

Microplastic abundance in three commercial fish from the coast of Lima, Peru.

De-la-Torre, Gabriel Enrique, Dioses-Salinas, Diana Carolina, Pérez-Baca, Barnaby Licinio y Santillán, Luis.

Cita:

De-la-Torre, Gabriel Enrique, Dioses-Salinas, Diana Carolina, Pérez-Baca, Barnaby Licinio y Santillán, Luis (2019). *Microplastic abundance in three commercial fish from the coast of Lima, Peru*. *Brazilian Journal of Natural Sciences*, 2 (3), 171-177.

Dirección estable: <https://www.aacademica.org/gabriel.e.delatorre/20>

ARK: <https://n2t.net/ark:/13683/podQ/07V>



Esta obra está bajo una licencia de Creative Commons.
Para ver una copia de esta licencia, visite
<https://creativecommons.org/licenses/by-nc-nd/4.0/deed.es>.

Acta Académica es un proyecto académico sin fines de lucro enmarcado en la iniciativa de acceso abierto. Acta Académica fue creado para facilitar a investigadores de todo el mundo el compartir su producción académica. Para crear un perfil gratuitamente o acceder a otros trabajos visite: <https://www.aacademica.org>.

Original article

PRELIMINARY OBSERVATIONS OF PLASTIC DEBRIS IN THE GASTROINTESTINAL TRACT OF SEA URCHIN TETRAPYGUS NIGER

Authors: Gabriel Enrique De-la-Torre^{1,A}, Diana Carolina Dioses-Salinas¹, Sandra Huamantupa-Aybar¹, Joseph Davila-Carrasco¹

¹Universidad San Ignacio de Loyola, Lima, Perú.

Article ID

Keywords:
echinoderm, Peru,
nanoplastic

Abstract

Plastic pollution is regarded as one of the major issues from the Anthropocene epoch. Microplastics (<5 mm) are the result of the excessive plastic production and littering, thus becoming widespread in the environment. In this study, the presence and characteristics of microplastics extracted from the gastrointestinal tract of sea urchin *Tetrapygus niger* was reported. An average abundance of 3.22 ± 0.49 microplastics per individual was found, ranging from 1 to 5. Fibers were the dominant type (75.9%), followed by fragments (24.1%). Regarding color, most of the particles found were blue > red > black > green. These results are in lower magnitude levels than those reported in others species from the same region. However, microplastics could transfer from sea urchins to predators in higher trophic levels, like marine mammals. Prospects for further research was discussed.

Introduction

Microplastics (MPs) are plastic particles smaller than 5 mm in diameter (1,2). These particle have been evidenced around the world, reaching marine (3), terrestrial (4), freshwater environments (5) and even remote areas (6). Thus, MP pollution has been regarded as ubiquitous and widespread globally. MPs are classified as primary or secondary. While primary MPs are manufactured micro-sized (e.g., face scrubs and production pellets), secondary MPs derive

from the break down of larger plastics under certain environmental conditions (1).

Marine species from any trophic level may be subject to MP ingestion due to its small size (7). Upon ingestion, MPs could potentially biomagnify along the food web and reach apex predators (8). MP uptake threatens marine biota due to the adhered contaminants and leaching additives under weathering conditions (9) by causing ecotoxicological effects at a biomarker level (10). Filter feeding organisms are expected to perceive a higher exposure. However, research shows

*Corresponding author:

Gabriel Enrique De-la-Torre: e-mail: Gabriel.e.dltp@gmail.com - <https://orcid.org/0000-0002-0268-2784>

DOI: <https://doi.org/10.31415/bjns.v3i2.94> - Article received on May 14 , 2020; Accepted on May 22, 2020; published on 23 July 2020 in the Brazilian Journal of Natural Sciences, Vol. 3, N.2, online, ISSN 2595-0584. www.bjns.com.br. All authors contributed equally to the article. The authors declare that there is no conflict of interest. This is an open access article under the CC - BY license: <http://creativecommons.org/licenses/by/4.0>.

that marine grazers, like gastropods, could retain MPs ingested from contaminated seaweed (11,12).

