Microplastic Consumption by Mole Crabs (*Emerita analoga*) in Mission Beach

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BACKGROUND

- Microplastics are small plastic particles (<1mm) that are a dominant form of marine pollution in marine and coastal environments.
- Microplastic may contain hazardous chemicals that can have a negative affect on the animals that ingest it (Teuten et al., 2009).
- Microfibers, a form of microplastics that come from sources such as clothing and rope, are commonly found in marine sediments (Browne et al., 2011).
- A single article of synthetic clothing can shed up to 1900 microfibers per wash cycle (Browne et al., 2011).
- Little is known about whether marine organisms are ingesting these microfibers, and once ingested if microfibers are impacting growth and reproduction (Teuten et al., 2009).

- Mole crabs (*Emerita analoga*) live in the swash zone of sandy beaches, burrow in the sand, and filter feed on plankton and detritus using their feathery antennae.
- Their antennae may inadvertently collect microfibers from the water column.

OBJECTIVES

Is there a temporal trend in microplastic ingestion rates found in mole crabs at Mission Beach?

- H_o: There will be no change in microplastic consumption over time.

Do microplastics have an effect on the condition (weight/length³) or egg weight of female mole crabs?

- H_o: Microplastic will not have an effect on the condition or egg weight of female mole crabs.

METHODS

Field Collection

- We collected ~ 30 Mole crabs from Mission Beach, San Diego every month from June - October 2018.
- Mole crabs were collected from the swash zone using a colander, placed in a Ziploc bag, and frozen.

Lab Processing

- Prior to dissection, we measured carapace length, body weight and egg weight.
- The mole crab's carapace was opened. The intestine was removed and placed onto a dish.
- The intestine was dissected to look for any microplastics.
- The amount of microplastic and color were documented.

Data Analysis

- To minimize bias in data, results were standardized by size including only mole crabs between lengths of 12 - 16mm.
- Only female mole crabs were used in the data analysis.
- To control for the effect of time, average condition and egg weight were examined by month (only July is presented).
- Condition was determined by (weight/length³).
- Comparison of average number of plastics by month was examined using Kruskal-Wallis. Condition and egg weight was examined using a t-test.

Figure 1a.

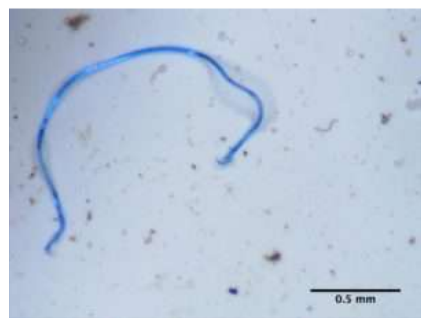

Figure 1b.

Figure 1c.

Figure Legend

Mole crabs being dissected (Figure 1a).
Microfiber found in mole crab (Figure 1b).
Female mole crab with eggs (Figure 1c).

