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Research Article

Microplastic Contamination in Commercially Important Bivalves of Sorsogon Bay, Philippines

Sarina Mae Bien Arciga[1,*], Charmaine Ardales Malonzo[2], Kenneth Nabor Ballaran[1]

[1] *Bicol University Tabaco, Albay, Philippines*
[2] *Biology Department, College of Science, Bicol University, Legazpi, Albay, Philippines*

*Corresponding Email: smbarciga@bicol-u.edu.ph

Abstract

Sorsogon Bay, a key fishing ground in the Philippines, is known for its commercially important bivalve species: *Perna viridis*, *Atrina pectinata*, and *Paphia undulata*. Despite their ecological and economic value, limited research has been conducted on microplastic contamination in bivalves harvested from this area. This study aimed to assess the abundance and types of microplastics in commercially important bivalves (*P. viridis*, *A. pectinata*, and *P. undulata*) from Sorsogon Bay, Philippines. Commercial bivalve samples were randomly collected, digested with 10% w/v potassium hydroxide (KOH) solution, filtered (8 µm), and examined under a compound microscope. Suspected microplastics were confirmed via hot needle tests and Fourier transform infrared (FTIR) spectroscopy and then classified by type. Fragments (70.1%) were most common, followed by fibers (18.4%) and pellets (11.5%), with *P. viridis* showing the highest mean abundance (0.44 items individual^{-1}). There were 0.07 and 0.06 items individual^{-1} for *P. undulata* and *A. pectinata*, respectively. Polypropylene (53%), polystyrene (38%), and polyacrylamide (9%) were the dominant polymers. These findings highlight significant microplastic contamination in bivalves and the need for better pollution management to ensure seafood safety.

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Introduction

Microplastics, which are defined as plastic particles smaller than 5 millimeters, have become more pervasive in aquatic ecosystems. These particles originate from the degradation of larger plastic debris (secondary microplastics) and from primary sources such as synthetic polymers from personal care products (primary microplastics) [1]. Both primary and secondary microplastics leach from refuse sites and waterways and contribute to total microplastic contamination in the aquatic environment. Microplastics can also carry harmful chemicals, such as persistent organic pollutants (POPs), which can be transferred to humans through the consumption of contaminated seafood [2–3]. The proliferation of microplastics in marine environments poses substantial risks to aquatic organisms, causing physical harm such as gastrointestinal blockage and reduced feeding efficiency [4–5]. Microplastics have emerged as a prevalent environmental concern, and their ubiquitous presence in aquatic ecosystems poses significant threats to aquatic life, including bivalves.

Bivalves are particularly vulnerable to microplastic pollution due to their filter-feeding nature, which can lead to the ingestion and accumulation of these tiny plastic particles [6]. Research is needed in regions such as the Philippines, where commercially important bivalves serve as dietary staples and sources of livelihood for locales. Given their role in the local diet, understanding microplastic contamination in bivalves is directly linked to food safety and public health. Therefore, understanding the extent of microplastic contamination is an essential step toward crafting strategies to mitigate the impacts of this pollution and ensure that bivalves are safe for protecting the health of consumers.

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Sorsogon Bay in the Bicol Region, Philippines, is a vital fishing ground in the country and is home to commercially important bivalves, particularly carpet shells (*P. undulata*), green mussels (*P. viridis*), and pen shells (*A. pectinata*), known locally as *baduy*, *tahong*, and *baloko*, respectively. The extent of microplastic contamination in these bivalves remains largely unexplored. Only two existing studies of microplastic contamination in Sorsogon Bay have identified microplastic contamination in both surface water and bivalve tissues, particularly mussels [7–8]; however, comprehensive studies that focus specifically on commercially important bivalves are needed. Therefore, this study marked an attempt to quantify microplastics found in the tissues of commercially important bivalves in Sorsogon Bay, specifically, to assess the abundance of microplastics in *P. viridis*, *A. pectinata*, and *P. undulata* and characterize the microplastics recovered from the sampled bivalves. This study aimed to establish a clearer understanding of microplastic contamination and its potential implications for food safety.