Sea urchins feed by rasping on top of their feeding substrate with calcitic teeth, leaving scratches while grazing for endolithic photosynthetic organisms (13). In the sea urchin *Paracentrotus lividus*, this behavior have shown to cause a bioerosion of larger plastics into MPs (14). Since marine litter is mainly composed of plastic items (15), benthic marine grazers with specific feeding ecology could play role in the release of secondary MPs to the environment. In spite of this, information regarding the presence of MPs in sea urchins from the environment is limited compared to other benthic macroinvertebrates (e.g., bivalves).

In Peru, some studies have studied the presence of MPs in marine environments (3,16,17), and two assessing invertebrates (18,19). Here, the abundance and characteristics of MPs extracted from the gastrointestinal tract of sea urchin *Tetrapygus niger* were reported.

Materials and Methods

Study area and sample collection

In February of 2020, *T. niger* samples (n = 9) were collected from a recreational sandy beach (12°58'56.7"S 76°30'14.1"W) located in Cañete Province, Lima Region, Peru. The specimens were carefully detached from intertidal rocks during low

tide. Then, samples were stored and transported to the laboratory in precleaned sealed glass containers with ice. In the laboratory, the sea urchins were stored at -20 °C until further analysis.

Microplastic extraction and identification

The specimens were thawed prior analysis. The MP extraction procedure from the soft tissues was described elsewhere (17) (Fig. 1). In brief, a clean cut was made along the circumference of the sea urchin using clean sharp scissors and the gastrointestinal tract was extracted by cutting from the esophagus (not including the Aristotle's lantern) to the rectum. The tissues were weighted and placed in a screw cap test tube filled with 10% (w/v) KOH for tissue digestion. The tubes were then shaken manually and incubated at 60°C overnight. The whole digestate was vacuum filtrated through a Whatman 41 filter paper. The filters were placed in closed petri dishes. Filters were scanned using a stereomicroscope. MPs larger than 100 µm were identified based on their morphology and characteristics and classified into fibers, fragments, films and microbeads. The color of the MPs was also recorded.

Since identifying the polymer type of the MPs is generally a mandatory procedure (20,21), the results from this study are regarded as preliminary. Herein, MPs are referred to "suspected microplastics".

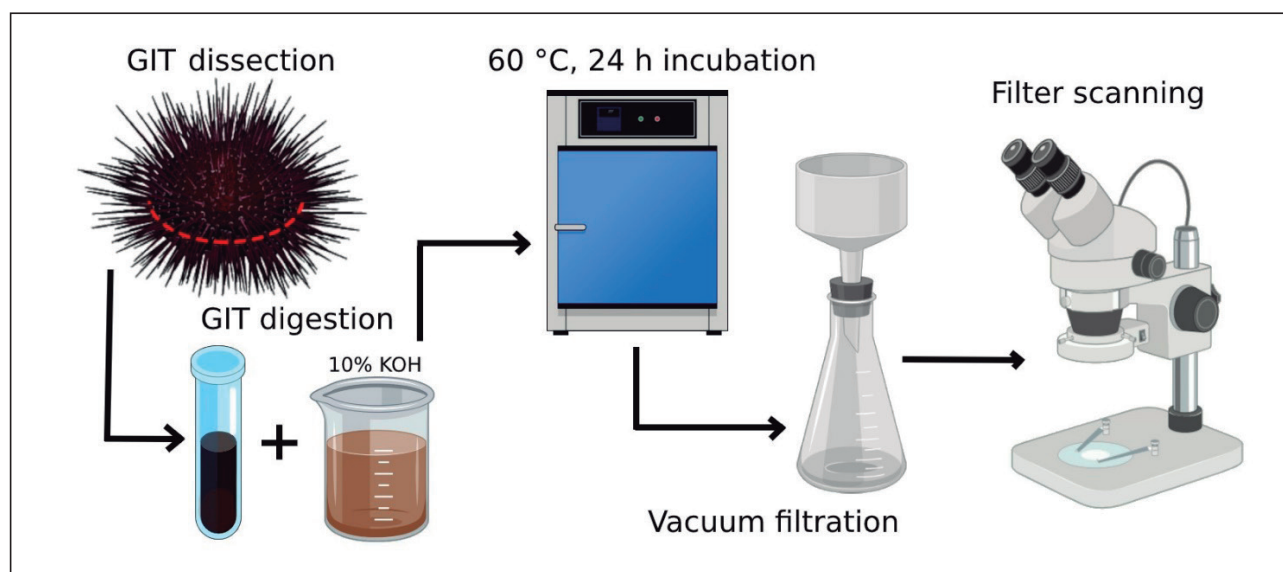


Fig. 1. Procedural steps for MP extraction and identification from the gastrointestinal tract of sea urchins.