RESULTS

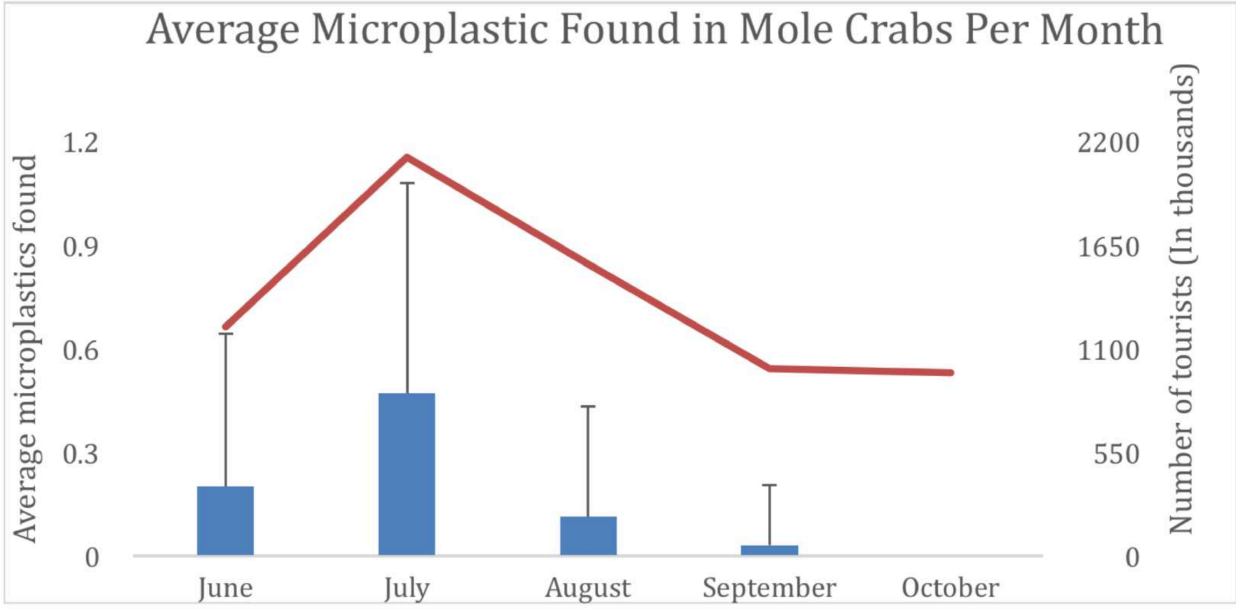

Figure 1. Average monthly microplastic consumption by mole crabs. Red line indicates number of tourists in San Diego per month (San Diego County Visitor Industry).

- July had the highest average number of microplastics ingested.
- There was a significant difference in microplastic consumption among months (Kruskal-Wallis, $p < 0.05$).

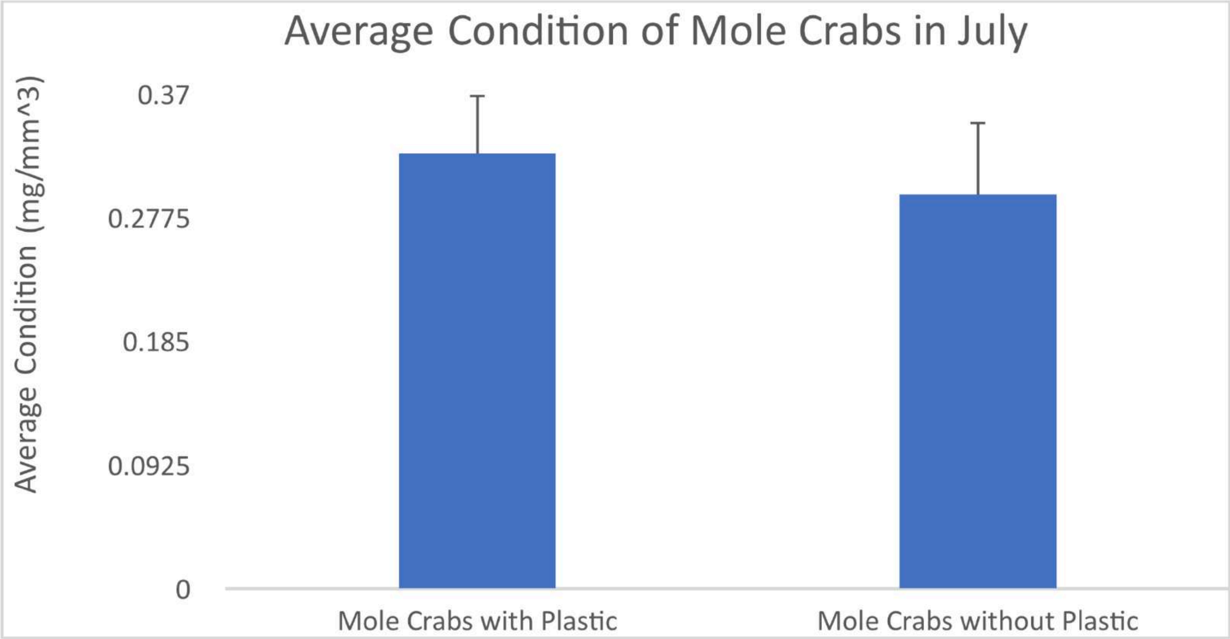

Figure 2. Average condition of mole crabs with and without plastic from July.

- The average condition of mole crabs without plastic was 0.29.
- The average condition of mole crabs with plastic was 0.33.
- There was no significant difference (t-test, $p > 0.05$).

