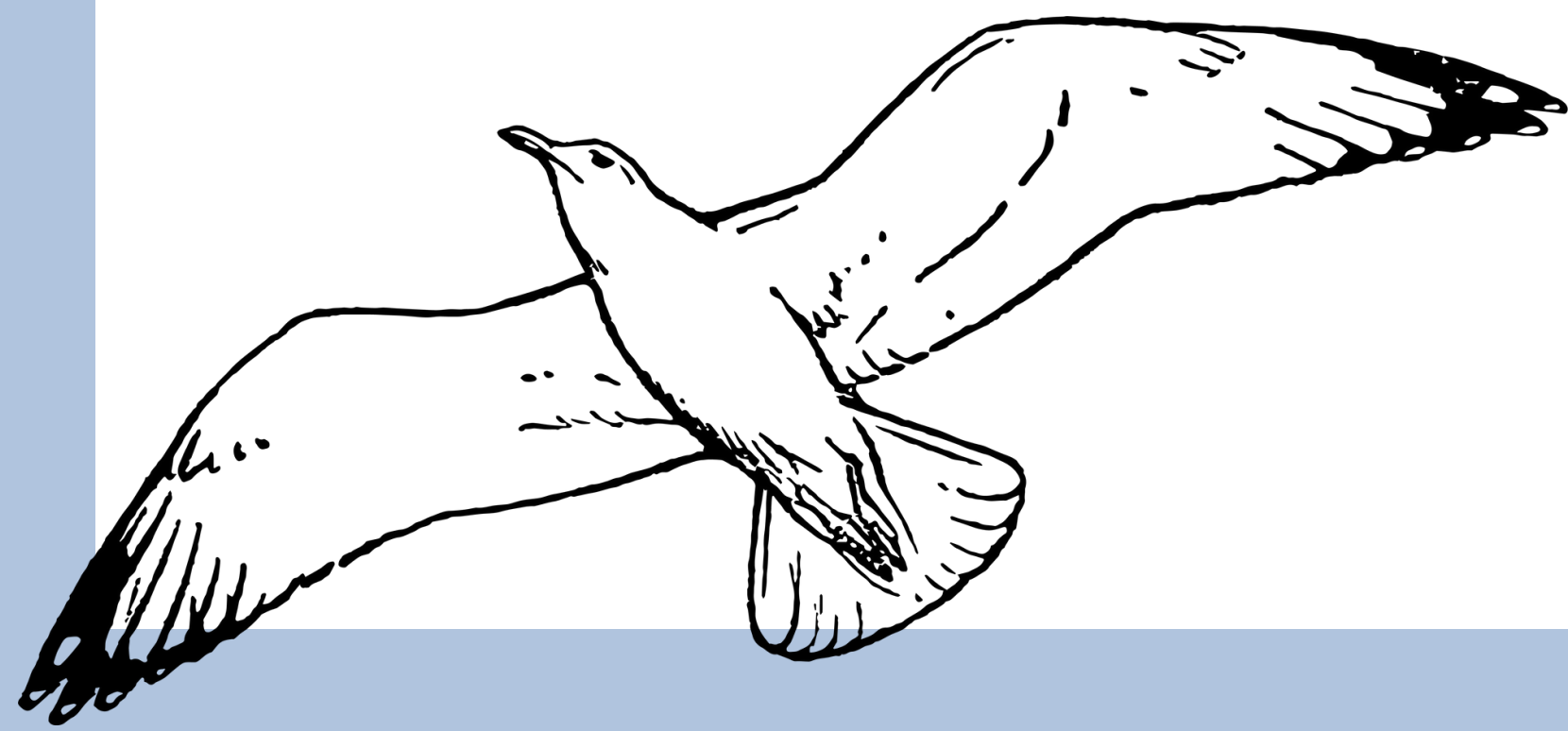# Examining herring gull (*Larus smithsonianus*) diet through noninvasive bolus collection as an index of predation pressure on co-nesting allospecific seabirds

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Introduction

🦅 In Nova Scotia, predation from anthropogenically inflated herring gull populations has detrimental impacts on other local seabird species.[1]

🦅 On Country Island, a predator management plan was implemented between 1998-2019 to protect nesting seabird species-at-risk from predation by gulls and other predators.