Quality control

Quality control measures followed the ones described as mandatory by Dioses-Salinas *et al.* (4). In general terms, lab coats and polymer free gloves were worn at all times. Plastic materials were avoided and metal and glass wear were preferred. All the surfaces were wiped clean with distilled water, samples and reagents were covered when not in use. Liquids were prefiltered using the glass filtration apparatus' sand core plate.

An airborne blank was conducted by placing a wet filter on the work surface for as long as the batch treatment lasted. Also, a 10% KOH blank was prepared by filtering the same amount of reagent used in the samples. Upon inspection, no fibres or

suspicious particles were found in the blanks. Thus, quality control measured deemed sufficient.

Results

MP particles were observed in all of the sea urchins. A total of 29 MPs were observed. Mean MP concentration was 3.22 ± 0.49 MP per individual (MP/ind. \pm SEM) and 0.07 ± 0.01 MP per gram of wet weight (MP/g \pm SEM). Individual occurrence ranged from 1 to 5 MPs per individual. Regarding morphology, films and microbeads were not found. The majority of the MPs were fibres (75.9%), followed by fragments (24.1%). Blue colored particles were the most abundant, followed by red, black and green (Fig. 2).

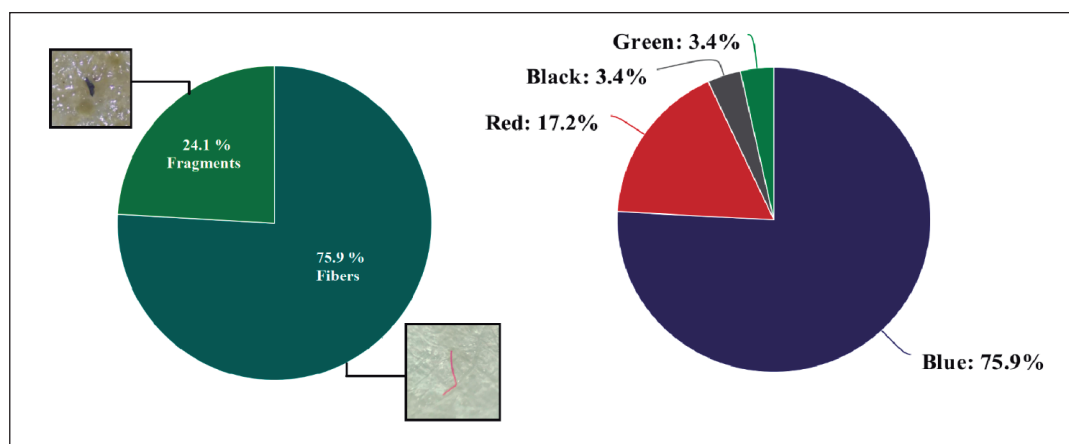


Fig. 2. Charts showing the percentage of MP morphotypes and color.

Discussions

A general low prevalence of MPs is reported in *T. niger* when compared to fish and bivalves from the Lima Region reported in previous research (17,19). MP intake by sea urchins are likely to be directly influenced by their foraging activity. Studies with periwinkles demonstrated macrophytes to be a viable vector for MPs (11,12). However, the likeliness of MPs to attach to biofilm surfaces in intertidal rocks used as foraging grounds for benthic invertebrates are unknown.

The dominance of fiber particles in marine species is commonly reported in literature (17,19,22,23). Importantly, Perez-Venegas (24) evidenced Otariids from the Peruvian and Chilean coast to have ingested mainly fibers. This indicates that MPs may pass from

prey to predator, scaling to higher trophic levels. Although the information regarding the presence of MPs in superficial waters is lacking in Peru, publications on marine sediment reported little to no fibres in their samples (3,16). This may be due to the smallest particles being overlooked, as these studies aimed for the “larger” MPs ranging from 1 to 5 mm.

