Research Article

Microplastics Abundance and Characteristics in *Mytilus* spp. from Southwest Western Australia Urban Estuaries

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Abstract

As global plastic production continuously increases, plastic waste is no doubt becoming an emerging threat to aquatic ecosystems. This condition has directly linked to the abundance of microplastics in the aquatic system, especially in the semi-enclosed system of estuary. This study aims to investigate the microplastics abundance and characteristics in sedentary filter feeder of *Mytilus* spp. inhabited urban estuaries of southwest Western Australia. Microplastics were detected in 69% of the total individual sampled. The mean of microplastics was 1.31±1.26 items per individual and 0.27±0.45 items per mussels wet weight (gww). The most common microplastic types from all samples were films (51%), then followed by fibers (43%). Our results highlight that microplastics contamination is widespread across the Western Australia estuaries and has contaminated the sedentary organisms lived in the estuary, including *Mytilus* spp. This study was a pilot study and is considered to be the first study in Western Australia among similar studies on microplastics in mussels. A further study in developing standard methods and expanding the study area and the sample size is important to be conducted. This will give more confirmation on using mussels (*Mytilus* spp.) for global microplastics biomonitoring.

Keywords: *Microplastics; Mussel; Mytilus spp.; Urban Estuary; Southwest Western Australia*

1. Introduction

In today's modern era, plastic waste is emerging pollution threatening the aquatic ecosystems, including estuary. Global plastic production has increased over the years, reaching 360 million tons every year (Plasctics Europe, 2021). The trend is in line with the increase of plastic waste in the aquatic environment. Plastic waste leakage into the aquatic ecosystem occurs due to the lack of waste management systems on land, especially in developing countries (Guerrero et al., 2013). Plastics waste can end up in the marine ecosystem mainly through rivers (van Emmerik et al., 2022). When an estuary exists between the river and ocean, land-based plastic waste transported via the river will likely accumulate in the estuarine ecosystem, especially after rain event (Hajbane & Pattiaratchi, 2016; Hitchcock, 2020). Therefore, rivers and estuaries can act as plastic waste reservoirs that accumulate the waste before transporting it to the ocean (van Emmerik et al., 2022).

Due to the persistent properties of plastic material, it can not be biodegraded naturally in the natural environment. Instead, the material will break into tiny pieces called microplastics. Microplastics are defined as plastic particles that are smaller than 5mm in size (Frias & Nash, 2018). This microscopic particle is predominant in aquatic systems, including in lakes (Dusaucy et al., 2021), rivers (D'avignon et al., 2022), estuaries

(Hitchcock & Mitrovic, 2019), and oceans (Alfaro-Núñez et al., 2021). In general, microplastics are grouped into primary and secondary microplastics. Primary microplastics are plastic particles that were originally manufactured in microscopic size for commercial purposes. Meanwhile, secondary microplastics are plastic particles as a result of the breaking of discarded large plastic products due to biological, chemical, and physical processes in the natural environment (Cole et al., 2011). As the particle is tiny, microplastics can be easily distributed to the aquatic systems through external forces such as prevailing wind and rainfall (Hitchcock, 2020).

Microplastics can pose risks to aquatic organisms' health through direct exposure. In the aquatic environment, microplastics can act as pollutant vectors (Caruso, 2019). Microplastic particles can adsorb chemical pollutants in the environment, such as persistent organic pollutants (POPs) and persistent bioaccumulative and toxic substances (PBTs) (Rodrigues et al., 2019). The toxicity is likely to be accumulated as plastic particles also contain chemical additives, including phthalates, UV-stabilizers, colorants, brominated flame retardants, and bisphenol A (Caruso, 2019). Microplastics can enter the organism's body mainly through ingestion. Numerous studies have reported that microplastics have been detected in aquatic organisms, such as in fish (Azevedo-Santos et al., 2019), crustacea (Yin et al., 2022), molluscs (Naji et al., 2018), and other aquatic organisms (de Sá et al., 2018). Ecotoxicological studies have also been carried out on a laboratory scale to observe the harmful effect of microplastics on aquatic organisms (de Sá et al., 2018). A review by de Sá et al. (2018) mentions that microplastics exposure to aquatic organisms can impair the organisms' growth and reproduction, increase oxidative stress, decrease survival ability, and cause mortality. The study also highlights that bivalve is more prone to microplastics contamination and bioaccumulation due to their sedentary life (de Sá et al., 2018).

