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# PRESENCE OF MICROPLASTICS IN THREE SPECIES OF MARINE SHRIMP FROM THE FAMILY PENAEIDAE IN THE GULF OF CALIFORNIA, MEXICO

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## Background & Objective

Given the impact of microplastics (MPs) on marine organisms and the significance of fisheries resources in the Gulf of California, it is crucial to assess the presence of these particles in our fisheries resources.

**Objective:** This study assesses the occurrence of MPs in three commercially and ecologically important species in this marine region: brown shrimp (*Penaeus californiensis*), blue shrimp (*P. stylirostris*), and white shrimp (*P. vannamei*).

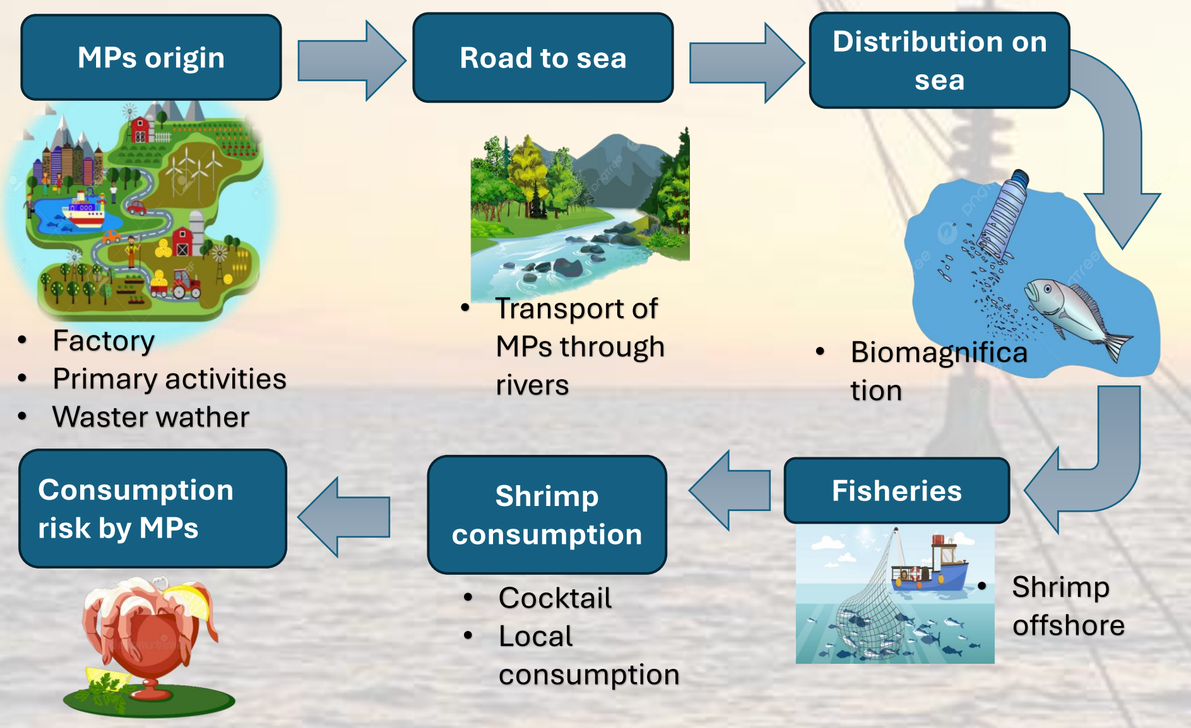



**Figure 1.** Environment, microplastics, resources, and consumers

## Methodology

**Sampling:** Organisms were captured during the fall of 2024 along the northern coast of Sinaloa.

**Extraction:** MPs were extracted via oxidative digestion of shrimp digestive tracts with $H_2O_2$.

**Analysis:** Particles were visualized via optical microscopy and classified according to color, shape, and size. The polymer composition has been analyzed using FTIR-ATR.

**Statistics:** The number of MPs was evaluated and compared across species using ANOVA tests, in addition to a dominance classification analysis (Olmstead-Tukey).

## Key results

- A total of 63 organisms were collected across four hauls.
- Organism lengths ranged from 14 to 23 cm, and weights ranged from 18.8 to 45.2 g.
- The incidence of MPs in the organisms was 100%, yielding a total of 665 items.
- The number of particles did not show significant differences across the three species ($p>0.05$; Table 1).