🦅 During the current management program suspension and subsequent return of nesting gulls, I am evaluating the impact of gull predation on Country Island's at-risk seabird species by examining gull diet through noninvasive bolus collection.

Question: What is the prevalence of at-risk seabirds in gull diet and how does it change through space (across the island) and time (with gull breeding phase)?
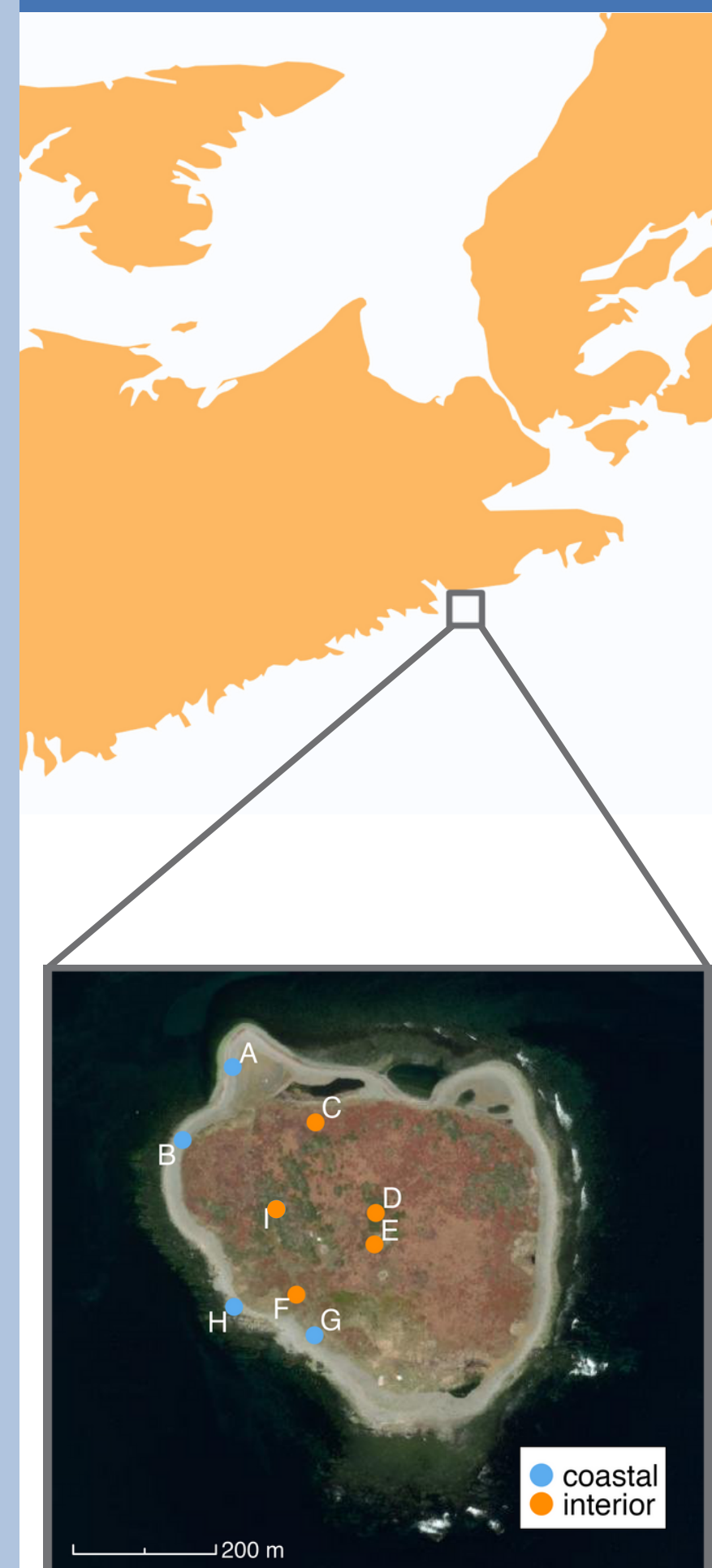
Methods

🐦 Boluses were collected on Country Island from May-July 2023.