Materials and methods

This study involved a systematic process for sampling and analyzing bivalves from Sorsogon Bay to investigate the presence of microplastics. The following steps were taken:

1) Study area and sample collection

Three species of bivalves from Sorsogon Bay, Philippines, were collected for this study in February 2023 with the help of local fishermen. The bivalves were *Perna viridis* (green mussels/tahong), *Atrina pectinata* (Pen shell/baloko), and *Paphia undulata* (carpet shell/badoy). Three sampling stations were chosen—Bucal-Bucalan, Rompeolas, and Casiguran (Figure 1)—due to the large number of harvested farmed bivalves in the area and their proximity to possible pollution sources, such as fishing ports and residential areas. Approximately 50 individual samples per species (Figure 2) were collected at each station. All bivalve samples were washed with distilled water to remove externally adhered plastics before being stored in a freezer for further analysis.

2) Morphometric measurement

Prior to measurement, the individual shells were allowed to air dry to remove excess water. Morphometric data, such as shell length, shell width, flesh weight, and total weight (shell and flesh), were measured for each individual bivalve via a Vernier caliper and analytical balance before being frozen to prevent sample shrinkage.

Figure 2 Bivalve species collected from Sorsogon Bay from the left: *P. viridis, A. pectinata*, and *P. undulata.*

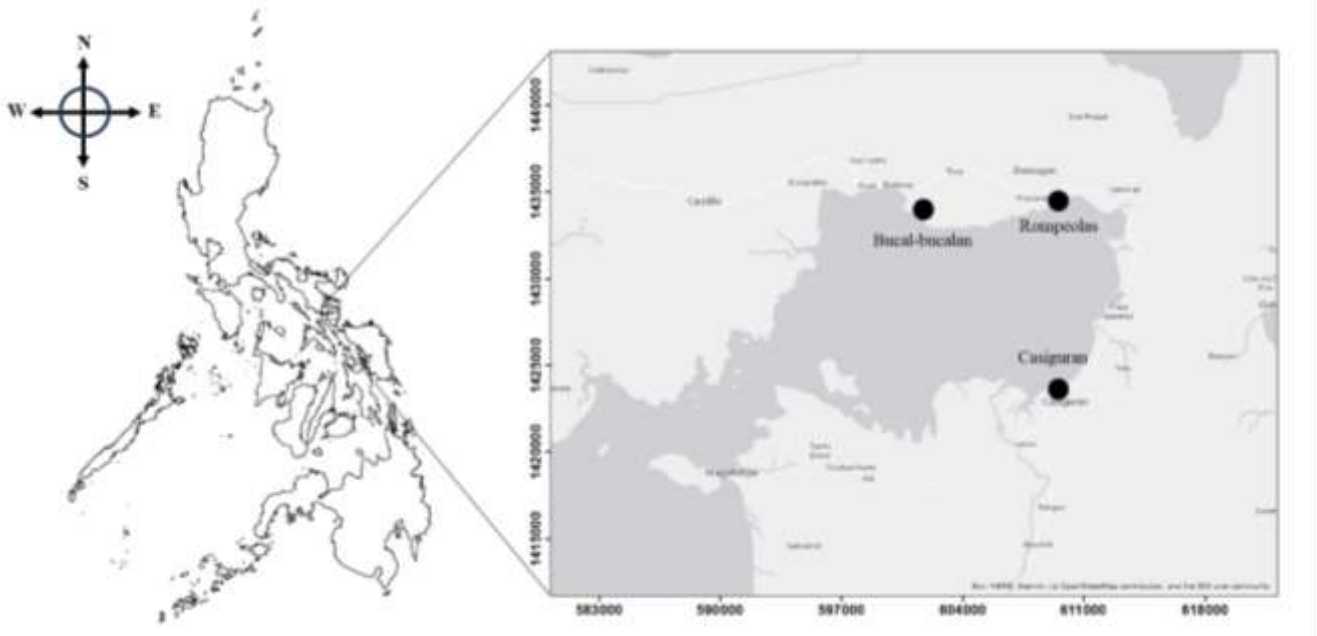

Figure 1 Sampling stations for the three bivalve groups. The map shows that the bay runs through various municipalities in the province. The samples were obtained in areas along the coast.

3) Sample processing

The next step involved the dissection of the bivalves and isolation of their soft tissues. All individual samples were subsequently digested with a 10% w/v KOH solution [9]. The samples were left for up to 48 hours at room temperature until all the tissues were completely digested. After digestion, density separation was performed to isolate the microplastics from the remaining sample matrix via a concentrated sodium chloride (NaCl) solution. The digested sample was transferred into a 500 mL separation funnel, and 100 mL of NaCl solution was added. The mixture was stirred gently with a glass rod to ensure proper dispersion of the particles. The funnel was then left undisturbed for 24 hours to allow denser nonplastic materials to settle while the microplastics remained suspended in the supernatant. After settling, the supernatants containing floating microplastics were decanted and filtered through Whatman Grade 2 (8 µm) filter paper with the assistance of a vacuum pump. This filtration process aimed to collect putative microplastics on filter paper.