Bivalves are filter-feeding organisms abundant in freshwater, estuary, and marine water. Bivalves, including mussels, are highly tolerant organisms in varied environmental conditions. Generally, in aquatic ecosystems bivalves provide an excellent ecosystem service in balancing the nutrient, removing the pollutant (i.e., heavy metal and pathogenic bacteria), and increasing the benthic primary production in the system (van der Schatte Olivier et al., 2020; Vaughn, 2017). Especially the estuarine mussels, have a high tolerance to salinity and temperature (McFarland et al., 2015). Mussels, especially the *Mytilus* spp., are distributed globally which makes them an excellent species for aquatic pollution monitoring (Gersberg et al., 1986), including for microplastics pollution. Several studies have shown that mussels can be a good bioindicator for microplastics pollution (Li et al., 2019).

This study aims to assess the microplastics characteristics in mussels (*Mytilus* spp.) from urban estuaries in southwest Western Australia. The species is non-native species in Western Australia estuaries (Wells et al., 2009). The dominant *Mytilus* spp. species found in Western Australia estuaries, especially in Perth and Albany, is *Mytilus galloprovincialis* (Dias et al., 2014). The existence of *Mytilus* spp. in Western Australia estuaries helps to maintain the health of estuarine ecosystems. As the decline in the number of shellfish reefs, recently one million of *Mytilus* spp. was deployed in Swan-Canning Estuary, in Perth as part of the mussel reef restoration project (Minderoo Foundation., 2021). In the emerging threat of microplastics pollution, there is still a lack of information related to microplastics contamination in *Mytilus* spp. from Western Australia estuaries. This study is a pilot study conducted in urban estuaries of southwest Western Australia that will inform the estuary managers about the microplastics threat to the estuarine mussels. Specifically, here, we calculated and identified microplastics concentration and characteristics (type, shape, and colour) in *Mytilus* spp. from urban estuaries in southwest Western Australia.

2. Materials and Methods

2.1 Sampling location

Mussels (*Mytilus* spp.) were sampled in three urban estuaries in southwest Western Australia, Swan River Estuary, Mandurah Estuary, and Oyster Harbour Estuary (Figure 1), from 16 to 24 November 2020. The three estuaries are permanently open to the ocean and influenced by different anthropogenic pressure (population size and land use) on the catchment. All collected samples were kept frozen until further analysis in the Plastic laboratory at the Indian Ocean Marine Research Center at the University of Western Australia.

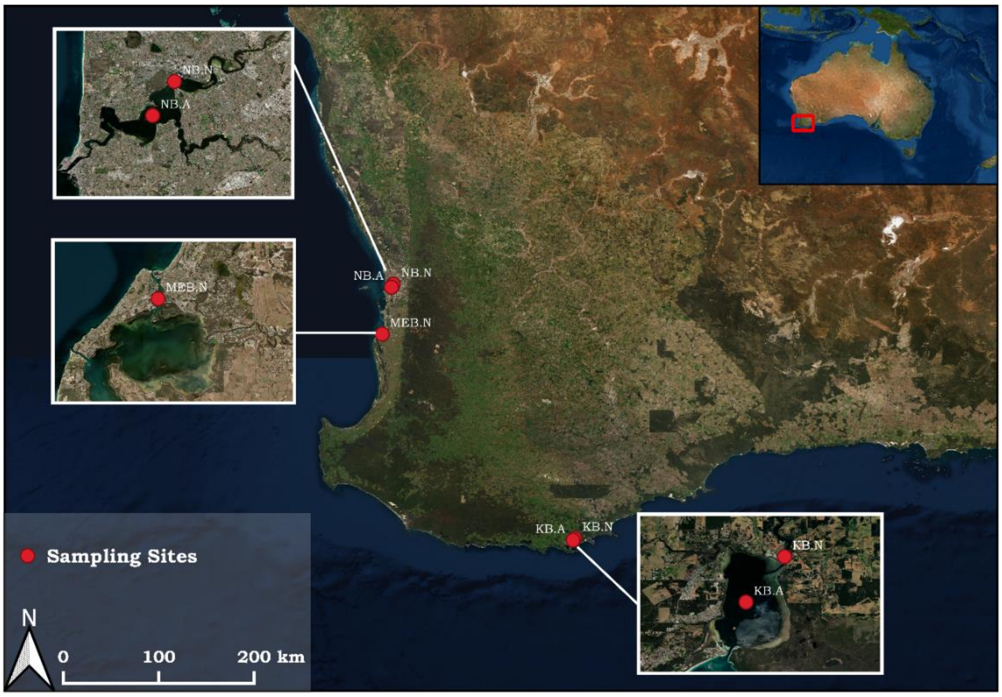

Figure 1. Sampling sites of *Mytilus* spp. in three urban estuaries of southwest Western Australia in November 2020. The map was created in QGIS Desktop 3.22.5 ver.

