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# Meiofaunal biofouling on marine plastic debris during golden tide events: Focus on potentially risky species


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## 1 Abstract



Large amounts of *Sargassum horneri* and marine plastic debris (MPD) were stranded on Naechi Beach, located on the southwestern coast of Korea, during the golden tide event in January 2021. This event highlighted MPD's role as a vector for dispersing meiofaunal biofouling organisms, including invasive or parasitic species. To investigate such meiofaunal biofouling, this study collected and categorized foreign-sourced MPDs according to polymer types: polyethylene (PE), polypropylene, polyvinylchloride (PVC), polyethylene terephthalate (PET), and others. Morphological identification and DNA metabarcoding characterized meiofaunal biofouling (40–1,000 µm) associated with the MPD, identifying 14 taxa from 6 phyla and 169 species from 12 phyla, respectively. The integrated abundance was 19–118 ind. 0.1 $m^{-2}$, with an average of 76 inds. 0.1 $m^{-2}$. PVC (containers and shoes) showed the highest abundance, and PET (bottles) exhibited the lowest abundance. Notably, the larvae of invasive species *Ciona intestinalis* (tunicate) and parasitic platyhelminthes *Plagiorchis maculosus* were found on PET (bottles), while the invasive species *Ficopomatus enigmaticus* (Annelida) and parasitic nematode *Spinitectus macrospinosus* were found on both PET (bottles) and PE (containers and buoys). Accordingly, MPD-induced species may facilitate the introduction of harmful species into new habitats. Despite being less abundant, PET (bottles) may pose greater ecological risks than PVC (containers, shoes) because of its stronger association with invasive and parasitic species. Thus, PET and PE may threaten new habitats more than PVC during golden tide events. These findings indicate that MPD accompanying golden tides can facilitate long-distance dispersal of invasive and parasitic meiofauna, elevating ecological risks to newly colonized coasts.

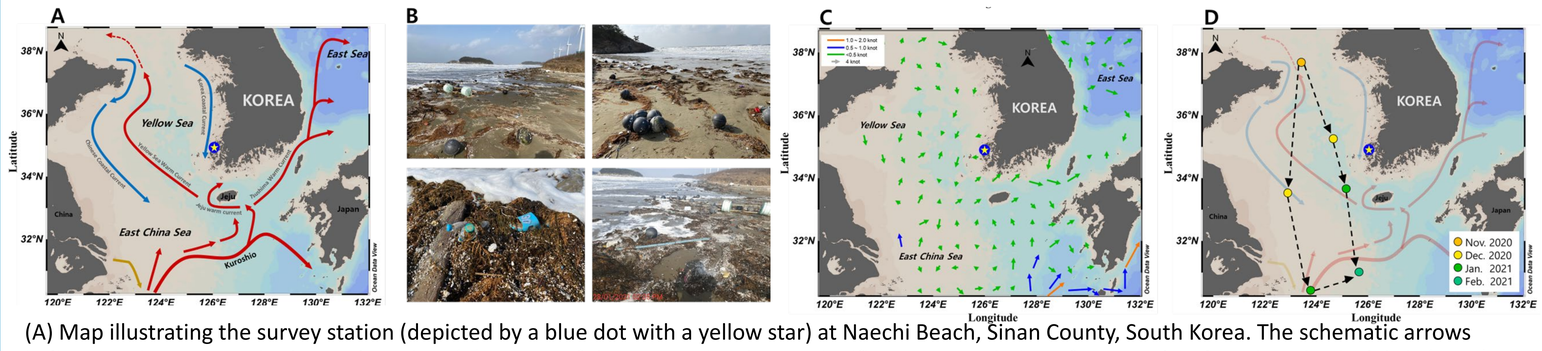

## 2 Background

1. Golden tides transport rafting substrates over long distances enabling species dispersal
2. MPD persists and rafts with *Sargassum* which is could be a potential pathway for non-native/parasites
3. There is a gap in the evidence for meiofaunal on MPD by polymer types

## 3 Objectives

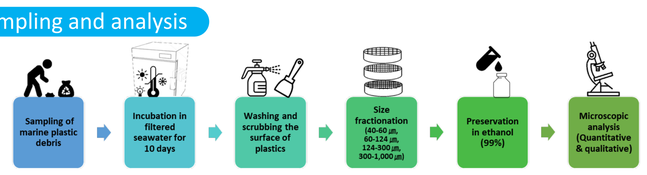
1. Quantify abundance and diversity of meiofaunal biofouling on common MPD polymers (PE, PP, PVC, PET)
2. Detect harmful taxa (invasive/parasitic) and their polymer associations
3. Provide risk-based guidance for MPD management during golden tide events

## 4 Methods and Materials

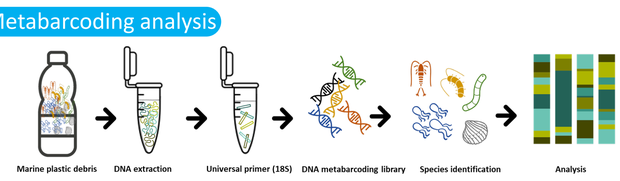



(A) Map illustrating the survey station (depicted by a blue dot with a yellow star) at Naechi Beach, Sinan County, South Korea. The schematic arrows indicate major currents in the study region. (B) Images of the survey site show a significant accumulation of seaweed and marine plastic debris (MPD). (C) Schematic diagram of surface geostrophic currents from the Korean Hydrographic and Oceanographic Agency (KHOA). (D) Changes in major locations of *Sargassum* blooms from November 2020 to February 2021, with circles indicating the centers of major blooms and arrows representing the inferred drifting path, were redrawn from Wang et al. (2023).