4) Microplastic identification and verification of plastic fragments

The collected materials on the filter papers were air dried on a glass Petri dish with a cover and manually observed under a compound microscope to determine their types (fragments, pellets, fibers, spheres, or films) on the basis of the characteristics explained in [10]. Owing to the absence of micro-Fourier transform infrared (FTIR), all suspected particles on the filter paper underwent a hot needle test as an initial screening tool with the aid of a compound microscope to confirm its plastic nature. Plastic particles typically melt, deform, or stick to the needle upon contact with heat [11]. Those particles that did not react with the hot needle were excluded. The positively identified microplastics were subsequently counted per sample, and to ensure completeness of the data and to provide a more comprehensive picture of the polymer types, all the recovered putative microplastics 500 µm above were subjected to FTIR spectroscopy analysis via a PerkinElmer Spectrum 2 spectrophotometer to identify their nature. This approach ensured accurate polymer identification for the detectable fraction of microplastics in the samples. FTIR spectra were recorded through 128 scans over the spectral range of 650–4,000 cm^{-1}. The polymer types were compared with a software library, and a hit index of at least 70% was considered acceptable. The amount of microplastics was expressed as the number of particles per individual and the wet weight of the tissue.

5) Quality control

Dissection was conducted in a controlled environment (fume hood with no air circulation) to avoid contamination of the samples. In addition, the work surfaces were thoroughly cleaned, and all the laboratory tools used were washed with distilled water. As a means to ensure the reliability and accuracy of the findings, a positive control with spike samples of ten pieces each of cut-out polypropylene (PP) and polyethylene (PE) were also prepared for each of the three species and were analyzed parallel to the bivalve samples. The percentage recovery of plastics was 95% for the mussels, 90% for the pen shells and 100% for the carpet shells. To assess contamination during processing, a procedural blank was also utilized and analyzed in the same manner as the samples.

6) Statistical analysis

Descriptive statistics, including total counts of microplastics found among all the species collected and average counts per individual and per wet weight, were utilized to identify the abundance of microplastics. One-way analysis of variance (ANOVA) was used to compare the significant differences in microplastic abundance among the different bivalve species. When ANOVA revealed significant differences, a post hoc test (Tukey's HSD) was used to identify which specific bivalve species were significantly different from each other in terms of microplastic counts. A Pearson correlation analysis was also conducted to determine whether there was a correlation between microplastic abundance and bivalve morphometric data. Furthermore, the estimated dietary intake (EDI) of microplastics was calculated via Eq.1.

$$MP_{per\ year} = MP_{per\ gram} \times \text{grams consumed per day} \times 365 \quad \text{(Eq.1)}$$

Results

1) Morphometric data

Table 1 presents the average morphometric measurements of three bivalve species: *P. viridis*, *A. pectinata*, and *P. undulata*. The parameters measured included shell length, shell width, flesh weight, and total weight. Among the three species measured, *A. pectinata* presented the greatest shell length (249.6 ± 21.1 mm) and shell width (119.8 ± 7.9 mm). *P. viridis* was moderately large (80.9 ± 17 mm in length and 36.8 ± 2.7 mm in width). *P. undulata* was the smallest, with a shell length of only 25.0 ± 1.3 mm and width of 42.9 ± 2.4 mm.

The highest flesh weight was recorded in *A. pectinata* (56.7 ± 24.2 g), which aligns with its large shell size. *P. viridis* presented a significantly lower flesh weight (9.2 ± 2.0 g), whereas *P. undulata* presented the lowest flesh weight (2.5 ± 0.44 g), which is consistent with its smaller shell dimensions.

The sizes of bivalve samples in this study correspond to the legal market sizes sold in local markets in the area and nearby provinces. For *P. viridis* and *P. undulata*, sizes are consistent with the typical adult size range reported in other studies. The literature suggests that

A. pectinata are 250–300 mm in length and approximately 100 mm in width. This aligns well with the general size range reported in other studies, particularly those focusing on adult specimens [12].

