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Alicia Terepocki  
aterepocki@pugetsound.edu

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# Using the Widely Distributed Seabird, the Northern Fulmar (*Fulmarus glacialis*), as an Indicator of Marine Plastic Pollution



Alicia Terepocki\* & Peter Hodum  
University of Puget Sound, Tacoma WA



Northern Fulmar photo by Peter Hodum

## Introduction

Since the production of plastic products began nearly a century ago, plastics have been making their way into the world's oceans. At least 250 marine species are known to have been affected by plastic debris through ingestion, starvation, suffocation and/or entanglement.<sup>1,2</sup> The susceptibility of marine birds to ingestion of plastics has proven to be a useful biological indicator of plastic pollution. Marine birds in the order Procellariiformes, including the Northern Fulmar (*Fulmarus glacialis*), are among those most at risk for ingestion of plastic debris due to their surface feeding methods.<sup>3,4</sup> Fulmars possess several characteristics that make them effective indicators: they are abundant, forage exclusively at sea, and have a wide geographical range.<sup>5</sup> In this study, the stomach contents of Northern Fulmars were examined to quantify patterns of marine plastic pollution in the Pacific Northwest.

### Study Questions

1. Do plastic ingestion levels differ as a function of region?

Oceanographic circulation and commercial shipping patterns may contribute to regional differences in marine plastic debris concentrations.

2. Does ingestion of plastic have an effect on body condition?

Most established plastic monitoring programs utilize beach-cast fulmars. If increased ingestion of plastic decreases fitness, then beached fulmars would most probably have the highest loads of plastic and, thus, not be representative of the population as a whole.

3. Do fulmars exhibit age-specific selective plastic ingestion behavior?

Previous studies suggest that age may affect plastic retention, with adults having less plastic in their stomachs than juveniles.<sup>6</sup> This may be due to differences in foraging experience.



The plastic contents from the proventriculus (left) and gizzard (right) of a Northern Fulmar.

## Methods

- Stomach (proventriculus + gizzard) contents from:
  - **Washington** and **Oregon**: Beach-cast fulmars supplied by the Wildlife Center of the North Coast (Astoria, OR).
  - **California**: Beach-cast fulmars provided by Hannah Nevins and Erica Donnelly of BeachCOMBERS and Oikonos.
  - **Alaska**: Fulmars caught in fisheries, also provided by Nevins and Donnelly.
- Analytical methods based on van Franeker et al. (2004).

