Microplastic Presence Within Waterfowl of the Prairie Pothole Region

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Introduction

Plastic usage and improper disposal is a growing ecological problem for marine and freshwater ecosystems. Plastics entering ecosystems do not fully breakdown but are rather subject to fragmentation into microplastics. Microplastics are plastic fragments <5mm in diameter and are more prone to enter organisms in the environment. Microplastics have been documented thoroughly in marine environments, but research in freshwater and terrestrial ecosystems is lacking. Further, the Prairie Pothole region plays a great importance to waterfowl health but has not seen thorough research on the presence of microplastics.

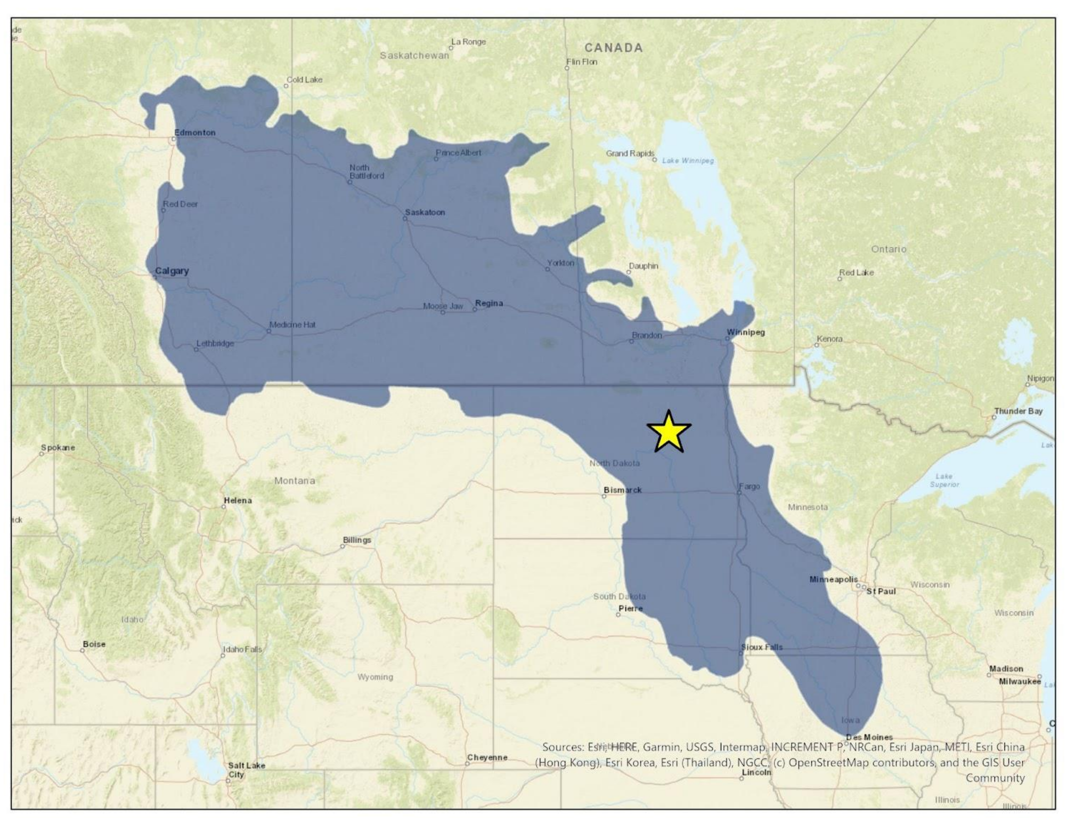

Figure 1: Prairie Pothole Region and Devil's Lake, ND.

There are three main feeding habits among waterfowl populations: dabblers, which graze food on the surface, divers, which feed beneath the water surface, and ground foragers, which consume both terrestrial and aquatic food sources (Sun et al., 2012).

Dabbling species include mallards, gadwalls, and northern pintails. Ground foragers include Canada geese and snow geese.