Table 1 Morphometric data of the three bivalve species

Morphometric parameters	*P. viridis*	*A. pectinata*	*P. undulata*
Shell length (mm)	80.9 ± 17	249.6 ± 21.1	25.0 ± 1.3
Shell width (mm)	36.8 ± 2.7	119.8 ± 7.9	42.9 ± 2.4
Flesh weight (g)	9.2 ± 2.0	56.7 ± 24.2	2.5 ± 0.44
Total weight (g)	32.2 ± 5.9	156.9 ± 38.0	7.3 ± 1.1

2) Abundance of microplastic in bivalves

The analysis of microplastic abundance in the bivalves collected from Sorsogon Bay revealed the presence of microplastics across three bivalve species (Figure 3).

Overall, 168, 92, and 85 particles were visually isolated and sorted from the 150 samples of *P. viridis*, *A. pectinata*, and *P. undulata*, respectively. A total of 87 particles were identified as microplastics, with *P. viridis* having 67 particles and *A. pectinata* and *P. undulata* having 9 and 11 particles, respectively. Among them, fragments dominated the microplastic types found in all three commercially important bivalves sampled at different stations, accounting for 70.1% of the total particle types. Fragments include small plastic fragments that may result from the degradation of larger plastic items such as bottles, containers, and packaging materials [13]. The documented fragments in the samples may have come from degraded plastics around the area and likely from the discarded Styrofoam boxes used during the harvest of bivalves. Moreover, pellets accounted for 11.5% of the particles recovered. The small number of pellets, which are considered primary microplastics, indicate that there could be spillage from personal care products or that these might be contributions from the industry around the area [14]. Moreover, the remaining 18.4% of the particles are fibers. Interestingly, more microplastics are recovered from mussels than from the other two bivalve species.

Figure 3 shows the total amount of microplastic items recovered from the three bivalve species around the bay after confirmation through the hot needle test. Mussels (tahong) contained a total of 45 fragments, which was much greater than the ten and six items recovered from carpet shell (baduy) and pen shell (baloko), respectively. Mussels had a greater number of pellets and fibers than carpet and pen shells did, with only one pellet recovered from each and no fibers in carpet shells and two in pen shells. While this study did not report the presence of films and other fragment types in bivalve tissue, [7] reported their presence in sediments and water samples from various sampling sites in Sorsogon Bay. Overall, the amount of microplastics per species was found to be 0.44 items individual^{-1} or 0.05 items gram^{-1} wet weight for mussels, 0.07 items individual^{-1} or 0.003 items gram^{-1} wet weight for carpet shells, and 0.06 items individual^{-1} or a negligible 0.002 items gram^{-1} wet weight for pen shells.

The results of the one-way ANOVA further revealed significant differences in terms of microplastic abundance among the three bivalve species, $F(1, 149) = 36.63$, $p = 0.000$. Pairwise comparisons via Tukey's HSD test revealed that *P. viridis* presented a significantly greater mean microplastic abundance than did *A. pectinata* and *P. undulata*. However, there was no significant difference between the two latter species (Figure 4).

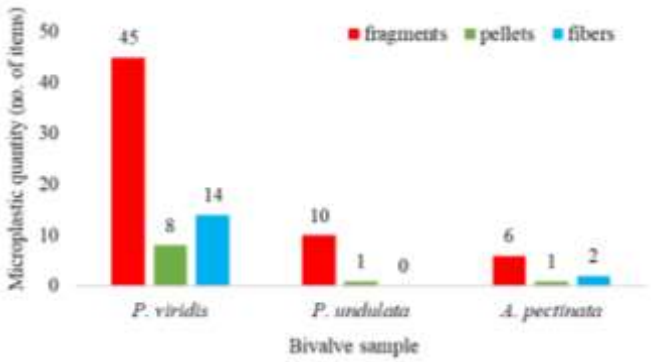

Figure 3 Types of microplastics recovered from bivalve samples at the three sampling sites.

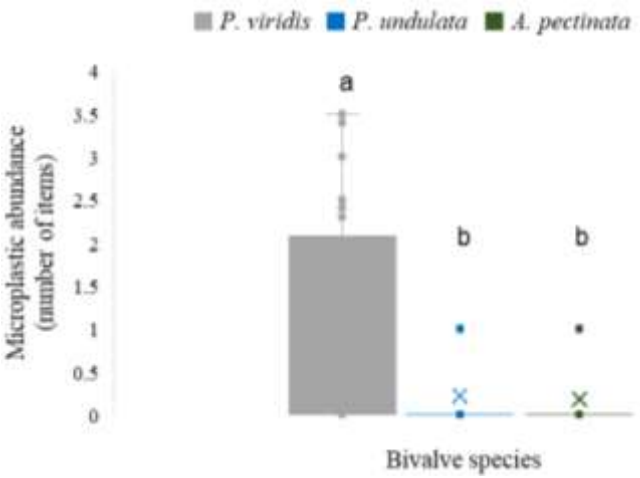

Figure 4 Boxplot of microplastic abundance among the three bivalve species. Groups with different letters are significantly different from each other at p=0.05.