## Results

### Regional Differences

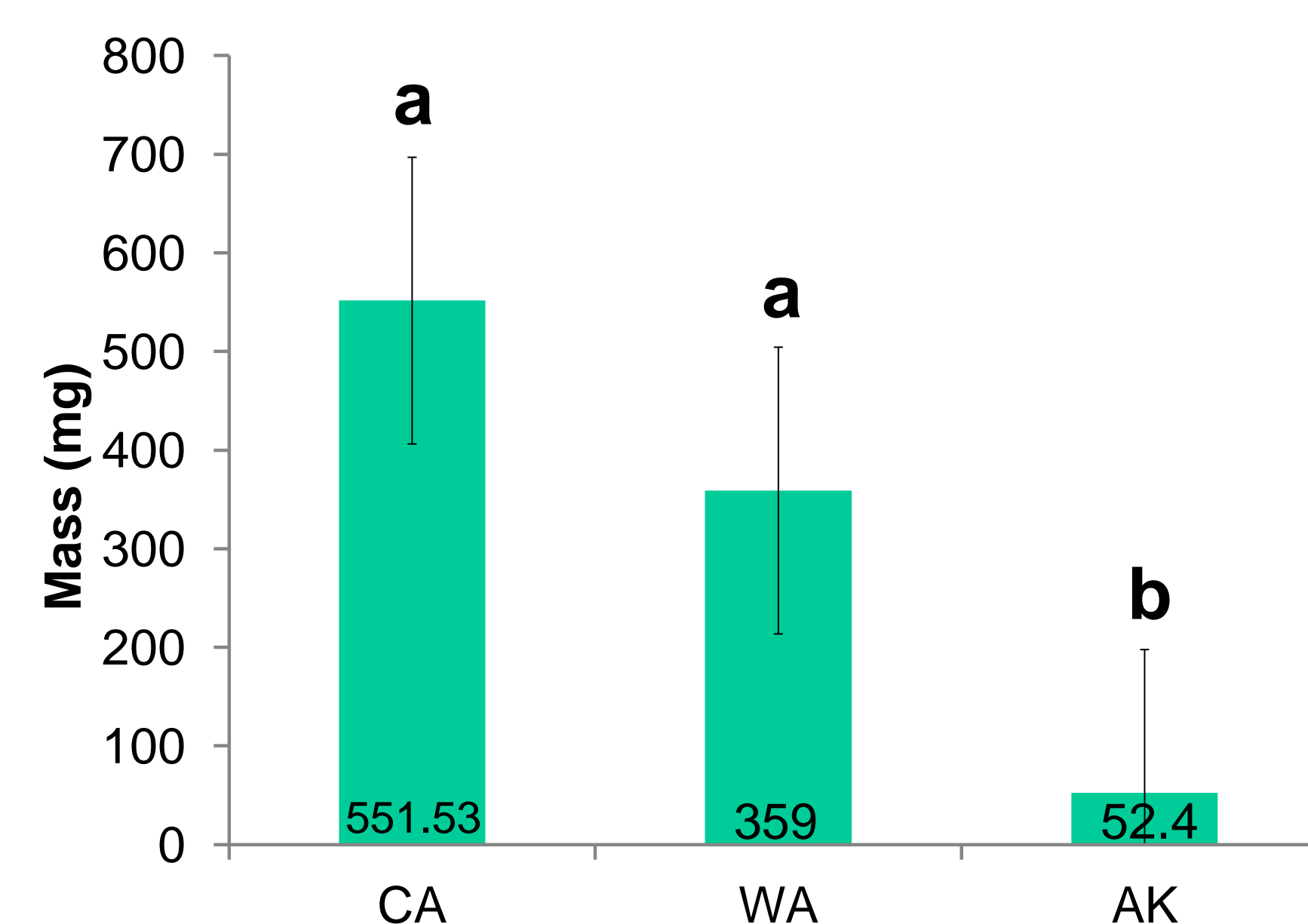


Figure 1. Average mass of plastic in the stomachs of fulmars from California ( $n=44$ ), Washington ( $n=77$ ) and Alaska ( $n=46$ ). Error bars represent 95% confidence intervals. Letters signify statistically different groups. AK ( $n=46$ ) had significantly less plastic by mass than both CA (ANOVA,  $p = 0.001$ ) and WA (ANOVA,  $p = 0.020$ ).

❖ The number of pieces per fulmar revealed the same pattern, with CA and WA fulmars containing significantly more pieces of plastic ( $\bar{x}=18.8$  and  $15.8$ , respectively) than AK birds ( $\bar{x}= 4.3$ ,  $p<0.001$ ).

❖ **Conclusions:** Levels of plastic ingestion differ as a function of region. A probable cause is the relative abundance of plastic in each respective region, suggesting that there are higher concentrations of debris in CA and WA relative to AK.