Various ecotoxicological studies have demonstrated that MPs can cause ill effects on sea urchins at early stages of development (25–28). For instance, in *Lytechinus variegatus*, production pellets cause anomalous development of embryos (27), while polystyrene and polymethyl methacrylate microplastics induced a decrease in fertilization success in *Sphaerechinus granularis* and caused transmissible damage (28). Indeed, the bioavailability of MPs may pose a threat to the development and

survival of sea urchin populations.

Here, a preliminary assessment was carried out reporting the presence of MPs in sea urchins from the coast of a sandy beach in Peru. This is the first known study to evidence such particles in echinoderms from this region. A general low prevalence was observed, although the MP morphologies are similar to those reported in literature. Further studies must focus on tracking the sources of MPs in the Peruvian coastline, intake mechanics based on feeding ecology and MP assessment at various trophic levels.

Acknowledgements

The authors are thankful to Prof. Sandra Casimiro for allowing the present research to be conducted in the research laboratory facilities of Universidad San Ignacio de Loyola and supplying with the necessary equipment.

References

1. Cole M, Lindeque P, Halsband C, Galloway TS. Microplastics as contaminants in the marine environment: A review. *Mar Pollut Bull* [Internet]. 2011;62(12):2588–97. Available from: <http://dx.doi.org/10.1016/j.marpolbul.2011.09.025>
2. Andrady AL. Microplastics in the marine environment. *Mar Pollut Bull* [Internet]. 2011;62(8):1596–605. Available from: <http://dx.doi.org/10.1016/j.marpolbul.2011.05.030>
3. De-la-Torre GE, Dioses-Salinas DC, Castro JM, Antay R, Fernández NY, Espinoza-Morriberón D, et al. Abundance and distribution of microplastics on sandy beaches of Lima, Peru. *Mar Pollut Bull*. 2020 Feb 1;151:110877.
4. Dioses-Salinas DC, Pizarro-Ortega CI, De-la-Torre GE. A methodological approach of the current literature on microplastic contamination in terrestrial environments: Current knowledge and baseline considerations. *Sci Total Environ* [Internet]. 2020 Aug 15 [cited 2020 May 11];730:139164. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0048969720326814>
5. Grbić J, Helm P, Athey S, Rochman CM. Microplastics entering northwestern Lake Ontario are diverse and linked to urban sources. *Water Res* [Internet]. 2020;174:115623. Available from: <https://doi.org/10.1016/j.watres.2020.115623>
6. Bergmann M, Wirzberger V, Krumpfen T, Lorenz C, Primpke S, Tekman MB, et al. High Quantities of Microplastic in Arctic Deep-Sea Sediments from the HAUSGARTEN Observatory. *Environ Sci Technol*. 2017 Oct 3;51(19):11000–10.
7. De-la-Torre GE. Microplastics: an emerging threat to food security and human health. *J Food Sci Technol*. 2020 May 1;57(5):1601–8.
8. Nelms SE, Galloway TS, Godley BJ, Jarvis DS, Lindeque PK. Investigating microplastic trophic transfer in marine top predators. *Environ Pollut*. 2018 Jul 1;238:999–1007.
9. Fred-Ahmadu OH, Bhagwat G, Oluyoye I, Benson NU, Ayejuyo OO, Palanisami T. Interaction of chemical contaminants with microplastics: Principles and perspectives. *Sci Total Environ*. 2020 Mar 1;706:135978.
10. Dioses-Salinas DC, Pérez-Baca B, De-la-Torre GE. Ecotoxicological effects of microplastics and adsorbed contaminants on aquatic organisms. *Manglar*. 2019 Dec 31;16(2):173–82.
11. Gutow L, Bartl K, Saborowski R, Beermann J. Gastropod pedal mucus retains microplastics and promotes the uptake of particles by marine periwinkles. *Environ Pollut*. 2019 Mar 1;246:688–96.
12. Gutow L, Eckerlebe A, Giménez L, Saborowski R. Experimental Evaluation of Seaweeds as a Vector for Microplastics into Marine Food Webs. *Environ Sci Technol*. 2016 Jan 19;50(2):915–23.
13. F Boudouresque C, Verlaque M. Chapter 13 Ecology of *Paracentrotus lividus*. In: *Developments in Aquaculture and Fisheries Science*. Elsevier; 2007. p. 243–85.
14. Porter A, Smith KE, Lewis C. The sea urchin *Paracentrotus lividus* as a bioeroder of plastic. *Sci Total Environ*. 2019 Nov 25;693:133621.
15. De-la-Torre G, Laura RP. Composition, physical characteristics and per capita generation of solid waste at Las Sombrillas beach, Lima. *Manglar*. 2019 Jun 28;16(1):39–44.
16. Purca S, Henostroza A. Presencia de microplásticos en cuatro playas arenosas de Per. *Rev Peru Biol*. 2017;24(1):101–6.
17. De-la-Torre GE, Dioses-Salinas DC, Pérez-Baca BL, Santillán L. Microplastic abundance in three commercial fish from the coast of Lima, Peru. *Brazilian J Nat Sci* [Internet]. 2019;2(3):171–7. Available from: <https://doi.org/10.31415/bjns.v2i3.67>
18. De-la-Torre G, Mendoza-Castilla L, Laura