Our Goals:

- Analyze the relationship between prevalence of microplastics and different types of feeding habits (dabbling and ground foraging)
- Distribution of microplastics in different organs
- Characterize microplastics (colors, types, measurements)

Methods

- **Sampling:** The gastrointestinal tracts of 102 waterfowl (79 dabblers and 23 ground foragers) were donated by a hunting guide in Devil's Lake, ND. We removed and separated the proventriculus, gizzard, and intestine to understand the distribution of microplastics within the gastrointestinal tract.
- **Filtration:** The contents of each organ were rinsed with water through a 500-micron sieve. The gut contents were then filtered through filter papers using a vacuum apparatus and a Büchner funnel. The filter papers were then put in Petri dishes, covered, and left to dry in a fume hood overnight.
- **Visual Identification:** Dried filters were examined under dissecting microscopes and microplastics were identified based on the following criteria:1) No observable organic or cellular structures present; 2) Fibers should have consistent width throughout their whole length while possessing neither tapered ends nor twisting or bending; 3) Colored particles should be homogenous and appear artificial; 4) Any debris with clear or whitish color would be inspected under a higher magnification for confirmation (Holland et al. (2016) and Zhao et al. (2016))

Results

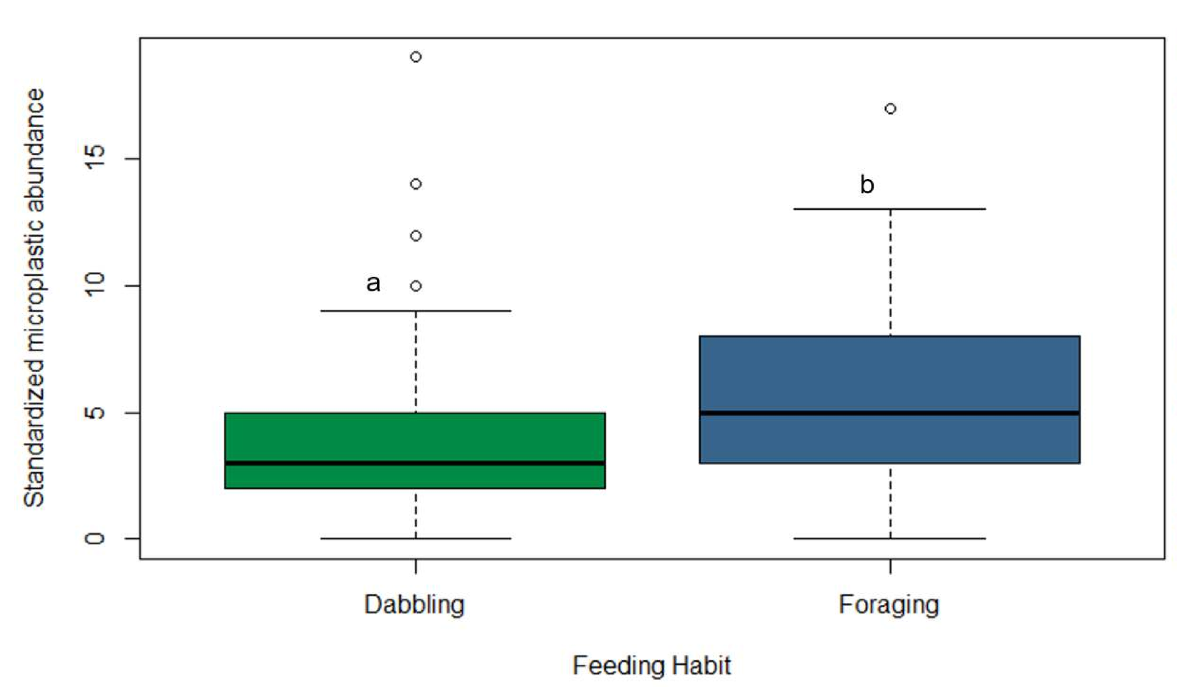

Figure 2: Standardized mean abundance of microplastics present the whole gastrointestinal tract in dabbling group and foraging group. (ANOVA-test, $p=0.0249$, $\alpha=0.05$)