### Body Condition

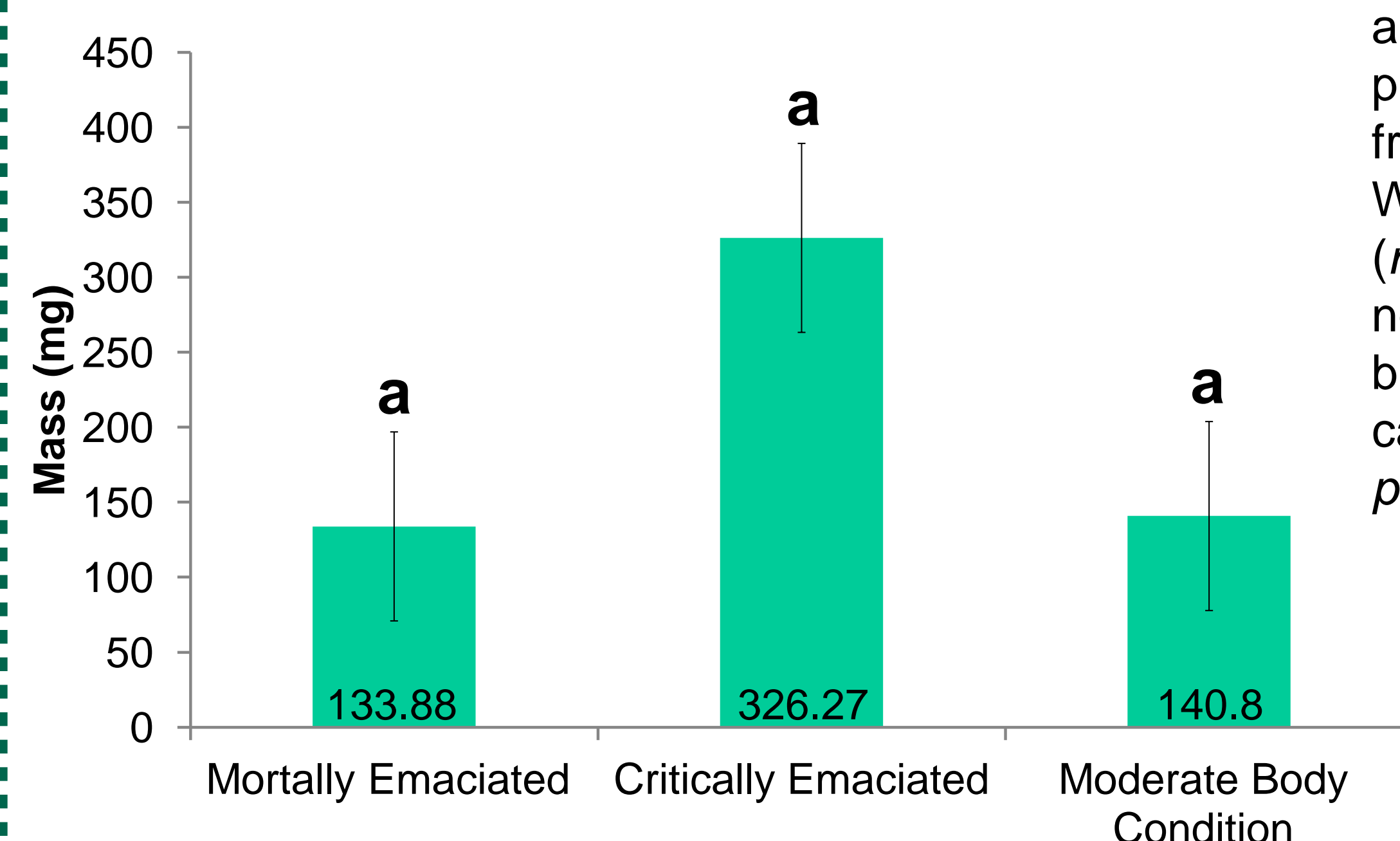


Figure 2. Body condition and average mass of plastic of fulmars salvaged from the beaches of Washington and Oregon ( $n=28$ ). Average mass did not differ significantly between body condition categories [F (2, 25) = 1.4,  $p=0.267$ ]

❖ **Conclusions:** Plastic load may not negatively affect body condition; but small sample sizes limited statistical power.