Swan River Estuary is located in the Perth Metropolitan region. Perth Metropolitan has the highest population in the state, with ~2 million people living in the city (DPIRD, 2017). In this estuary, mussels (*Mytilus* spp.) were sampled in the lower zone of the estuary (Perth Water and Melville Water), attached to the bridge pylon of Narrow Bridge (NB.N) and floating channel marker away from the bridge (NB.A). The catchment area of this zone is intensively developed as suburban areas, urban areas, industrial settlements, and parks/recreational landscapes. The second estuary was in Mandurah Estuary, about 80 km south of Perth. This estuary is located in the Mandurah region, with a population size of ~130 thousand people living in the catchment area (DPIRD, 2017). The region catchment is dominated by agriculture, and industrial and settlement areas (Kelsey et al., 2010). In this estuary, we only found *Mytilus* spp. on the bridge pylon of Mandurah Estuary Bridge (MEB.N). The last estuary we sampled was Oyster Harbour Estuary in the Albany region. Compared to the other two estuaries, Oyster Harbour Estuary is influenced by less anthropogenic pressure. The population of the estuary catchment is ~34 thousand people, concentrated in Albany City (WAPC, 2015). The majority of land used in this region is for agriculture and horticulture. In Oyster Harbour Estuary, the mussels (*Mytilus* spp.) were sampled on the old wood jetty near Kalgan Bridge (KB.N) and on a floating channel marker away from Kalgan Bridge (KB.A).

2.2 Microplastics extraction and identification

In the laboratory, Mussels (*Mytilus* spp.) were cleaned with distilled (DI) water to remove external debris to avoid contamination. The morphometric measurement was measured before separating the soft tissue, including the shell length (SL) and total weight (TW). The soft tissue weight was also measured as wet weight (WW). The separated soft tissue was kept in cleaned aluminium foil and stored at -20 °C before further analysis steps.

Microplastics extraction followed the protocol from previous studies (Crutchett et al., 2020; Hermabessiere et al., 2019; Phuong, Zalouk-Vergnoux, et al., 2018) with a minor modification. The soft tissue of mussels was thawed at room temperature, then digested with 10% KOH solutions. The ratio between 10% KOH solution and a soft tissue sample was 1 g of soft tissue: 10 ml of 10% KOH solution m/v. The mixed sample was then incubated at 40 °C for 6 – 24 hours and agitated for 60 seconds every three hours. Once the soft tissue dissolved, the sample was filtered on glass fiber filter paper MN GF-4 with 1.4 µm pore size, then transferred to a sterile petri dish and oven-dried for 24 hours at 40°C.

Microplastics in this study were carefully identified through visual identification with a dissecting microscope. A microplastic particle was defined by the following criteria: (1) no cellular or organic structures (shell fragments, dried algae, and animal parts) identified, (2) similar thickness of fibers throughout the length, (3) clear and homogenous colours on the suspected particles, (4) hard and durable, not easily broken with gently pressed(Gove et al., 2019; Hidalgo-Ruz et al., 2012). A hot needle test was also conducted to double confirm the suspected particle as microplastic. A particle will be confirmed as microplastic when the particle melts or stick, curve or flex, and leave a burn mark. Each suspected microplastics was captured and characterized by several types (foam, fiber, film, and fragment), size class (<0.5mm, 0.5mm – 1mm, 1mm – 3mm, 3mm – 5mm), and colour. The ImageJ software was used for measuring the microplastic size (in mm).

2.3 Quality assurance

During the analysis, we took care of the cleanliness of the workspace and glassware. All surface areas, such as benches and tables were cleaned with 70% ethanol and wiped with lint-free wipes Kimwipes*Kimtech before starting any laboratory work. All glassware was acid washed and rinsed with DI water before conducting any analysis. Cleaned aluminium foil was used to cover the samples to avoid airborne contamination. A procedural blank sample was also performed during all sample analysis processes. Fully cotton laboratory coats dyed with bright fuchsia colour were worn during the laboratory analysis to detect contamination from the coat.

2.4 Data analysis

Data analysis was conducted in Microsoft Excel 365 and RStudio 4.0.3 version. Microplastics abundance was calculated as the average number of microplastics items detected per individual (items/individual) and per gram wet weight (items/gWW). Microplastics abundance in this study is presented as mean ± standard deviation (SD). The microplastic dataset was tested for normality with Shapiro-Wilk test. Since the data were not normally distributed, a non-parametric statistical test was performed. The Mann-Whitney *U* test was used to analyse the difference in mean between two group samples. The significant difference among multiple groups of samples was tested with the Kruskal-Wallis test. Fischer Exact test was also performed to determine the significant difference of each microplastics characteristic towards sampling sites. Significant difference was represented as *p-value* < 0.05. All charts of microplastics characteristics (types, size, and colour) were made in RStudio 4.0.3 version.