The greater number of mussels in this study could be due to the type of habitat it prefers compared with the other two bivalve species. Although all the mussels were gathered from Sorsogon Bay, they inhabit rocky intertidal zones and coastal areas, where they attach to hard substrates. These areas are exposed to wave action, and their proximity to the more populated and

industrial areas of the bay can influence the availability and concentration of microplastics in their tissues [15], [16]. The amount of microplastics in the three bivalve species of the bay was, however, generally lower than the concentrations recorded in other aquatic ecosystems in the Philippines, such as the Pasig River in Metro Manila and Bacoor Bay in Cavite [14,17], since Sorsogon Bay is situated in a rural province with less exposure to plastic-producing industries and urban development. Lesser industrialized areas typically generate lower volumes of plastic waste and effluents, resulting in less availability for the ingestion of filter-feeding organisms.

This study also attempted to determine whether there was a correlation between microplastic abundance in the three bivalve species and their morphometric data. In *P. viridis*, shell length had a moderate positive correlation with microplastic abundance ($r=0.75$, $p<0.05$) and a weak positive correlation with both *A. pectinata* ($r=0.570$, $p<0.05$) and *P. undulata* ($r=0.574$, $p<0.05$). However, there were no correlations between microplastic abundance and the shell width, flesh or total weight of the bivalve samples. These results were similar to those of Phaksopa et al. [18], where a strong positive correlation was recorded in terms of shell length, but not with those of Werorilangi et al. [19], who investigated *P. viridis* and Meretex clams. Zhang et al. [20] reported a significant positive correlation between microplastic abundance and the tissue weight of bivalves, which was not the case in this study. These patterns indicate that the relationships between microplastic abundance and morphometric characteristics may be species-specific and influenced by ecological or physiological factors unique to each organism. The moderately positive correlation observed in *P. viridis* suggests that larger individuals may have greater filtration capacity, leading to increased microplastic ingestion. Furthermore, the larger shell size of mussels is associated with older age and therefore longer exposure to microplastics present in the water. In contrast, the absence of similar correlations for other morphometric traits and species implies that other factors, such as feeding behavior, filtration efficiency, or digestive processes, may also play significant roles [21]. Since these biological traits vary among species, they significantly affect how many and what types of microplastics are ingested and retained. For example, species with higher filtration rates have greater chances of encountering and accumulating microplastics. Bivalves typically ingest food particles suspended in water through filter feeding. Furthermore, ingested microplastics cannot be digested due to the absence of enzymatic pathways capable of breaking down the polymers, leading to their accumulation in body tissues such as the hepatopancreas and ovaries of bivalves [22].

3) Microplastic characterization

Approximately 67% fragments, 21% fibers, and 12% pellets were obtained from the mussel samples. Moreover, the carpet shells contained only 90% fragments and 10% pellets. The pen shells had 67% fragments, 11% pellets and 22% fibers. Figure 5 shows the distribution of microplastic types per sampling area and bivalve species.

Since degradation processes are continuous, fragments are constantly being introduced into marine environments [23]. Considering that residential areas surround Sorsogon Bay, inadequate waste management and high plastic consumption contribute significantly to fragment pollution. Fibers, as the second most abundant, indicate potential sources such as fishing gear, synthetic textiles, or wastewater discharge, especially around the Bucal-Bucalan and Casiguran stations. Pellets, which are the least abundant, suggest that direct industrial sources contribute less to microplastic pollution in these areas. A similar study [7] on *P. viridis* at different sampling sites in Sorsogon Bay revealed fibers as the most prevalent type in this species and in the water column. Although pellets were also detected, they were fewer in number than other microplastic types. Notably, the prevalence of microplastic types can vary depending on the species studied and the specific environmental conditions of the sampling sites. For example, research analyzing microplastics in barnacles and wild bivalves along the coast of the Yellow Sea in China revealed that fibers were the most common type of microplastic, followed by fragments, films, and microbeads [20].