### Age Selectivity

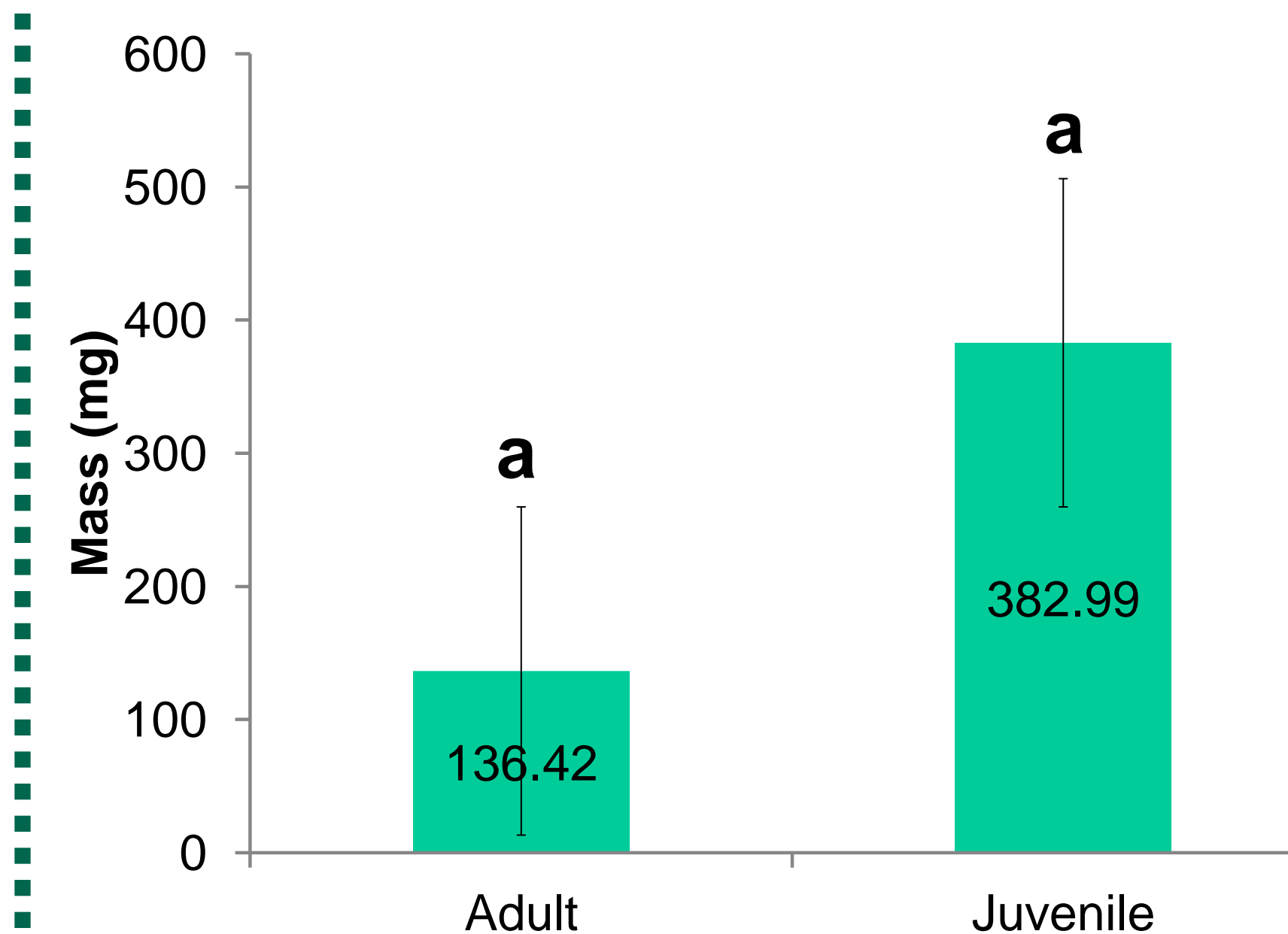


Figure 3. Average mass of plastics in adult ( $n=16$ ) and juvenile ( $n=52$ ) fulmars. There was a non-significant trend of higher average mass in juveniles vs. adults ( $p= 0.120$ ).

❖ Juveniles ( $\bar{x} = 16.3$ ) had significantly more pieces of plastic in their stomachs than did adults ( $\bar{x} = 7.5$ ,  $p=0.009$ ).

❖ **Conclusions:** Juveniles consume greater amounts of plastic than adults. This may be due to lack of foraging experience as juveniles may be less able to distinguish between food and non-food items.

