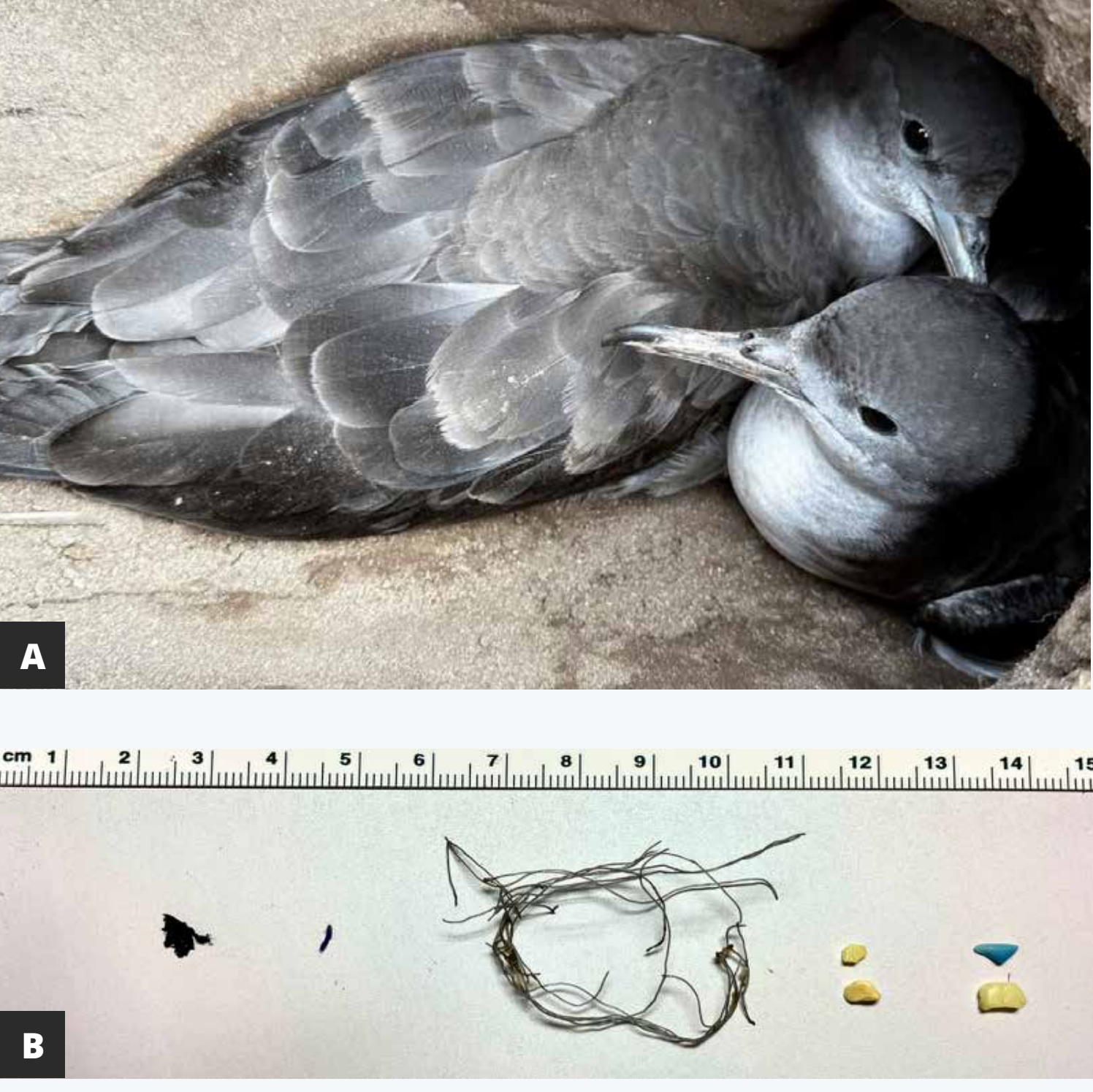


# Effects of plastic ingestion on blood chemistry, gene expression and body condition in wedge-tailed shearwaters (*Ardenna pacifica*)