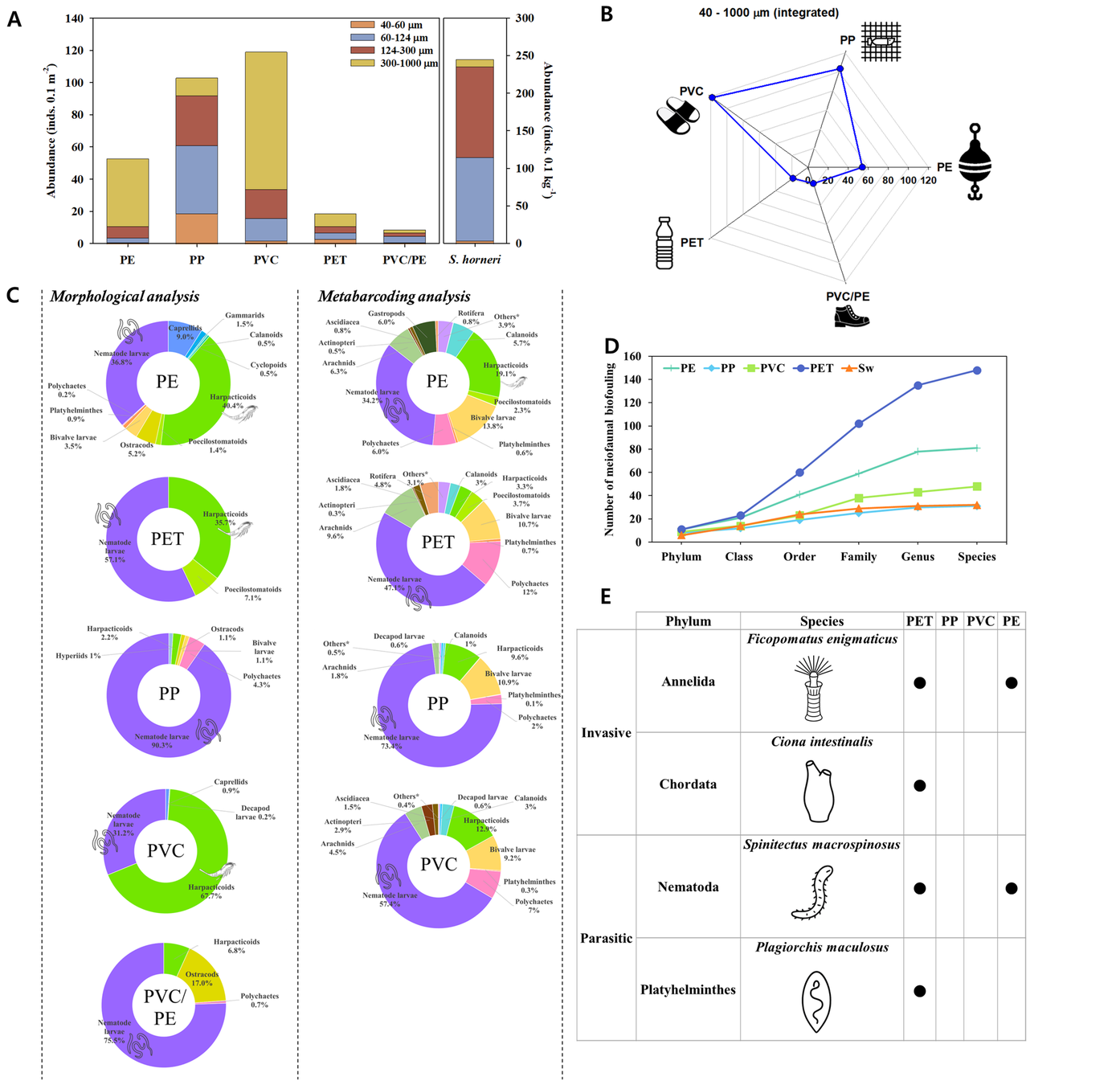
### Sampling and analysis




### Metabarcoding analysis




## 5 Results and Discussion




| | Phylum | Species | PET | PP | PVC | PE |
|---|---|---|---|---|---|---|
| Invasive | Annelida | *Ficopomatus enigmaticus* | ● | | | ● |
| | Chordata | *Ciona intestinalis* | ● | | | |
| Parasitic | Nematoda | *Spinitectus macrospinosus* | ● | | | ● |
| | Platyhelminthes | *Plagiorchis maculosus* | ● | | | |

(A) Abundance of meiofaunal biofouling according to size groups (40–60 µm, 60–124 µm, 12 –300 µm, and 300–1,000 µm) across different polymer types of MPD, including polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). (B) Integrated abundance (40–1000 µm) of meiofaunal biofouling across the same polymer types. (C) Relative abundance of meiofaunal biofouling taxa associated with each polymer type for morphological and metabarcoding analysis.

## 6 Take-home messages

- MPD carried diverse meiofaunal biofoulers (40–1,000 µm); metabarcoding revealed 169 spp., 12 phyla
- Harmful taxa detected: *Ciona intestinalis*, *Ficopomatus enigmaticus*, *Plagiorchis maculosus*, *Spinitectus macrospinosus*
- Risk is polymer-specific: PET & PE hosted invasive/parasites despite lower abundances than PVC
- Management: prioritize PET/PE removal at *Sargassum* accumulation sites; monitor biofouling on MPD