3. Results

3.1 Bivalves morphometric measurement

Statistically, the morphometrics measurement of *Mytilus* spp. were significantly different across the sampling sites (Kruskal-Wallis test, *p-value* < 0.05). On average, the mussels (*Mytilus* spp.) collected from Swan River Estuary were significantly larger than mussels in Mandurah Estuary (Mann-Whitney *U* test, *p-value* < 0.05) and Oyster Harbour Estuary (Mann-Whitney *U* test, *p-value* < 0.05) (Table 1).

Table 1. Morphometric measurement (total weight, shell length, and soft tissue wet weight) of *Mytilus* spp. collected from three urban estuaries of southwest Western Australia.

Sampling Location	Total Weight (g)		Shell Length (cm)		Soft Tissue Wet Weight (g)	
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
Swan River Estuary	19.83 - 33	26.31±2.93	6.65 - 8.20	7.48±0.41	9.06 - 29.98	17.67±8.12
Mandurah Estuary	5.70 - 8.59	7.11±0.81	4.30 - 5.35	4.67±0.25	1.62 - 1.91	1.72±0.09
Oyster Harbour Estuary	7.15 - 20.44	13.45±3.95	4.30 - 8	6.14±1.24	2.21 - 6.54	4.34±1.61

3.2 Microplastics abundance

A total of 75 mussels (*Mytilus* spp.) were collected from Swan River Estuary (30 individuals), Mandurah Estuary (15 individuals), and Oyster Harbour Estuary (30 individuals). In general, microplastics occurred in 69% of total mussel (*Mytilus* spp.) samples, with the total of microplastic identified was 98 items (Table 2). The highest microplastics occurrence was found in mussels from Swan River Estuary (86.67%), followed by mussels sampled from Oyster Harbour (60%). The range of microplastics items detected in mussel samples was from 0 to 5 items/individual (Figure 2).

Table 2. Summary of microplastics occurrence and abundance (Mean±SD) in all examined mussels (*Mytilus* spp.) samples from three urban estuaries of southwest Western Australia.

Location	n	%FO	∑MP count (items)	Mean MP Abundance (Mean±SD)	
				Items/Individual	Items/gww
Swan River Estuary	30	86.67	55	1.83±1.32	0.13±0.11
Mandurah Estuary	15	53.33	16	1.07±1.44	0.62±0.83
Oyster Harbour Estuary	30	60	27	0.90±0.92	0.25±0.32
Total	75	69.33%	98	1.31±1.26	0.27±0.45

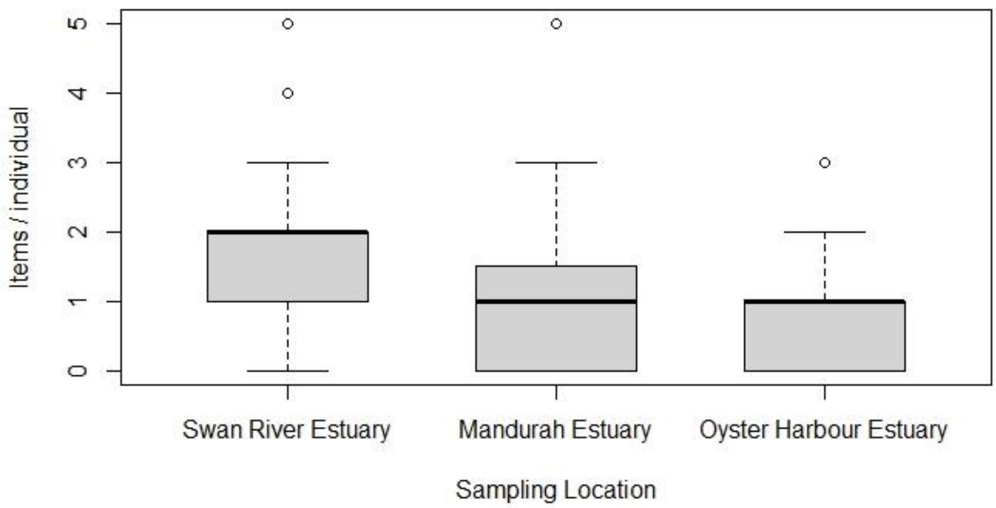

Figure 2. Boxplot of microplastics items per individual mussels (*Mytilus* spp.) across the three urban estuaries in southwest Western Australia.