## INTRODUCTION

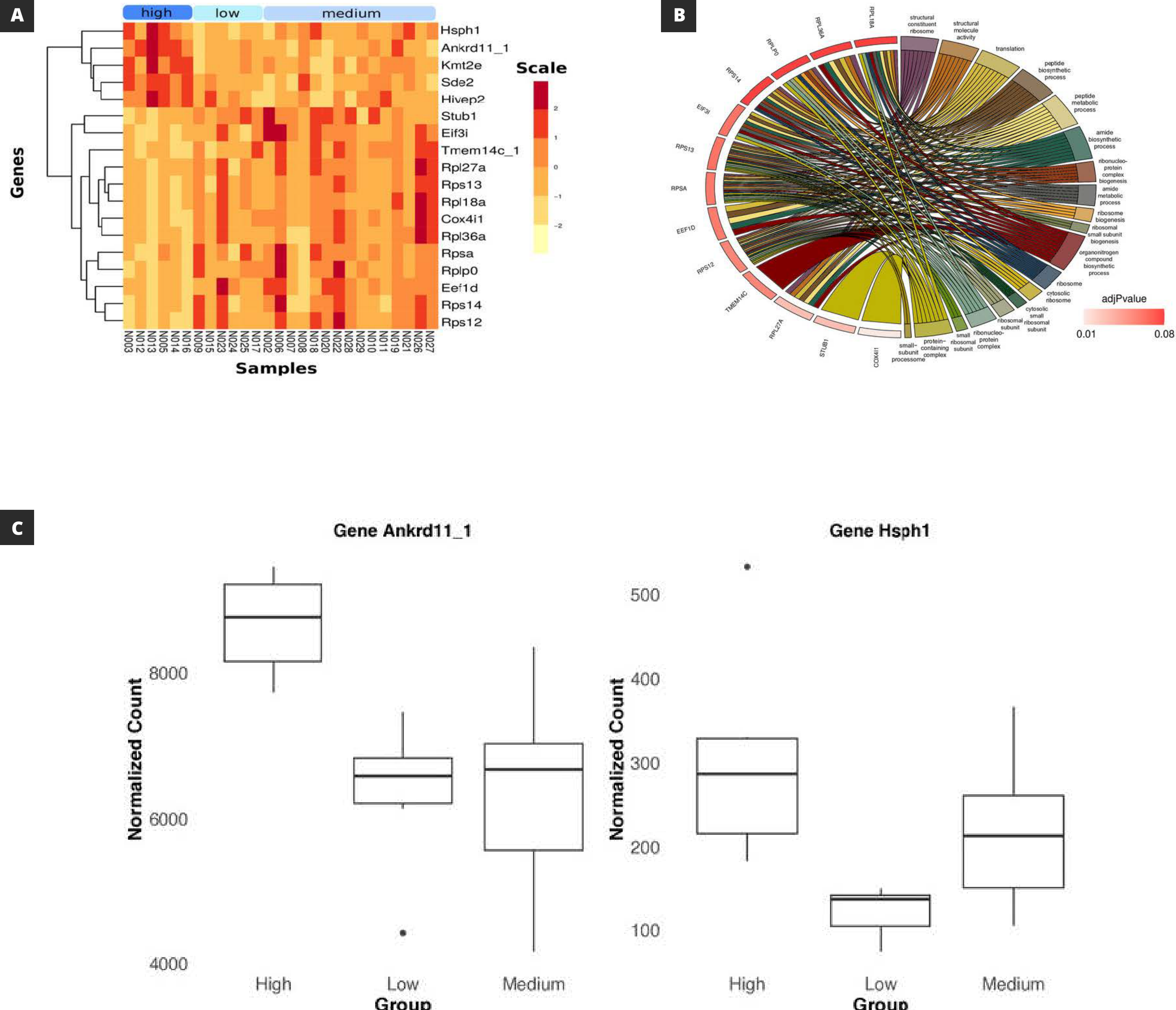
Plastic pollution is a global threat and occurs in almost every marine ecosystem. The amount of plastic in the ocean has increased substantially over the past decade, posing a mounting threat to biodiversity. Seabirds, typically top predators in marine food chains, have been negatively affected by plastic pollution. Here we explored the sublethal effects of plastic ingested by wedge-tailed shearwaters (*Ardenna pacifica*, WTSH) on the island of Maui, Hawai'i.



**Figure 1:** (A) Wedge-tailed Shearwater (*Ardenna pacifica*) in Hawai'i (by Jennifer Learned). (B) Plastic samples. Plastic collected from stomach samples from wedge-tailed shearwaters.

## METHODS

Three established colonies of wedge-tailed shearwaters were sampled in June 2021, before the egg-laying period, on the island of Maui. Sampling was conducted in the evening. In total, we captured and processed 28 birds as they returned from feeding. We used blood chemistry panels, gene expression, morphometric measurements, and regurgitated stomach contents.



**Figure 2:** Differential Expression of genes in three categories of weight: low, medium and high. (A) Heatmap showing the 18 differentially expressed genes between weight categories. (B) Chord diagram of gene ontology terms. This plot depicts the relationship between key differentially expressed genes in low and higher weight birds and their associated Gene ontology (GO) terms. A significant portion of the genes are linked to ribosomal biogenesis and protein synthesis. (C) Boxplots of normalized count in the two top genes showing differences in average counts between the three weight categories.

## KEY POINTS

- Knowledge gaps and questions remain about the effects of plastic on living organisms, including the severity of impact on human health and marine organisms, effective mitigation measures, and biomagnification across the food webs
- We investigated wedge-tailed shearwaters on Maui, Hawai'i, an island with significant concentrations of floating plastic debris in surrounding waters.
- We used multiple indexes of exposure and status, including gut samples, morphometric measurements and genomic data, to characterize the health of this population of seabirds.
- We detected plastic in 12 of 28 birds, but we did not detect a clear effect of plastic ingestion on the health of this population.
- We found a negative relationship between body weight, blood urea nitrogen (BUN), hematocrit and potassium, which could reflect body condition in this population. There were differences between lighter birds and heavier birds in the expression of genes associated with metabolic, biosynthetic pathways, and inflammatory response.
- We suggest that upregulated metabolic activity and elevated levels of hematocrit, BUN and potassium in birds weighing less might imply dehydration and a response to increased energetic demands from environmental stressors in this population.
- To our knowledge, ours is the first study combining gene expression, blood analyte panels and morphometric measurements to assess the effects of plastic ingestion in a free-living population of any species.

## CONCLUSION

We suggest that upregulated metabolic activity and elevated levels of hematocrit, BUN and potassium in light weight birds might imply dehydration and a response to increased energetic demand from stressors. Repetitive sampling could better inform whether body condition improves throughout the breeding season. We urge researchers to continue using multiple proxies to study effect of plastic ingestion in freelifving populations. Repetitive sampling and a larger sample size could better inform whether body condition improves throughout the breeding season.