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Northern Fulmars (Fulmarus glacialis) as bio-indicators of endocrine disrupting plasticizers in the marine surface environment

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INTRODUCTION

Modern estimates conservatively report that the global oceans currently contain 315 billion pounds of plastics1. A number of plastics are synthesized with phthalate plasticizers which are utilized as an additive to improve durability and flexibility of the product2.

Many phthalates have been identified as endocrine disrupting chemicals (EDCs), and studies have shown dramatic deleterious effects as a result of exposure to growing numbers of EDCs in the environment. Impacts include heightened susceptibility to diseases and cancers as well as skewed gender ratios due to estrogen-mimicking plasticizers.

Northern Fulmars (Fulmarus glacialis) are a widely distributed, circumpolar species of seabird that is used as a bio-indicator of marine environmental conditions3. As an opportunistic species, feeding on what can be found near the surface, fulmars are particularly susceptible to ingesting and, importantly, retaining plastics as they are unable to offload plastic effectively. Plastic residency in the digestive system limits nutrient absorption by an individual and may cause disruption of the endocrine system as phthalate plasticizers leach out of the products4.

This study had the following two principal objectives: 1. Quantify levels of plastics containing harmful phthalate plasticizers in the coastal marine environment using Northern Fulmars as an indicator species. 2. Determine if spatial patterns exist in the distribution of plastic types in fulmar diets from Alaska, Washington, and California.

METHODS

-Plastics were extracted from the proventriculus and ventriculus of Northern Fulmars from:
  -Washington: n= 65 (died in rehabilitation or on the beach)
  -California: n= 45 (died in rehabilitation or on the beach)
  -Alaska: n= 49 (collected as fisheries bycatch)
-Plastics were identified through a density test described in Figure 1.

RESULTS

-HDPE made up >88% of the plastic in fulmar diets across all regions (range 88.9-97%) (Fig. 2).
-As low as 1.4% of plastics in California and as high as 2.6% of plastics in Alaska that made up the diet of Northern Fulmars in tested regions are currently known to contain harmful plasticizers (Fig. 2).
-Proportions of plastics in AK differed from those in CA and WA based on a Chi-Square analysis. \( \chi^2 = 18.15, p < 0.001 \)

DISCUSSION

-Northern fulmars are effective bio-indicators of plastics in marine environments and of the presence of plasticizer containing plastics in surface waters.
-May need other species to sample benthic regions where phthalate-containing plastics tend to concentrate due to their density.
-Very low proportion of phthalate-containing plastics in fulmar diet at present. These are reference data to be used to monitor population and environmental trends over time.

• HDPE impairs nutrient absorption, but contains no known endocrine disrupting components.
-Regardless of the presence of EDCs, ingested plastics still have an impact as they occupy volume in the stomach and thus constrain digestive capacity/nutrient absorption.
-Secondary ingestion through prey (particularly prey that forage benthically) can result in an indirect accumulation of EDCs.

FUTURE STUDIES

-Determine the toxicity levels and thresholds of plastics containing harmful phthalate plasticizers.
-Conduct biomagnification studies focusing on the ingestion of plastics by benthic foragers.

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REFERENCES


Northern Fulmar immortalized in cake. Baked by Olivia Feinstein and Alicia Terepocki

Stomach contents of a dead albatross chick on Midway Islands, HI. Photograph by Chris Jordan.