Microplastics items found in each mussel were significantly different among the three urban estuaries (Kruskal-Wallis test, *p-value* < 0.05), with a total average of 1.31±1.26) items per individual. Microplastics items found in mussels from Swan River Estuary (1.83±1.32 items per individual) were significantly higher than in Mandurah Estuary and

Oyster Harbour Estuary (Mann-Whitney *U* test, *p-value* < 0.05). However, there was no significant difference in microplastics items per individual in mussels from Mandurah Estuary and Oyster Harbour Estuary (Mann-Whitney *U* test, *p-value* > 0.05).

Microplastics abundance per gram wet weight (gww) was not significantly different (Kruskal-Wallis test, *p-value* > 0.05). The overall average of microplastics abundance per gww from all sampling sites was 0.27(±0.45) items per gww, ranging from 0 to 2.9 items per gww. Despite the significant statistics test result, smaller mussels in Mandurah Estuary had higher microplastics abundance per gww than in Swan River Estuary and Oyster Harbour Estuary.

3.3 microplastics characterization

Four microplastics types (fiber, film, foam, and fragment) were identified in mussels (*Mytilus* spp.) from all three urban estuaries of southwest Western Australia (Figure 3). Although the proportion of microplastics types varied among the sampling sites (Figure 4A), it did not differ significantly between sites (Fisher's Exact test, *p-value* > 0.05). Film was the most abundant microplastics type found, accounting for 50 items (51%), with the highest proportion identified in Swan River Estuary (53%). It was followed by fibers, accounting for 42 items (43%). A small portion of foam (1%) was only found in Mandurah Estuary, while fragments (5%) were found in Swan River Estuary and Mandurah Estuary.

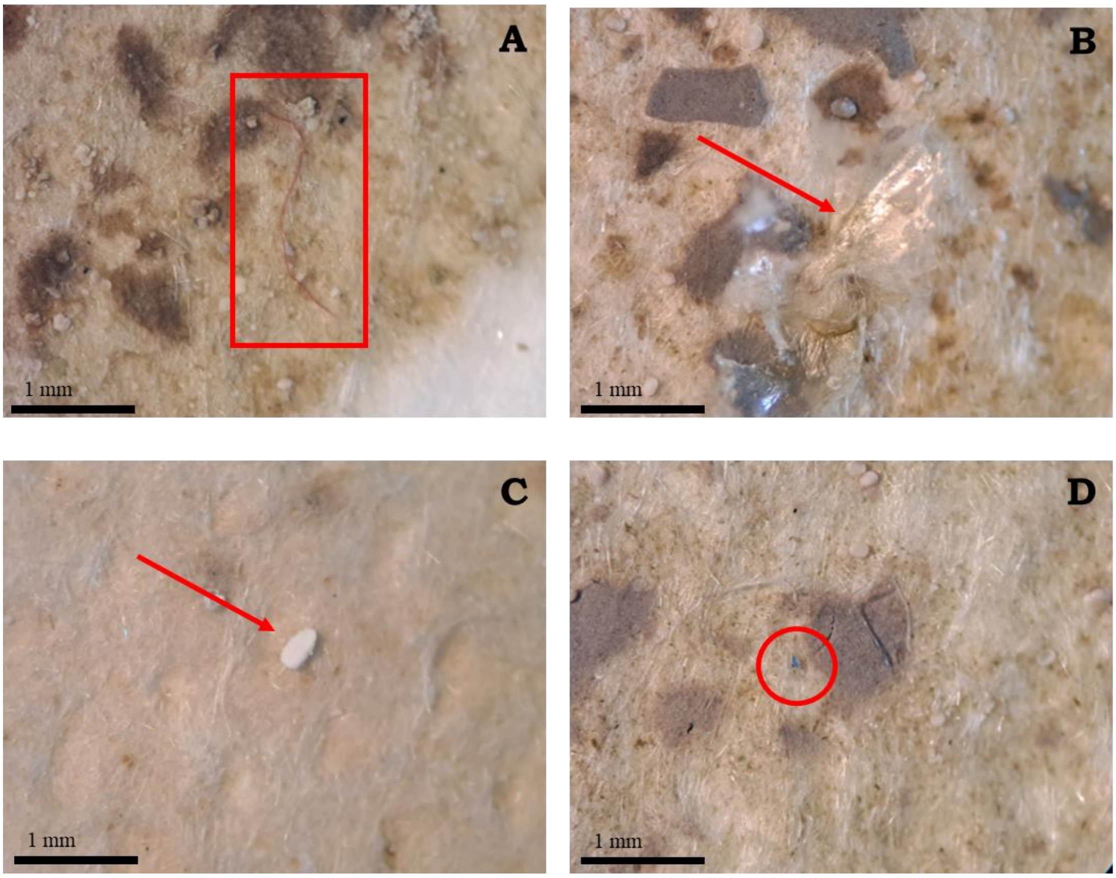

Figure 3. Examples of microplastics identified in *Mytilus* spp., A) red fiber, B) translucent film, C) white foam, and D) blue fragment, from three urban estuaries of southwest Western Australia.