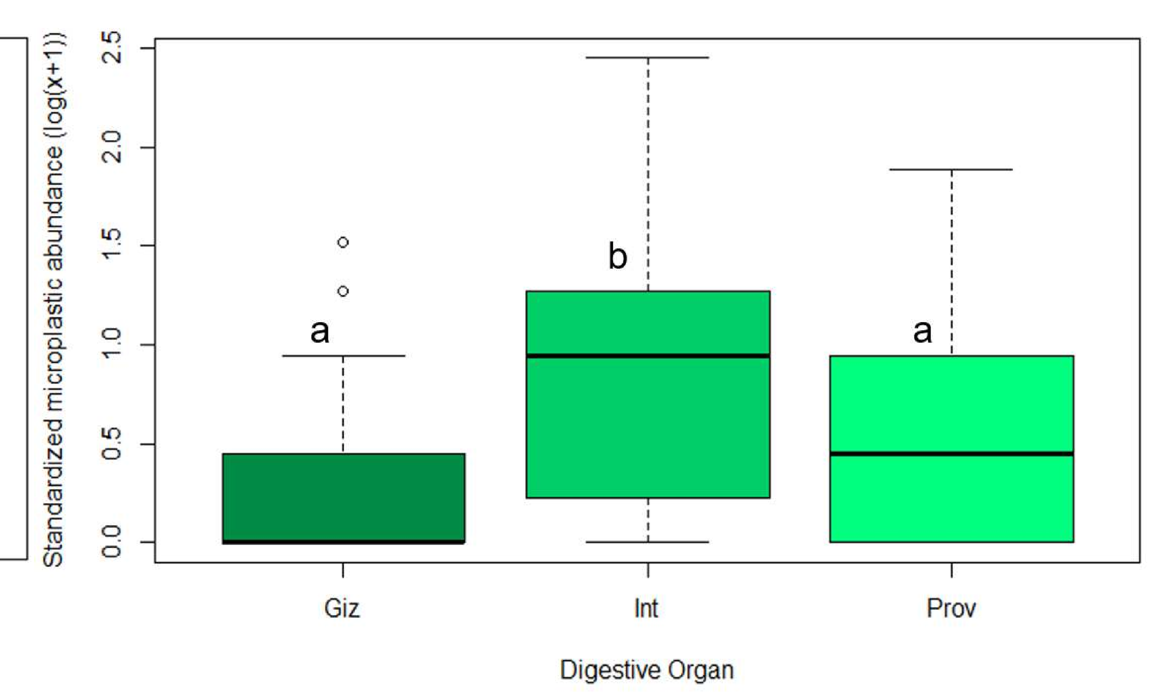

Figure 3: Standardized mean of microplastic abundance in different organs within the subset of dabblers N=80. (Giz= Gizzard, Int= Intestine, Prov= Proventriculus). (ANOVA-test, $p<0.0001$, $\alpha=0.05$).

