisms were examined using the same method.

【Results】

①freshwater snails,
②Asian clams
discharge rate in 1 hour

Percentage of MP remaining in the body
Percentage of MP discharged from the body

【Discussion】

Most of the MP was expelled from the body of the freshwater snails, whereas the Asian clams expelled less from their bodies. This suggests that the Asian clams may have quantitatively more MP remaining in their body, making it a more suitable pollution indicator. Further studies on other filter-feeding organisms and time-specific emission rates are needed.

7.Future Research

Find filtration feeders other than hydrillas which show high correlations in near-natural (low-concentration) environments. To obtain further data on discharge rates and find suitable organisms to act as more accurate pollution indicators. To investigate the MP pollution status at different sites based on the pollution indicators we have created.

8. References

・「Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods」 Guidlines for Harmonizing Ocean Surface Microplastic Monitoring Methods (env.go.jp)
・広島国泰寺高校、海環境におけるマイクロプラスチック汚染指標の作成   ・中田晴彦、北原 健一、恵良 要一、「淡水・陸域環境のマイクロプラスチック汚染の 実態把握と起 源推定」本文／特集_中田氏他 １４-１８ (jst.go.jp)   ・波部 重久、板垣 博、「カワニナの生態学的研究」、_pdf (jst.go.jp)
・DATA VIZ LAB、回帰分析とは？目的や Excel でのやり方までわかりやすく解説！ 回帰分析とは？目的やExcelでのやり方までわかりやすく解説！ (data-viz-lab.com)
・岸根卓郎 (1966): 理論応用統計学, 養賢堂, pp. 391-394、相関係数のＴ検定 ・内閣府政府広報室、政府広報オンライン、「環境問題に関する世論調査」の概要
    gairyaku.pdf (gov-online.go.jp) ・未来創造サポート https://www.future-creation-support.com/2017/05/29/sdgs-goal15/