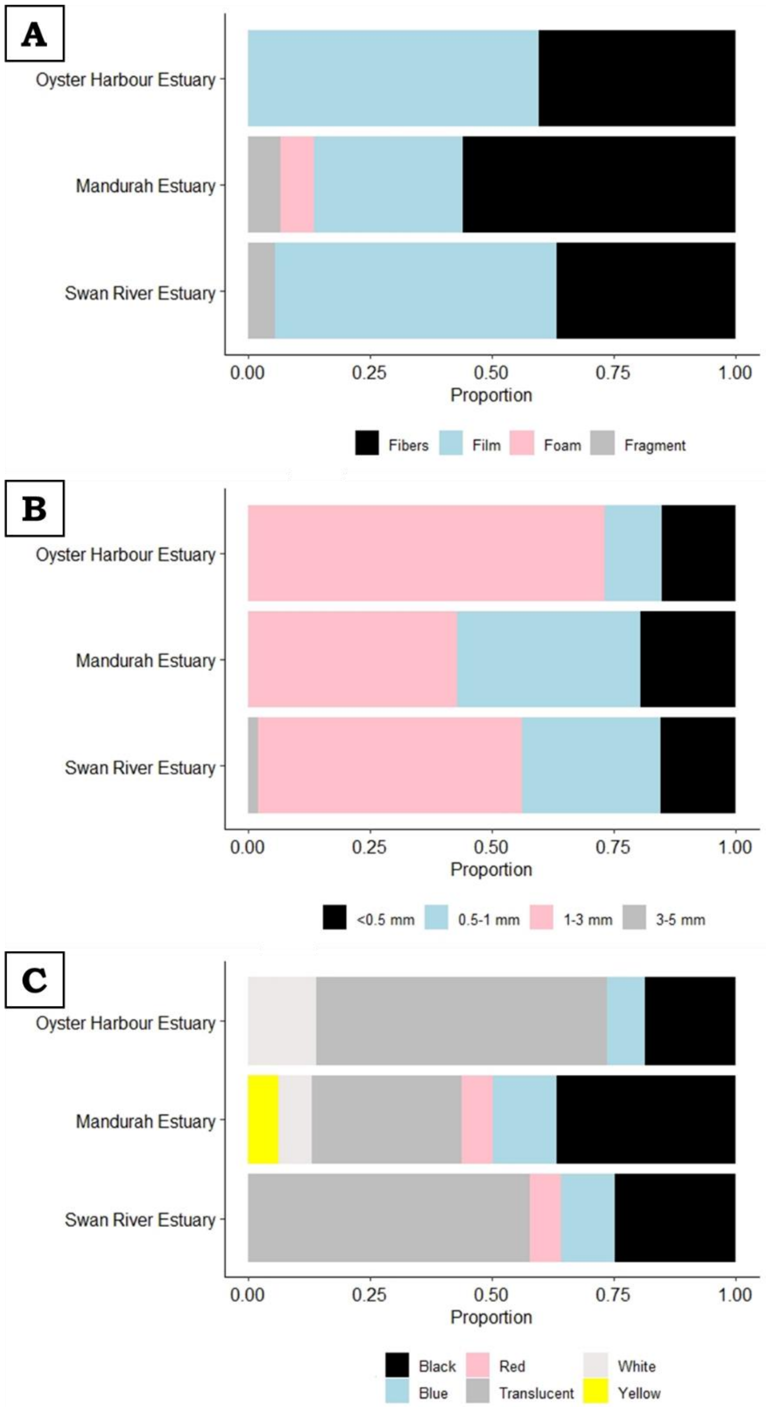

Figure 4. The proportion of microplastics A) types, B) size, and C) colours found in mussels (*Mytilus* spp.) collected from three urban estuaries of southwest Western Australia

The average microplastics size found in mussel (*Mytilus* spp.) samples was 1.18±(0.70) mm, ranging from 0.07mm to 3.03mm. The size of microplastics was categorized into four size classes, <0.5mm, 0.5mm – 1mm, 1mm – 3mm, and 3mm – 5mm (Figure 4B). The most common size found in mussels (*Mytilus* spp.) in each sampling site was between the range of 1mm – 3mm size class (56.12%). It was followed by microplastics in the size class of 0.5m – 1mm (25.50%). Despite the microplastics size variation among samples, the size did not differ significantly between the sampling sites (Fisher's Exact test, *p-value* > 0.05).