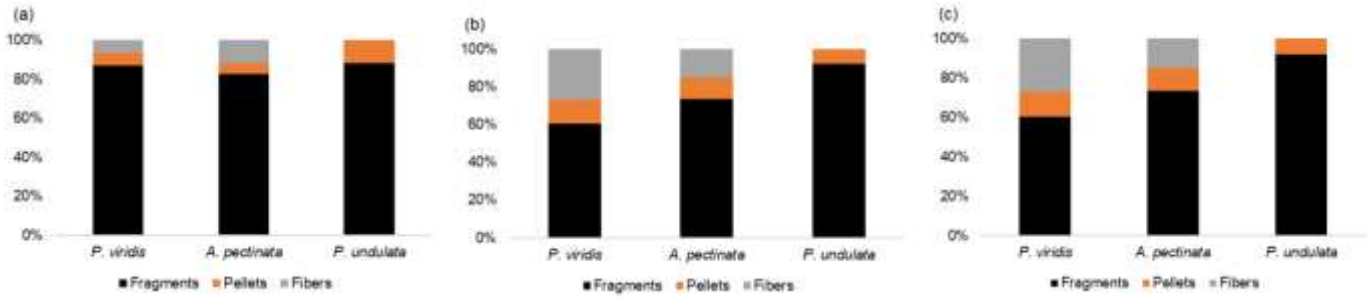

Figure 5 Percentages of microplastic types obtained per sampling area and bivalve species: (a) Rompeolas; (b) Casiguran; (c) Bucal-bucalan.

The identification of plastic polymers was made possible by observing their peaks and looking into the library of the FTIR spectra used. Upon FTIR examination, most of them were confirmed to be polystyrene (PS, Figure 6a), polypropylene (PP, Figure 6b) or polyacrylamide (PAM, Figure 6c). However, microplastics <500 µm in size were not included in the FTIR analysis in this study because of size limitations.

Among the representative particles analyzed, PP microplastics accounted for 53% of the total, whereas they accounted for 38% and 9% for PS and PAM, respectively. PS and PP are low-density microplastics that are expected to float on the surface of water. However, they are found in the tissues of bivalves that are cultured below surface water due to biofouling or the adsorption of natural substances to the surface of plastics [14,25]. Microorganisms, such as algae, fungi, and bacteria, colonize the surface of degraded plastics in aquatic environments. As these organisms accumulate and form biofilms [26], they add mass to the plastic particles, increasing their overall density. These particles can then be transported to lower depths. Water currents and turbulence can further distribute them throughout the water column, exposing both bivalves attached to substrates and those burrowing in sediment areas.

The detection of microplastics in bivalves from Sorsogon Bay aligns with previous studies documenting microplastic contamination in the same type of organisms (Table 2).

The microplastic contamination levels in bivalves from Sorsogon Bay were generally lower than those reported in most regional studies. *P. viridis* in Indonesia (Bekasi Estuary: 13.5–15.7 MPs individual^{-1}) and Vietnam (4.33 MPs individual^{-1}) presented markedly higher microplastic loads than Sorsogon Bay did, likely due to proximity to urban or industrial discharge [27, 29]. The microplastic abundance was also substantially lower than that in China's Pearl River Estuary or Hong Kong [34], where dense populations and industrial activities drive greater plastic leakage.

Moreover, the microplastic abundance in Sorsogon Bay was similar to that in Thailand's Sri Racha Bay [18]. This may be partly explained by their shared semi-enclosed bay morphology, which influences microplastic retention, transport, and bioavailability. While semi-enclosed bays trap locally derived microplastics, their openness, compared with estuaries, dilutes extreme pollution; thus, both bays have comparably lower loads of microplastics in bivalve samples. For example, the Bekasi Estuary in India [27] recorded 13.4 and 13.6 particles per individual of *P. viridis* at the surface and at a depth of 6 m, respectively. Human activities, including industrial operations, port activities, shipbreaking, and tourism, likely impact this estuarine ecosystem through effluent discharge, municipal sewage outfalls, and urban runoff. The dominance of PP, PE, and PET in bivalves from regional studies (Table 2) shows that these polymers are abundant in the environment. However, in the present study, only three types of polymers (PS, PP, and PAM) were detected in the bivalve samples. A previous investigation by Malto and Mendoza [7] on *P. viridis* and *A. pectinata* detected other types, including PE, PET, POL, and PUR. However, no PAM plastics were detected in their study. This discrepancy in polymer composition could be attributed to variations in pollution sources across sampling sites and methodological differences in microplastic detection.

