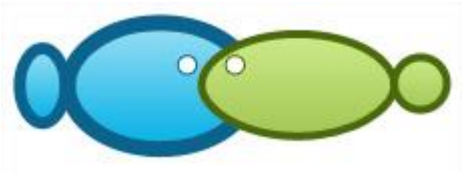

Microplastics study needs rigorous study design: a commentary on Laput et al (2024) on bioaccumulation of microplastics in *Echinolittorina* sp. from the Philippines

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Abstract. The lack of information on microplastics bioaccumulation from the Philippines necessitates investigation. However, a rigorous study design is needed to avoid drawing inaccurate conclusions. Here we review the article published in AACL Bioflux Volume 17, Issue 1 on bioaccumulation of microplastics in *Echinolittorina* sp. by Laput et al (2024). We found that the study design used by the authors was inadequate, resulting to a misleading conclusion that is not supproted by the results. This commentary highlighted the inadvertencies and how these affected the validity of the microplastics bioaccumulation study conducted by Laput et al (2024).
Key Words: bioaccumulation, ingestion, marine pollution, microplastics, Philippines.

Bioaccumulation is defined as "the increase of contaminant concentration in aquatic organisms following uptake from the ambient environmental medium" (Wang 2016). Several factors are to be considered in order to conclude that there is accumulation of pollutants in an organism (Burkhard 2003). In the case of microplastics, bioaccumulation remains unclear and depends on whether these materials translocate to other tissues (McIlwraith et al 2021). However, depending on the size and type, evidence is now emerging on the translocation of microplastics from the gut, signifying absorption, and distribution of the material in an organism's body (McIlwraith et al 2021; Merrill et al 2023).

The lack of information on microplastics bioaccumulation from the Philippines necessitates a thorough investigation (Abreo 2018). The study conducted by Laput et al (2024) entitled "Bioaccumulation of microplastics in *Echinolittorina* sp. along intertidal areas of Barangay Buru-un, Iligan City, Philippines" published in AACL Bioflux (Volume 17, Issue 1) tried to address the knowledge gaps on marine litter bioaccumulation in the Philippines. Although information on bioaccumulation of this type of pollutant is needed, a rigorous study design is a matter of paramount importance and should be prioritized in conducting microplastics bioaccumulation studies, or microplastics studies, in general.

A crucial factor to account when investigating bioaccumulation of pollutants in organisms, particularly in organisms like *Echinolittorina* sp., is the duration of exposure (Diop et al 2022). Bioaccumulation unfolds gradually over time as organisms interact with pollutants in their surroundings (Alava 2020). However, it is worth noting that the study of Laput et al (2024) overlooked this vital parameter. Instead, their research merely focused on assessing the presence of microplastics in *Echinolittorina* sp. While the specific duration of exposure may vary, conducting experiments over multiple time points or durations provides a more comprehensive understanding of the bioaccumulation process and its implications. Moreover, to quantify the relationship between exposure and bioaccumulation, bioaccumulation metrics such as Bioaccumulation Factor (BAF) or Biota-Sediment Accumulation Factor (BSAF) are employed (Melake et al 2023). These metrics

are calculated taking into account pollutant concentrations in organisms and their surrounding environment (Burkhard & Votava 2023). The bioaccumulation study by Laput et al (2024) failed to quantify and characterize microplastics in the study location, which is essential in determining bioaccumulation of pollutants in organisms. Given that BAF and BSAF are not designed for microplastics contamination, the concept of comparing the ambient pollutant concentration to that found within the organism is fundamental in bioaccumulation studies (Karlsson et al 2017).

At the minimum, Laput et al (2024) should have put forward empirical evidence on the absorption of the material and translocation to other tissues or organs (McIlwraith et al 2021; Merrill et al 2023). Although several studies suggest that organisms have the ability to egest microplastics, making accumulation unlikely (Ohkubo et al 2020; Spanjer et al 2020), evidence points that elimination efficiency of microplastics translocated in different tissues differ, possibly allowing persistence of the material in the organism (Crooks et al 2019; Goncalves et al 2019). Laput et al (2024) digested the entire body tissue of the collected specimen. Digestion of the entire body tissue of *Echinolittorina* sp. does not allow to discriminate the specific tissue or organ from which the microplastics were recovered and thus, only confirm the presence of microplastics and not provide information on microplastic absorption and translocation.

Simple inadvertencies in the methodology, like failure to conduct microplastic contamination control protocol during sample processing could lead to confounded results (Gwinnett & Miller 2021). In the study by Laput et al (2024), it is unclear whether they performed contamination control protocol in the entirety of the sample processing duration. The contamination control stated in the paper was only performed during the drying of the filter used to separate microplastics from the potassium hydroxide – dissolved organic matter – sodium chloride solution. Moreover, no notes on procedural blank processing were mentioned. Procedural blanks are necessary to ensure the quality of microplastics data and identify contamination (Munno et al 2023).