There were six colours of microplastics identified in all mussels (*Mytilus* spp.) samples, black, blue, red, translucent, white, and yellow (Figure 4C). All six colours were detected in mussel (*Mytilus* spp.) samples from Mandurah Estuary. A half portion of total microplastics had translucent colour (51%), followed by black colour (26.53%). The colours of microplastics found in mussel (*Mytilus* spp.) samples were significantly different between sampling sites (Fisher's Exact test, *p-value* < 0.05).

4. Discussion

This study presents evidence of microplastics contamination in mussels (*Mytilus* spp.) sampled from urban estuaries of southwest Western Australia. The present study is also among the first study on microplastics pollution in bivalves in Western Australia. The results showed that microplastics have contaminated more than half of the mussels (*Mytilus* spp.) sampled in each sampling site (Table 2). The body size of mussels collected in Swan River Estuary was significantly larger than in the two other estuaries. This is perhaps the reason for higher microplastics occurrence and counts per individual in mussels in Swan River Estuary. High anthropogenic pressure on the Swan River Estuary catchment may also influence the high microplastics concentration in individual mussels. Interestingly, there was no significant difference in microplastics count between smaller-sized mussels from Mandurah estuary and larger-sized mussels from Oyster Harbour. This is possible because the smaller-sized mussels are not effectively and efficiently ingesting microplastics as the larger mussels (Bråte et al., 2018).

A gradual increase of microplastics concentration by individual mussels is observed in this study with increasing human activities on land in each urban estuary. Microplastics concentration in estuarine water is known to be linear with the intensity of human activities on land (Hitchcock & Mitrovic, 2019; Jang et al., 2020). This condition will influence the microplastics uptake by sessile organisms, like mussels, in an estuary. A similar result was observed in a study from China where a significant positive correlation was shown between microplastics levels in the water and mussels in different coastal waters of China (Qu et al., 2018). Moreover, the abundance of natural food for mussels (i.e., microalgae) in the estuary will also increase the microplastics persistence in mussels' bodies, as mussels mistakenly ingest plastic particles that resemble their natural food (Chae & An, 2020).

Microplastics concentrations detected in mussels varied globally (Li et al., 2019). The reason for this high variation is due to the lack of a standardised method for extracting microplastics in bivalves. It is difficult to directly compare the result from this study with other studies of the same species but with different extraction methods. Therefore, we quantitively compare the microplastics concentration in mussels in this study with other studies that have similar methods of extraction, using 10% KOH (Table 3). Generally, microplastics abundance in mussels (*Mytilus* spp.) in this study is within the range of particle findings in Norway, Spain, and the U.K. (Olsen, 2017; Reguera et al., 2019; Scott et al., 2019), and lower compared to studies in South Africa (Sparks, 2020). Microplastics abundance in mussels from Korea and French is lower than in this study (Cho et al., 2019; Hermabessiere et al., 2019; Kazour & Amara, 2020; Phuong, Poirier, et al., 2018). This indicates that microplastics contamination in mussels in this study is relatively low but possible to increase over time.

The common microplastics types found in mussels (*Mytilus* spp.) in this study were films and fibers. These two microplastics types were also commonly detected in *Mytilus* spp. samples globally (Li et al., 2019). A slightly different finding from the selected studies in Table 3 shows that fibers and fragments were the most common microplastics type detected. The possible origin of microplastics film is from the fragment of discarded larger plastic bags and plastic packaging and wraps (Tziourrou et al., 2021). Microplastics film can be formed as a result of photodegradation, thermal degradation, and microbial degradation, which destructing the polymer composition in plastic to be more brittle (Cooper & Corcoran, 2010; Fotopoulou & Karapanagioti, 2019; Shah et al., 2008; Tziourrou et al., 2021). Microplastic fibers detected in this study potentially originated from the washing of textile and discarded weathered fishing line, and tire erosion (de Falco et al., 2019; Rebelein et al., 2021). However, natural fibers could be detected in this study due to the absence of a polymer test. (i.e., cellulose, cotton, and wool) (Rebelein et al., 2021).

