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Microplastic in the gastrointestinal tract of fishes along the Saudi Arabian Red Sea coast

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ABSTRACT

This study assesses the presence of microplastic litter in the contents of the gastrointestinal tract of 26 commercial and non-commercial fish species from four difference habitats sampled along the Saudi Arabian coast of the Red Sea. A total of 178 individual were examined for microplastics. In total, 26 microplastic fragments were found. Of these, 16 being films (61.5%) and 10 being fishing thread (38.5%). FTIR analysis revealed that the most abundant polymers were polypropylene and polyethylene. The grouper (*Epinephelus* spp.) sampled at Jazan registered the highest number of ingested microplastics. This fish species is benthic and feeds on benthic invertebrates. Although differences in the abundance of microplastic ingestion among species were not statistically significant, a significant change was observed when the level of ingestion of microplastics particles was compared among the habitats. The higher abundance of microplastics particles may be related to the habitats of fish and the presence of microplastics debris near the seabed. The results of this study represent a first evidence that microplastic pollution represents an emerging threat to Red Sea fishes, their food web and human consumers.

1. Introduction

Plastic has become one of the most common manufacturing materials in the world because it is reusable, durable, cheap, and lightweight (Andrady and Neal, 2009). However, the properties that make plastic so useful also make it a significant threat in the environment, where it lasts for decades (Sigler, 2014). Their low density leads to low weight but also renders much of plastic material positively buoyant, allowing for long-range transport in the ocean (Ryan et al., 2009). As a consequence of their global spread across the ocean, marine plastic litter has become a global pollutant, present across all oceans, including the most remote areas of the planet (Cózar et al., 2014, 2015, 2017).

It has been estimated that around 80% of marine debris originates from land-based activities, including litter derived from agriculture, industry, dumping of waste, and discharge with land run-off and rivers. The remaining 20% is derived from ocean based sources, including plastic materials released by commercial shipping, fishing activity (e.g. fishing lines and nets), and recreational boats (Li et al., 2016). Once entering the ocean, heavier plastic materials sink to the seafloor, while lighter, buoyant pieces are dispersed by currents or might sink after being ballasted by biofouling, entering oceanic circulation to accumulate in ocean gyres and semi-enclosed seas (Cózar et al., 2014, 2015, 2017).

Marine plastic litter is slowly broken up by mechanical, chemical, and photolytic degradation processes, resulting in a continuous decline in size, with the modal size of offshore fragments of floating plastic debris being smaller than 1 cm in diameter (Cózar et al., 2014). In general, the term (MP) refers to pieces of plastic smaller than 5 mm, either because of design, such as small rounded microbeads produced as resin pellets and powders in cosmetics and scrubs (Zitko and Hanlon, 1991) or as the outcome of fragmentation processes (Ryan et al., 2009). The size of microplastics, from 10's of microns to a few mm, overlaps with the prey size of a broad range of marine organisms (Lusher et al., 2015), creating a risk of micro plastic ingestion by marine organisms. Indeed, plastic particles have been found across the marine consumer food web, including zooplankton (e.g. salps and copepods), benthic

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Table 1
Mean values and range of fish length, weight, and stomach weight for all species, (n) = number of fish collected.