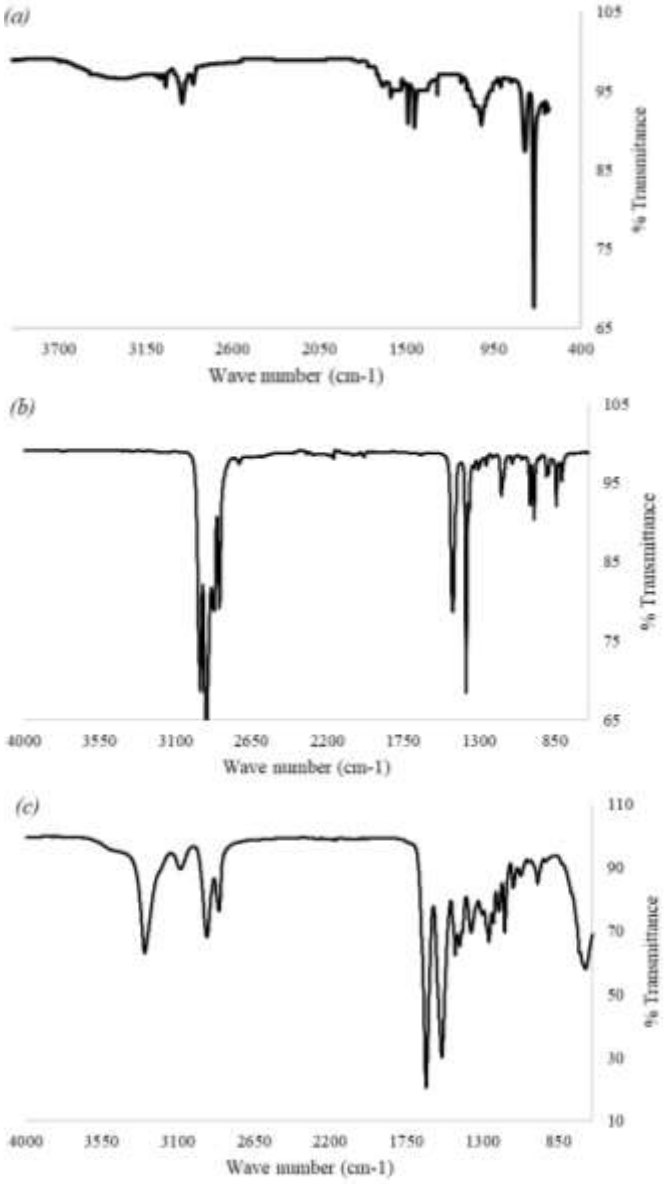

Figure 6. Spectra of microplastic samples with peaks typically associated with specific molecular vibrations. Each peak corresponds to a characteristic vibrational mode, which can involve stretching, bending, or twisting of the atoms in the polymer bonds [24]. These peaks serve as fingerprints of the polymer, allowing it to be distinguished from other plastics and confirming its composition. (a) PS with seven peaks; (b) PP; (c) PAM.

Table 2 Recent studies assessing the abundance of microplastics in commercially important bivalves from other Asian countries