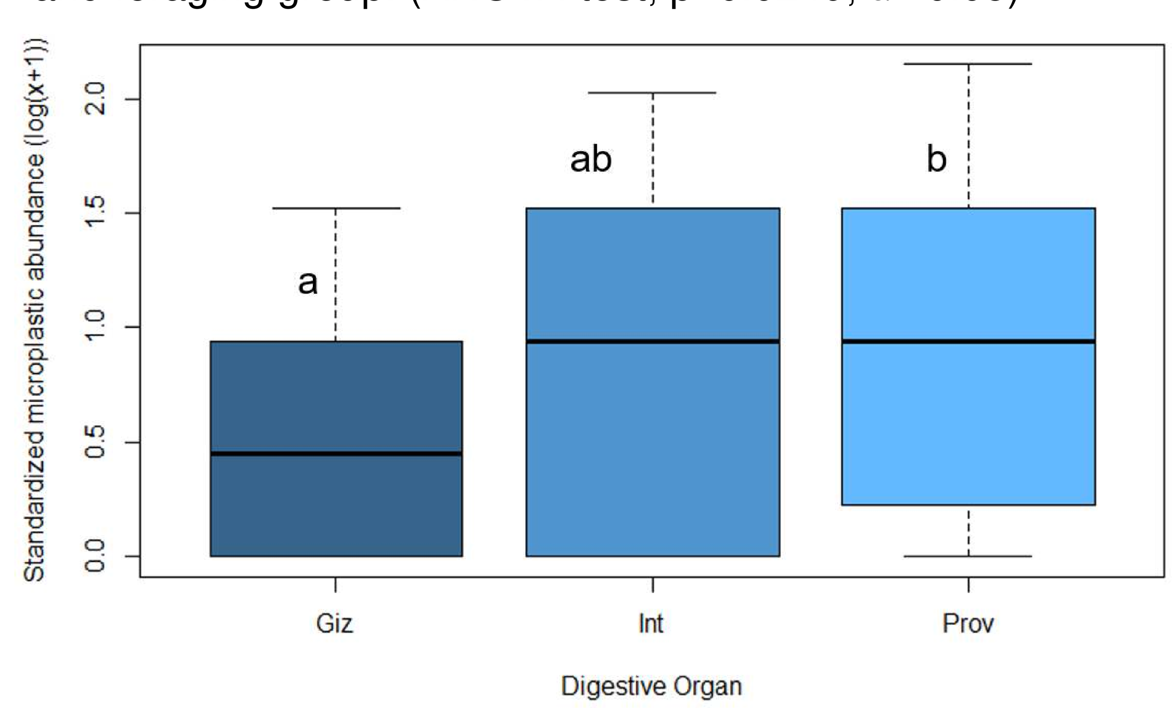

Figure 4: Standardized mean of microplastic abundance in different organs within the subset of foragers N=21. (Giz= Gizzard, Int= Intestine, Prov= Proventriculus). (ANOVA-test, $p=0.0385$, $\alpha=0.050$.

Figure 5: Blue microplastic fragment.

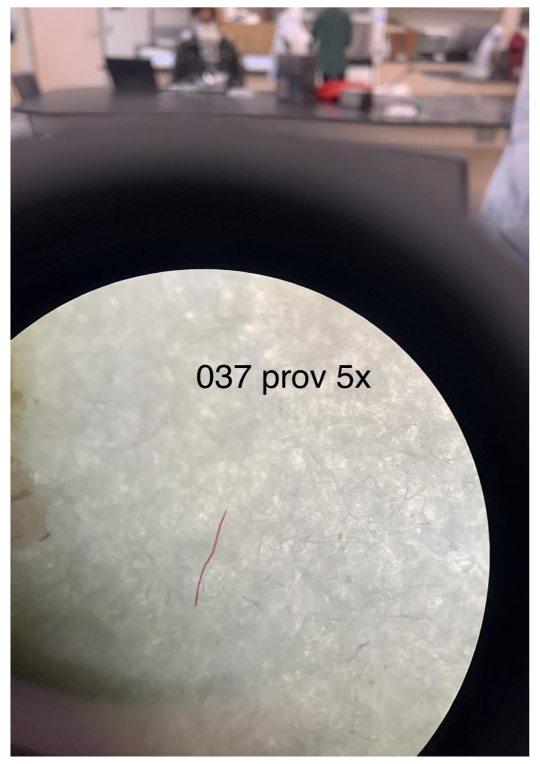

Figure 6: Red microplastic fiber.

Discussion

We found a significant difference in microplastic abundance based on the feeding habits of waterfowl and across organs within the two feeding habits analyzed (Fig. 2). Because the residence time of plastics in different organs along the digestive tract, the location in which microplastics are found and where they accumulate can provide general information on where the plastics were consumed (Fig. 3).

Waterfowl may mistake microplastics for food while foraging or dabbling. Of our identified microplastics, the most popular color groups were black/brown, blue/green, and red/orange (Fig. 5). Microfibers dominated our samples with 99.1% of total microplastics found being fibrous (Fig. 6), notably affecting dabblers due to its low density.

The presence of microplastics within waterfowl in this region warrants the need for further research on the abundance and distribution of microplastic pollution at multiple levels.

Future Studies

Future studies aim to assess the abundance of microplastics in the gastrointestinal tracts of diving ducks to have a better understanding of how feeding habit affects the accumulation of microplastics in waterfowl. We also aim to understand the prevalence of microplastics in the environment by analyzing invertebrate, soil, and water samples from prairie potholes across the region.

Acknowledgements

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Literature Cited

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