Species name	Species common name	Habitat	Location	Commercial Yes/No	Sample (n)	Mean length (cm) ± SD	Length range (cm)	Mean weight (g) ± SD	Weight range (g)	Mean stomach weight (g) ± SD
Acanthurus gahhm	Black surgeonfish	Demersal	Jizan	Yes	10	33.82 ± 3.72	40–28.1	535.1 ± 187.97	848–308	21.27 ± 6.71
Pristipomoides typus	White snapper	Demersal	Jizan	NO	5	28.46 ± 2.46	32.1–25.7	252.2 ± 70.08	368–188	3.71 ± 0.48
Epinephelus areolatus	Areolate grouper	Seagrass	Jizan	Yes	5	28.42 ± 4.24	33.7–23.8	281.6 ± 127.85	447–175	9.43 ± 1.29
Pristipomoides multidens	Goldbanded jobfish	Demersal	Jizan/ Qahmah	Yes	10	28.2 ± 2.66	33.2–25.5	236.7 ± 66.26	364–185	5.47 ± 2.19
Lutjanus kasmira	Bluestripe snapper	Coral reef	Jizan	Yes	12	24.45 ± 3.77	34.9–20.3	233.17 ± 143.5	665–121	4.22 ± 3.52
Lethrinus microdon	Smalltooth emperor	Coral reef	Jizan	Yes	10	29.53 ± 5.2	38.5–22.7	316.5 ± 146.22	605–147	6.66 ± 2.52
Epinephelus chlorostigma	Brownspotted grouper	Seagrass	Jizan	Yes	3	36.33 ± 9.92	42.7–24.9	700.33 ± 443.36	1019–194	12.27 ± 5.87
Gymnocranius grandoculis	Bluelined large-eye bream	Coral reef	Jizan	No	10	28.23 ± 2.31	33.1–26.1	344 ± 110.16	609–244	5.21 ± 2.32
Parascolopsis eriomma	Rosy dwarf monocle bream	Demersal	Jizan	Yes	5	23.3 ± 1.13	24.8–22.2	171 ± 21.37	200–147	4.13 ± 2.41
Sargocentron spiniferum	Sabre squirrelfish	Coral reef	Qahmah	NO	5	30.68 ± 0.89	32–30.1	427 ± 45.39	505–394	11.8 ± 3.11
Epinephelus radiatus	Oblique-banded grouper	Demersal	Qahmah	NO	7	29.34 ± 3.33	34.6–25.2	359.29 ± 129.06	582–217	9.14 ± 3.13
Lipocheilus carnolabrum	Tang's snapper	Demersal	Qahmah	Yes	7	24.39 ± 3.9	31.6–20.7	214 ± 120.32	444–117	4.29 ± 2.56
Plectorhinchus gaterinus	Blackspotted rubberlip	Demersal	Qahmah	Yes	6	26.53 ± 1.96	29.5–24.2	235.17 ± 46.23	298–181	6.33 ± 3.44
Epinephelus epistictus	Dotted grouper	Demersal	Jizan	NO	5	31.4 ± 6.9	38–21.5	424.4 ± 231.23	716–148	9.2 ± 3.7
Pygoplites diacanthus	Royal angelfish	Coral reef	Offshore KAUST	No	5	14.06 ± 2.55	17–10	74 ± 21.82	99–47	7.6 ± 2.07
Cephalopholis argus	Peacock hind	Coral reef	Yanbu	Yes	4	23.63 ± 1.3	25.5–22.5	201 ± 43.64	266–172	7.25 ± 5.85
Abudefduf sexfasciatus	Scissortail sergeant	Coral reef	Al-Lith	No	5	14.63 ± 0.63	15.5–14	60.8 ± 5.4	67–55	1.35 ± 0.43
Acanthurus sohal	Red Sea surgeonfish	Coral reef	Al-Lith	Yes	3	18.9 ± 3.29	21.5–15.2	92 ± 37.04	128–54	3.67 ± 1.15
Dascyllus trimaculatus	Threespot dascyllus	Coral reef	Al-Lith	No	2	10.5 ± 0.71	11–10	32.5 ± 0.71	33–32	1 ± 0
Chaetodon austriacus	Blacktail butterflyfish	Coral reef	Duba	No	10	10.82 ± 0.44	11.5–10	34.8 ± 3.94	39–26	1.1 ± 0.57
Neoniphon sammara	Sammara squirrelfish	Coral reef	Al-Lith	No	5	15.62 ± 1.64	18.2–13.8	31.2 ± 6.65	37–23	1.6 ± 0.55
Naso unicornis	Bluespine unicornfish	Coral reef	Offshore KAUST	Yes	2	40 ± 2.83	42–38	901 ± 70.71	951–851	130 ± 7.07
Thalassoma rueppellii	Klunzinger's wrasse	Coral reef	Al-Lith	Yes	12	16.12 ± 1.75	19.5–14	49.25 ± 17.7	85–23	1.33 ± 0.65
Benthosema pterotum	Skinnycheek lanternfish	Mesopelagic	KAEC	No	10	0 ± 0	2.5–1.9	0 ± 0	0.194–0.112	2.24 ± 0.2
Maurolicus mucronatus	Dragonfishes	Mesopelagic	KAEC	No	10	0 ± 0	2.9–2	0 ± 0	0.188–0.11	2.34 ± 0.25
Vinciguerria mabahiss	Panama lightfish	Mesopelagic	KAEC	No	10	0 ± 0	1.9–1.5	0 ± 0	0.027–0.014	1.72 ± 0.13