Table 3. Summary of selected microplastics studies in *Mytilus* spp. extracted with 10% KOH compared to this study

Location	MP Identification Technique	Microplastic Concentration		MP size (μm)	MP Types (%)	Reference
		item/ individual	item/gww			
			***Mytilus* spp.**			
Southwest Western Australia	Visual identification and hot needle test	1.31±1.26 (0 - 5)	0.27±0.45 (0 - 2.9)	<5000	Films (51%); Fibers (43%); Fragments (5%); Foam (1%)	This study
Norway	μFT-IR	1.84 ± 2.06 (0–14.67)	1.85 ± 3.74 (0–24.45)	<1000	Fibers (85%); Fragments (11%); Film and foam (4%)	(Olsen, 2017)
Norway	Visual identification and μFTIR	0 - 6.9	0 - 7.9	<5000	Fibers (82%); Fragments (12%); Film and foam (3%)	(Bråte et al., 2018)
Spain	Visual identification	2.19 – 2.81	1.59 – 2.55	<1000	Fibers (34% - 56%); Fragments (30% - 33%); Pellet (9% - 34%)	(Reguera et al., 2019)
			Mytilus Edulis			
French	μFT-IR	0.60 ± 0.56	0.23 ± 0.20	50–100	Fragments (82%); Filaments (18%)	(Phuong, Poirier, et al., 2018)
French	Visual identification and μ-Raman	0.76 ± 0.40 - 0.78 ± 0.30	0.15 ± 0.06 - 0.25 ± 0.16	No data	Fibers (10.1 % - 50.2%)	(Hermabessiere et al., 2019)
French	Visual identification and μ-Raman	No data	0.41 - 2.76	<150 - 200	Fragments (82.3%)	(Kazour & Amara, 2020)
Korea	Visual identification and μFTIR	0.68 ± 0.64 (0–2.4)	0.12 ± 0.11 (0–0.35)	100 - 200	Fragments	(Cho et al., 2019)
U.K.	Visual identification and μFTIR	1.43 -7.64	No data	< 5000	Fibers (87%); Fragments (12%); microbeads (<1%)	(Scott et al., 2019)
			Mytilus galloprovincialis			
South Africa	Visual identification	4.27 ± 0.5	2.33 ± 0.2	<1000	Filaments (67%); Fragments (21%); Spheres (12&)	(Sparks, 2020)

Mytilus spp. is suggested to be eminent species for microplastics biomonitoring in the estuary and coastal aquatic systems (Li et al., 2019). The species have been studied in the coastal aquatic systems globally and recommended as sentinel species for microplastics contamination. It is included in coastal waters of the U.K. (Li et al., 2018), Norwegian (Bråte et al., 2018), China (Li et al., 2016; Qu et al., 2018), French–Belgian–Dutch (van Cauwenberghe et al., 2015), Spain (Reguera et al., 2019), and Belgian (de Witte et al., 2014). The widely spread of *Mytilus* spp. distribution worldwide makes the species become an excellent biomonitoring species for microplastics pollution (Gersberg et al., 1986; Li et al., 2019). Moreover, there are several reasons for mussels to be a potential species for microplastics biomonitoring including 1) known for their ability in absorbing and accumulating pollutants, 2) having a high tolerance to aquatic contamination and environmental parameter changes (i.e., wave exposure, temperature, and salinity), 3) sessile organisms that actively filter the water from its surrounding environment, and 4) feed on microalgae and other micro size organisms (i.e., bacteria) which has similar size as microplastics (Beyer et al., 2017). However, the method of extracting microplastics particles in *Mytilus* spp. globally is still varied. Determine a global standard extraction method will lead to a more accurate and reliable global comparison (Ding et al., 2022). Due to the absence of a polymer test in this study, we are unable to inform the polymer types of microplastics in *Mytilus* spp. from urban estuaries in southwest Western Australia. The polymer test is an important test to further understand the possible origin of suspected microplastics particles.

5. Conclusions

Worldwide studies about microplastics contamination in bivalves have been extensively growing. Bivalves, particularly mussels (*Mytilus* spp.), are even suggested to be microplastics biomonitoring. However, the discrepancy among microplastics extraction methods still becomes an issue in consistently comparing the contamination among similar species. This study demonstrated the microplastics contamination in *Mytilus* spp. from urban estuaries in southwest Western Australia. Despite the difference in anthropogenic pressure on each estuary catchment, this study highlights the widespread microplastics pollution in Western Australian estuaries. This is shown by the contamination of the sedentary filter feeder inhabited the estuary. The result on microplastics abundance in this study is also comparable to other studies with similar extraction methods (Table 3). Due to the global distribution of Mytilus spp. and other potential reasons discussed above, we suggested that *Mytilus* spp. can be a suitable candidate for microplastics pollution biomonitoring in the estuary.

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Conflicts of Interest

"The authors declare no conflict of interest"

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