**Table 1.** Abundance and distribution of microplastics (MPs) per individual in *Penaeus californiensis*, *P. stylirostris*, and *P. vannamei* from the Gulf of California.

| Category | Species | *P. vannamei* | *P. stylirostris* | *P. californiensis* | *p-value* |
|---|---|---|---|---|---|
| | Total #MPs | 16.1±2.3 | 16.4±1.9 | 13.1±2.2 | ($p\geq0.05$) |
| Organs | Hepatopancreas | 3.7±0.4 | 2.7±0.5 | 3.6±0.7 | ($p\geq0.05$) |
| | Intestine | 6.1±1.2 | 9.5±1.7 | 6.9±1.7 | ($p\geq0.05$) |
| | Stomach | 7.1±1.5 | 5.7±1.3 | 6.0±0.7 | ($p\geq0.05$) |
| Color | Black | 8.7±1.7 | 10.3±2.2 | 8.1±2.0 | ($p\geq0.05$) |
| | Clear | 8.4±2.6 | 5.7±1.0 | 7.6±1.3 | ($p\geq0.05$) |
| | Blue | 2.4±0.6 | 2.7±0.5 | 2.3±0.5 | ($p\geq0.05$) |
| Shape | Fiber | 16.1±2.3 | 16.1±1.9 | 13.1±2.2 | ($p\geq0.05$) |
| Size (mm) | 0.12-1.37 | 8.0±1.2 | 9.0±1.1 | 10.8±2.1 | ($p\geq0.05$) |
| | 1.37-2.63 | 8.3±1.6 | 8.2±1.8 | 4.5±0.3 | ($p\geq0.05$) |
| | 2.63-3.89 | 3.7±1.0 | 3.0±0.7 | 4.3±0.6 | ($p\geq0.05$) |
| | 3.89-5.13 | 1.5±0.2 | 1.6±0.4 | 1.5±0.5 | ($p\geq0.05$) |

Different subscript letters within the same row indicate significant differences (*one-way* ANOVA, *p-value 0.05*). Mean±standard error.

The black, blue, and clear color MPs have been dominant (Figure 2A).

Fiber shape MPs have been dominant (Figure 2B).

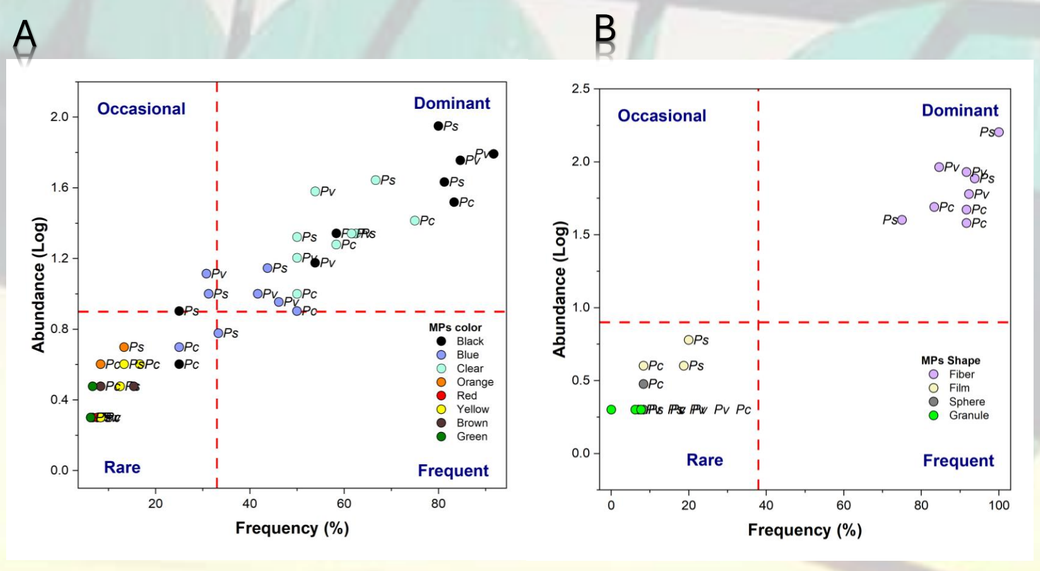



**Figure 2.** Olmstead-Tukey quadrant analysis illustrates the ecological relevance of microplastics (MPs) based on color (**A**) and shape (**B**) in three species of penaeid shrimp collected from the Gulf of California. ***Ps*** (*Penaeus stylirostris*), ***Pc*** (*Penaeus californiensis*), and ***Pv*** (*Penaeus vannamei*). Axes represent frequency of occurrence and relative abundance for dominance classification. **Source:** Author's own work.