- RP. Microplastic contamination in market bivalve *Argopecten purpuratus* from Lima, Peru. *Manglar*. 2019 Dec 31;16(2):85–9.
19. Valencia-Velasco F, Guabloche-Zuñiga A, Alvarino L, Iannacone J. Estandarización de un protocolo para evaluar microplásticos en bivalvos marinos en el Departamento de Lima, Perú. *Biol*. 2020 May 2;18(1).
20. De-la-Torre G. Microplásticos en el medio marino: Una problemática que aborda. *Rev Cienc Y Tecnol*. 2019 Dec 26;15(1):9–15.
21. Dehaut A, Hermabessiere L, Duflos G. Current frontiers and recommendations for the study of microplastics in seafood. *TrAC - Trends Anal Chem*. 2019 Jul 1;116:346–59.
22. Li J, Qu X, Su L, Zhang W, Yang D, Kollandhasamy P, et al. Microplastics in mussels along the coastal waters of China. *Environ Pollut*. 2016 Jul 1;214:177–84.
23. Naji A, Nuri M, Vethaak AD. Microplastics contamination in molluscs from the northern part of the Persian Gulf. *Environ Pollut*. 2018 Apr 1;235:113–20.
24. Perez-Venegas DJ, Toro-Valdivieso C, Ayala F, Brito B, Iturra L, Arriagada M, et al. Monitoring the occurrence of microplastic ingestion in Otariids along the Peruvian and Chilean coasts. *Mar Pollut Bull* [Internet]. 2020;153(August 2019):110966. Available from: <https://doi.org/10.1016/j.marpolbul.2020.110966>
25. Messinetti S, Mercurio S, Parolini M, Sugni M, Pennati R. Effects of polystyrene microplastics on early stages of two marine invertebrates with different feeding strategies. *Environ Pollut*. 2018 Jun 1;237:1080–7.
26. Della Torre C, Bergami E, Salvati A, Faleri C, Cirino P, Dawson KA, et al. Accumulation and embryotoxicity of polystyrene nanoparticles at early stage of development of sea urchin embryos *Paracentrotus lividus*. *Environ Sci Technol*. 2014 Oct 21;48(20):12302–11.
27. Nobre CR, Santana MFM, Maluf A, Cortez FS, Cesar A, Pereira CDS, et al. Assessment of microplastic toxicity to embryonic development of the sea urchin *Lytechinus variegatus* (Echinodermata: Echinoidea). *Mar Pollut Bull*. 2015 Mar 15;92(1–2):99–104.
28. Trifuoggi M, Pagano G, Oral R, Pavičić-Hamer D, Burić P, Kovačić I, et al. Microplastic-induced damage in early embryonal development of sea urchin *Sphaerechinus granularis*. *Environ Res*. 2019 Dec 1;179:108815.