Bivalve species	Total number of samples	Average microplastic	Digestion reagent	Identified polymer types	Sampling location	Reference
Perna viridis	120	13.4 particles individual^{-1} (surface) 13.6 particles individual^{-1} (6 m depth)	30% H_2O_2	PVC, PC, PS, CA, PMMA, ABS, EVA, PA	Bekasi Estuary, West Java, Indonesia	[27]
Perna viridis	300	13.5 to 15.7 MPs individual^{-1}	30% H_2O_2	PVC, PAN, PC, PS, PMMA, PPSU, MF, PET, PVAc, PP, PTFE, epoxy resin	Jakarta seafood markets	[28]
Perna viridis, *Mactra chinensis*, *Meretrix meretrix*	170	0.70–14.64 particles individual^{-1} (Perna sp.) 2.29 particles individual^{-1} (Mactra sp.) 1.00 particles individual^{-1} (Meretrix sp.)	20% KOH	PS, NYL, PUR, PP	Makassar Strait, Indonesia	[19]
Perna viridis; *Anadara* sp.	60 (*P. virids*); 180 (*Anadara* sp.)	1.84 particles individual^{-1} (*Anadara* sp.); 4.33 particles individual^{-1} (*P. viridis*)	10% KOH	PE, PP, PVC	Vietnam	[29]
Perna viridis; *Villorita cyprinoides*	288	2.31± 0.93 particles individual^{-1}	30% H_2O_2	PP, ABS, PET, PE, POL	Chandragiri River, Southwest India	[30]
Perna viridis; *Meretrix casta*	120	2.38 ± 1.56 particles individual^{-1} (*P. viridis*) 1.35 ± 1.02 particles individual^{-1} (*M. casta*)	10% KOH	PP, PE, PA	Beypore Estuary, Southern India	[31]
Perna virids	240	3.2 ± 1.6 particles individual^{-1}	30% H_2O_2 with iron (II) catalyst	HDPE	Sriracha Bay in Chonburi and Phetchaburi, Thailand	[32]
Perna viridis; *Atrina pectinata*	240	0.31 - 2.50 particles individual^{-1} (*P. viridis*) 0.93 - 4.27 particles individual^{-1} (*A. pectinata)*	30% H_2O_2	PE, PET, POL, PS, PUR	Sorsogon Bay, Philippines	[7]
Perna viridis	90	4.13 particles individual^{-1}	1% KOH 30% H_2O_2	POL, PET, UF, Rayon, PE, PA, PS	Phuket, Thailand	[33]
Perna viridis	1000	0.15 ± 0.41 particles individual^{-1} (dry season) 0.22 ± 0.57 particles individual^{-1} (wet season)	10% KOH 30% H_2O_2	PET, PP, nylon	Sri Racha Bay, Thailand	[18]
Perna viridis	50	1.60–14.7 particles individual^{-1}	10% KOH and 14% EDTA	PP, PET, PS, PET	Hongkong, China	[34]
Perna viridis; *Atrina pectinata*; *Paphia undulata*	150 each	0.44 particles individual^{-1} (*P. viridis*) 0.06 particles individual^{-1} (*A. pectinata*) 0.07 particles individual^{-1} (*P. undulata*)	10% KOH	PS, PP, PAM	Sorsogon Bay, Philippines	This Study

Remark: PVC= polyvinyl chloride; PAM= polyacrylamide; PAN= polyacrylonitrile; PC= polycarbonate; PS= polystyrene; PMMA= polymethyl methacrylate; PPSU= polyphenylsulphone; MF= melamine-formaldehyde; PE= polyethylene; PET= polyethylene terephthalate; PVAc= polyvinyl acetate; PP= polypropylene; PA= polyacrylamide; PTFE= polytetrafluoroethylene; NYL=nylon; PUR= polyurethane; ABS= acrylonitrile-butadiene-styrene; CA= cellulose acetate; EVA= ethene-vinylacetate; POL= polyester; UF= urea-formaldehyde

Seafood consumption is a major route through which microplastics can enter the human diet, especially among coastal populations that depend on seafood as their main source of protein. On the basis of the average microplastic count per gram wet weight of microplastics present in green mussels, the annual microplastic dietary intake was estimated on the basis of the per capita consumption of shellfish among Filipinos. The data obtained by DOST-FNRI in 2017, as cited in the Philippine Fisheries Profile Report [35], estimate an average of 0.8 grams day^{-1} per capita consumption of mussels; however, no exact data are available for pen shells and carpet shells. The annual intake of microplastics per individual consuming mussels was therefore estimated via Eq.1. (see Methods). In short, Filipinos can consume 14.6 microplastics annually in their diet with mussels alone, which is lower than that in Hong Kong and India, as well as other shellfish species found in more urbanized geographic regions [34]. However, this finding indicates a potential route of microplastic exposure through seafood consumption, even at relatively low intake levels. The estimated annual intake, although modest, underscores the pervasive presence of microplastics in marine organisms and the importance of continuous monitoring of seafood safety.

Conclusions

This study provided quantitative and qualitative assessments of the presence of microplastics in bivalves from Sorsogon Bay, Philippines. The findings revealed that all three groups of bivalves collected from Sorsogon Bay, Philippines, were contaminated with microplastics, with fragments being the most dominant type of pollutant, accounting for 67% of both mussels and pen shells and 90% of carpet shells. The microplastic abundance in mussels was also significantly greater than that in the two bivalve species, as shown by post hoc comparisons. Given the different types of polymers present, this study offered valuable clues about the local polymer use patterns in the area and the distribution of microplastics in the water. Careful identification protocols are therefore necessary for accurate quantification of microplastics, as imprecise methods can lead to overestimation of contamination. The presence of microplastics in edible bivalves highlights a potential pathway for microplastic exposure to humans through seafood consumption. These results emphasize the urgent need for more stringent management of plastic waste and further research to better understand the implications of microplastic contamination for seafood and human health.

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