The spectroscopic analysis confirmed the prevalence of polyurethanes (characterized by isocyanate functional groups) at 45%, followed by polyvinyl ketones (36%) and poly(acrylamide/amide)s (18%). All spectra exhibited a match higher than 70% with the polymer reference databases (Figure 3B).

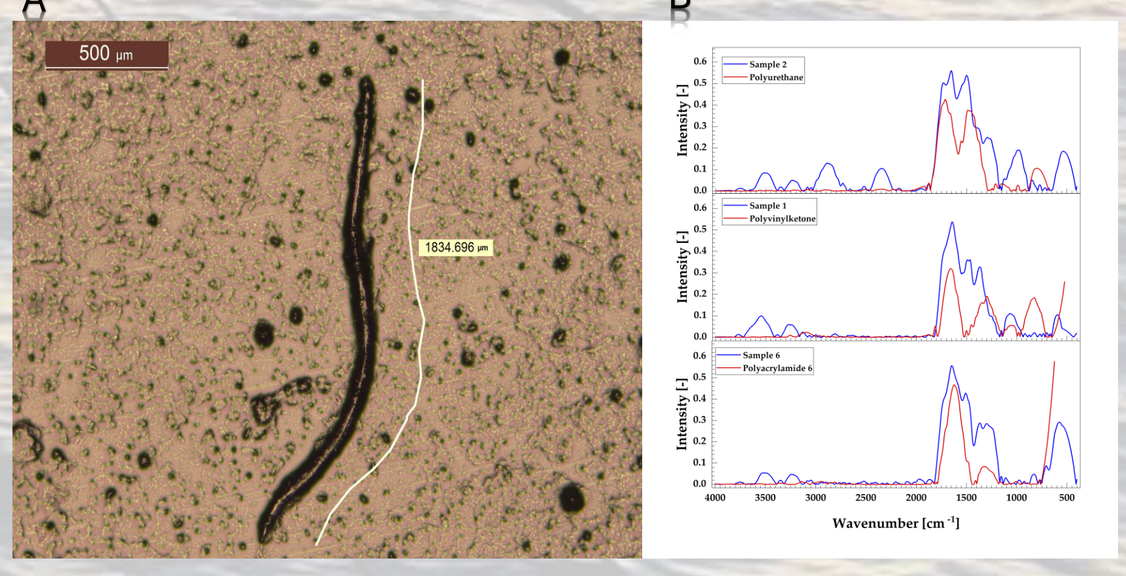
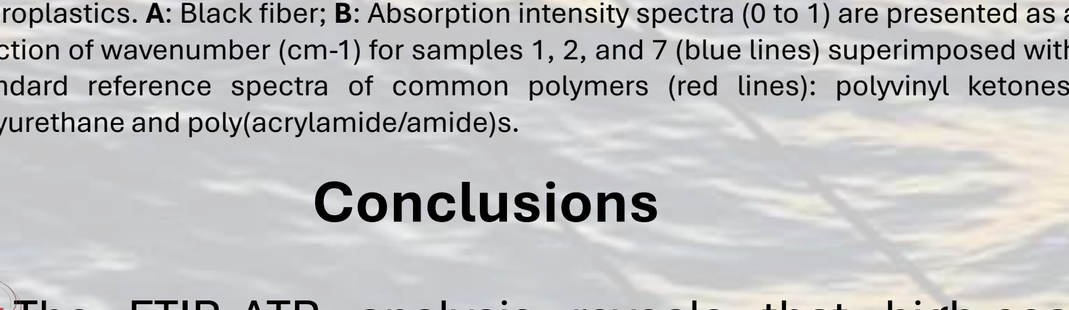



**Figure 3.** FTIR-ATR spectral fingerprint analysis of unknown environmental microplastics. **A**: Black fiber; **B**: Absorption intensity spectra (0 to 1) are presented as a function of wavenumber (cm-1) for samples 1, 2, and 7 (blue lines) superimposed with standard reference spectra of common polymers (red lines): polyvinyl ketones, polyurethane and poly(acrylamide/amide)s.

## Conclusions

- The FTIR-ATR analysis reveals that high-seas contamination stems from industrial and nautical sources, rather than local aquaculture.
- The pervasive presence of microplastics in commercial species urgently demands the expansion of spatial monitoring programs.



- It is a priority to improve agricultural and fishing waste management, particularly by recovering derelict fishing gear.
- Sustainable solutions require involving coastal populations to ensure their food security and protect their biocultural heritage.