Conclusions. To sum it up, there is a need to study bioaccumulation of microplastics in marine organisms, especially in the Philippines. However, the flawed study design invalidates the conclusion put forward by Laput et al (2024) on the bioaccumulation of microplastics in *Echinolittorina* sp. The mere presence of ingested plastic does not constitute bioaccumulation. At best, the paper only provided confirmation on microplastic ingestion by the studied organism.

Conflict of Interest. The authors declare that there is no conflict of interest.

References

Abreo N. A. S., 2018 Marine plastics in the Philippines: a call for research. Philippine Science Letters 11(1):20-21.

Alava J. J., 2020 Modeling the bioaccumulation and biomagnification potential of microplastics in a cetacean foodweb of the northeastern pacific: a prospective tool to assess the risk exposure to plastic particles. Frontiers in Marine Science 7:566101.

Burkhard L. P., 2003 Factors influencing the design of bioaccumulation factor and biota-sediment accumulation factor field studies. Environmental Toxicology and Chemistry: An International Journal 22(2):351-360.

Burkhard L. P., Votava, L. K., 2023 Biota-sediment accumulation factors for per-and polyfluoroalkyl substances. Environmental Toxicology and Chemistry 42(2):277-295.

Crooks N., Parker H., Pernetta A. P., 2019 Brain food? Trophic transfer and tissue retention of microplastics by the velvet swimming crab *Necora puber*. Journal of Experimental Marine Biology and Ecology 519:151187.

Diop M., Couteau J., Bado-Nilles A., Tavernier E., Ouddane B., Denis J., Duong G., Gevaert F., Monchy S., Laroche J., Amara R., 2022 Bioaccumulation of trace metal

elements and biomarker responses in caged juvenile flounder at a polluted site: Effects of fish density and time exposure. Marine Pollution Bulletin 185:114289.
Gonçalves C., Martins M., Sobral P., Costa P. M., Costa M. H., 2019 An assessment of the ability to ingest and excrete microplastics by filter-feeders: a case study with the Mediterranean mussel. Environmental Pollution 245:600-606.
Gwinnett C., Miller R. Z., 2021 Are we contaminating our samples? A preliminary study to investigate procedural contamination during field sampling and processing for microplastic and anthropogenic microparticles. Marine Pollution Bulletin 173:113095.
Karlsson M. V., Carter L. J., Agatz A., Boxall A. B., 2017 Novel approach for characterizing pH-dependent uptake of ionizable chemicals in aquatic organisms. Environmental Science & Technology 51(12):6965-6971.
Laput J. R. L., Adamat L. A., Tumang V. M. C., Moneva C. S. O., 2024 Bioaccumulation of microplastics in *Echinolittorina* sp. along intertidal areas of Barangay Buru-un, Iligan City, Philippines. AACL Bioflux 17(1):499-507.
McIlwraith H. K., Kim J., Helm P., Bhavsar S. P., Metzger J. S., Rochman C. M., 2021 Evidence of microplastic translocation in wild-caught fish and implications for microplastic accumulation dynamics in food webs. Environmental Science & Technology 55(18):12372-12382.
Melake B. A., Endalew S. M., Alamirew T. S., Temesegen L. M., 2023 Bioaccumulation and biota-sediment accumulation factor of metals and metalloids in edible fish: A systematic review in Ethiopian surface waters. Environmental Health Insights 17:11786302231159349.
Merrill G. B., Hermabessiere L., Rochman C. M., Nowacek D. P., 2023 Microplastics in marine mammal blubber, melon, & other tissues: Evidence of translocation. Environmental Pollution 335:122252.
Munno K., Lusher A. L., Minor E. C., Gray A., Ho K., Hankett J., Lee C. F. T., Primpke S., McNeish R. E., Wong C. S., Rochman C., 2023 Patterns of microparticles in blank samples: A study to inform best practices for microplastic analysis. Chemosphere 333:138883.
Ohkubo N., Yoneda M., Ito M., Hano T., Kono K., 2022 Microplastic uptake and gut retention time in Japanese anchovy *Engraulis japonicus* under laboratory conditions. Marine Pollution Bulletin 176:113433.
Spanjer A. R., Liedtke T. L., Conn K. E., Weiland L. K., Black R. W., Godfrey N., 2020 Evidence for rapid gut clearance of microplastic polyester fibers fed to Chinook salmon: A tank study. Environmental Pollution 265:115083.
Wang W. X., 2016 Bioaccumulation and biomonitoring. In: Marine ecotoxicology. Blasco J., Chapman P. M., Campana O., Hampel M. (eds), Academic Press, pp. 99-119.

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