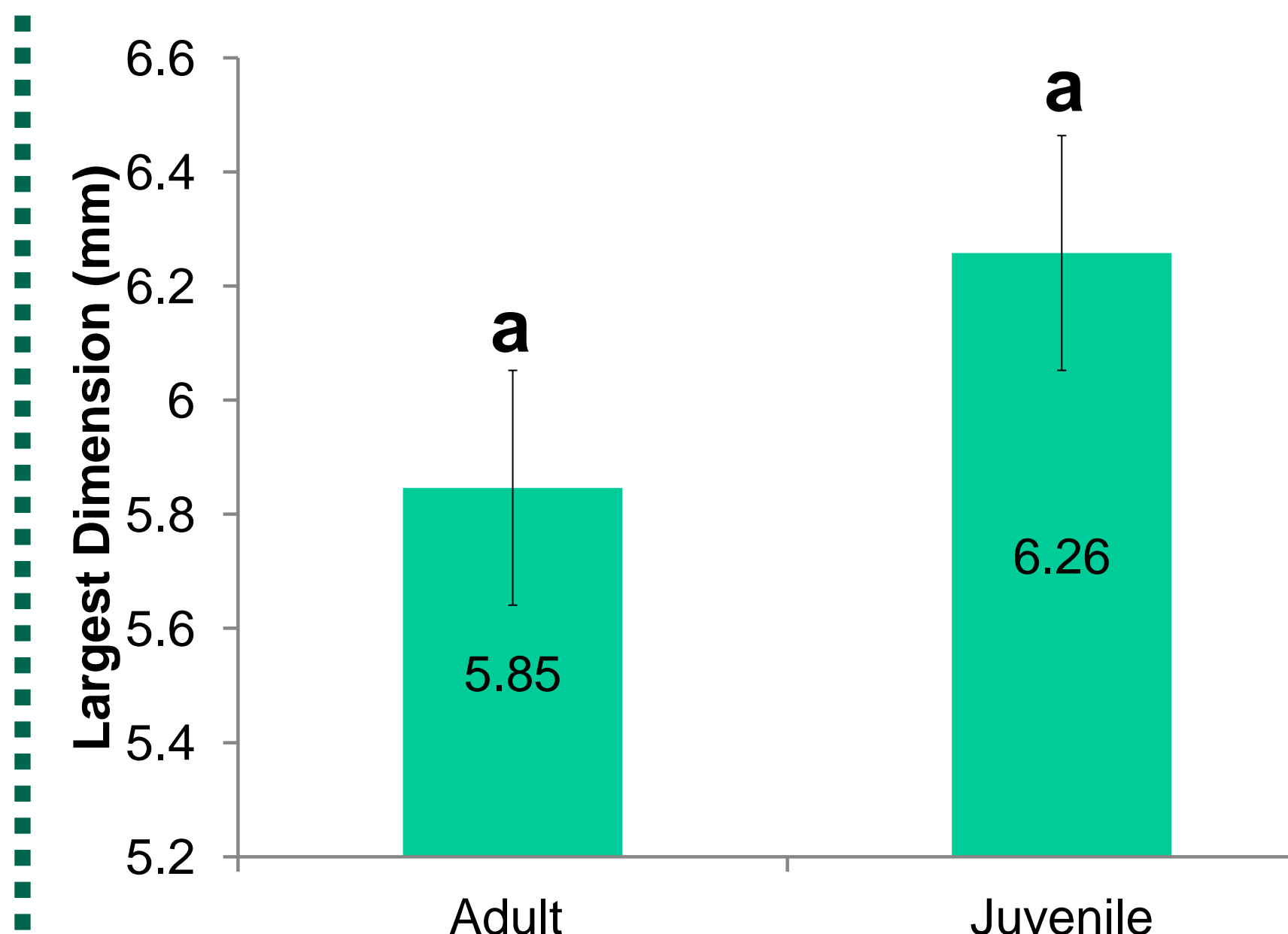


Figure 4. Average largest dimension of plastic pieces consumed by juveniles ( $n=758$ ) and adults ( $n=101$ ). The mean largest dimension did not differ between juveniles and adults, although there was a trend towards larger pieces in juveniles ( $p=0.266$ ).

❖ **Conclusions:** Increased consumption of larger plastic pieces in juveniles may be a function of lack of experience as larger pieces should be easier to distinguish as non-food.

❖ The proportion of colors of plastic in the diet differed between adults and juveniles ( $p<0.001$ ). For example, blue plastic comprised 2.6% of the plastic ingested by juveniles but was not consumed by adults.

❖ **Conclusions:** Due to differences in foraging experience, adults and juveniles may interpret colors differently when evaluating possible food items.

## Acknowledgments & References

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