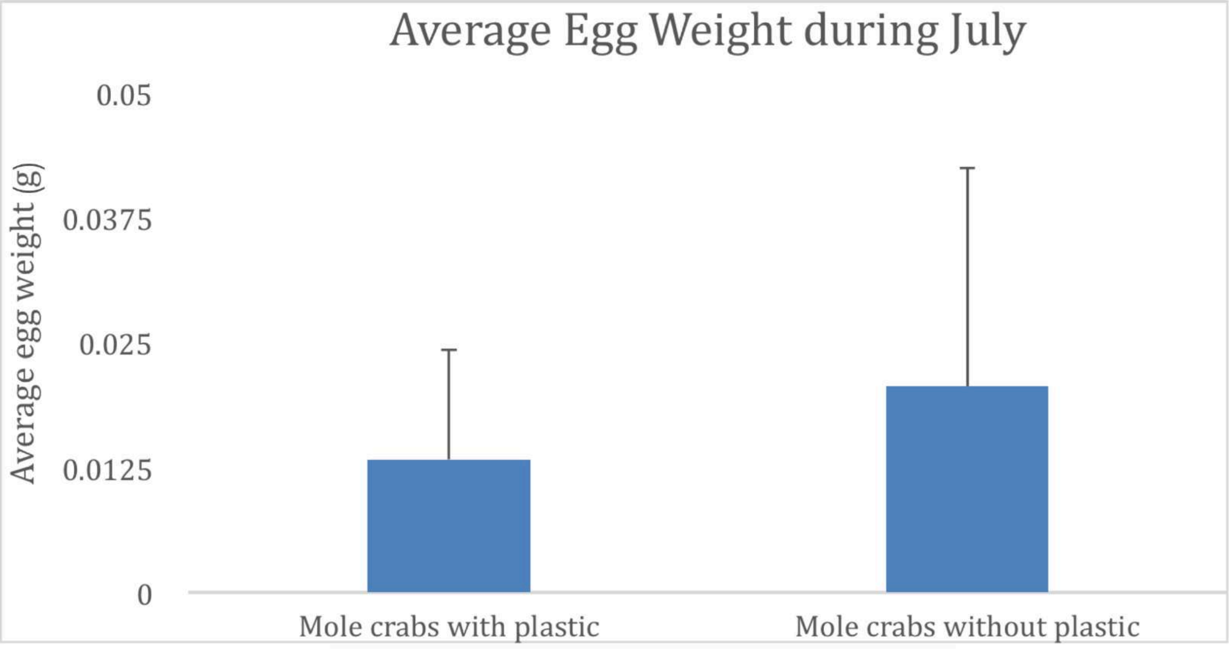

Figure 3. Average egg weight of mole crabs with and without plastic consumption in July.

- The average egg weight of mole crabs without plastic was 0.02 g.
- The average egg weight of mole crabs with plastic was 0.01 g.
- There was a significant difference (t-test, $p < 0.05$).

CONCLUSION

- Overall, there was a significant difference in microplastic ingestion among months, with the highest levels found during July, which is the peak tourist season in San Diego.
- Plastic fibers may be coming from clothing (Browne et al., 2011) or increased levels of sewage effluent discharged from Point Loma sewage treatment facility.

- Although there was no significant difference between the average condition of mole crabs with plastic versus without, there was a trend that mole crabs with microplastic in their digestive tract had a higher condition. This may be explained by individuals with a higher condition filtering more water.
- Mole crabs that had ingested microplastic had a significantly lower egg weight. This may be explained by microplastics having a negative effect on the reproduction system of mole crabs. Previous work suggests that microplastic had a negative effect on the reproduction rate of some fish and aquatic invertebrates (Foley et al., 2018).

FUTURE STUDIES

- To examine if human activity in coastal areas is linked to an increase in microplastic abundance and ingestion rates in other marine species.
- Chemically analyze microfibers to determine microplastic source (see Teuten et al., 2009).
- To compare fiber concentrations in the sand and in the water (see Horn et al., 2019).
- To determine why individuals that ingested microplastic had lower egg weight.
- Further analysis in this field of study is necessary to understand if microplastics are negatively affecting the growth, reproduction, and survival rate of mole crabs.
- To determine if maternal ingestion of microplastic effects their larva's growth or survival rate.
- Future studies should address issues of the potential effects of microplastic on different tropic levels.

ACKNOWLEDGEMENTS

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SELECTED REFERENCES

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Tourism volume data taken from, San Diego Country Visitor Industry Performance 2018. San Diego Industry Research.