🐦 Systematic and opportunistic collection methods were used (Figure 1).

🐦 Boluses were dried, dissected, and weighed by prey type (Figure 2).

🐦 Prey type prevalence was measured by frequency of occurrence (FOO).

🐦 Generalized linear mixed modelling (GLMM) was used to predict the probability of occurrence of prey types based on sample location and gull breeding phase.

Figure 1. Location of nine systematic study plots on Country Island, classified as coastal (within 50m of shoreline) or interior
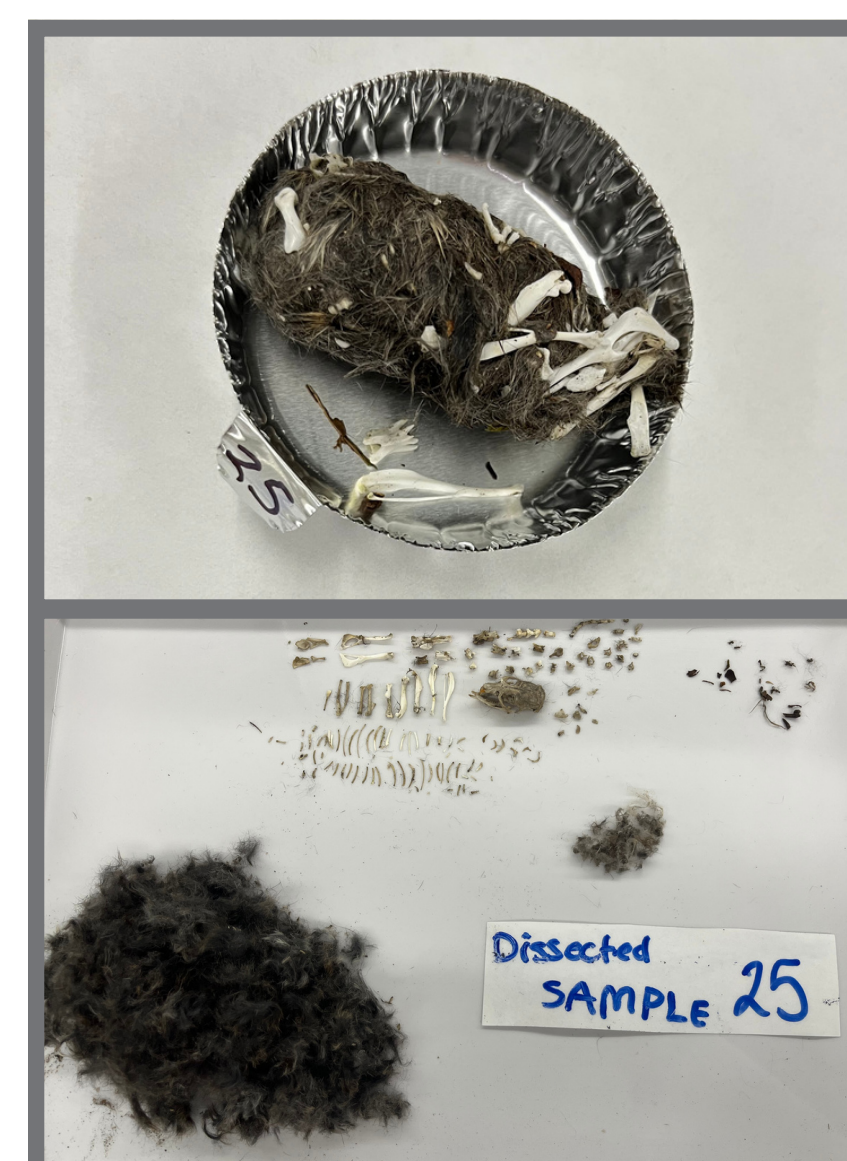
Figure 2. A bolus before (top) and after (bottom) drying and dissection
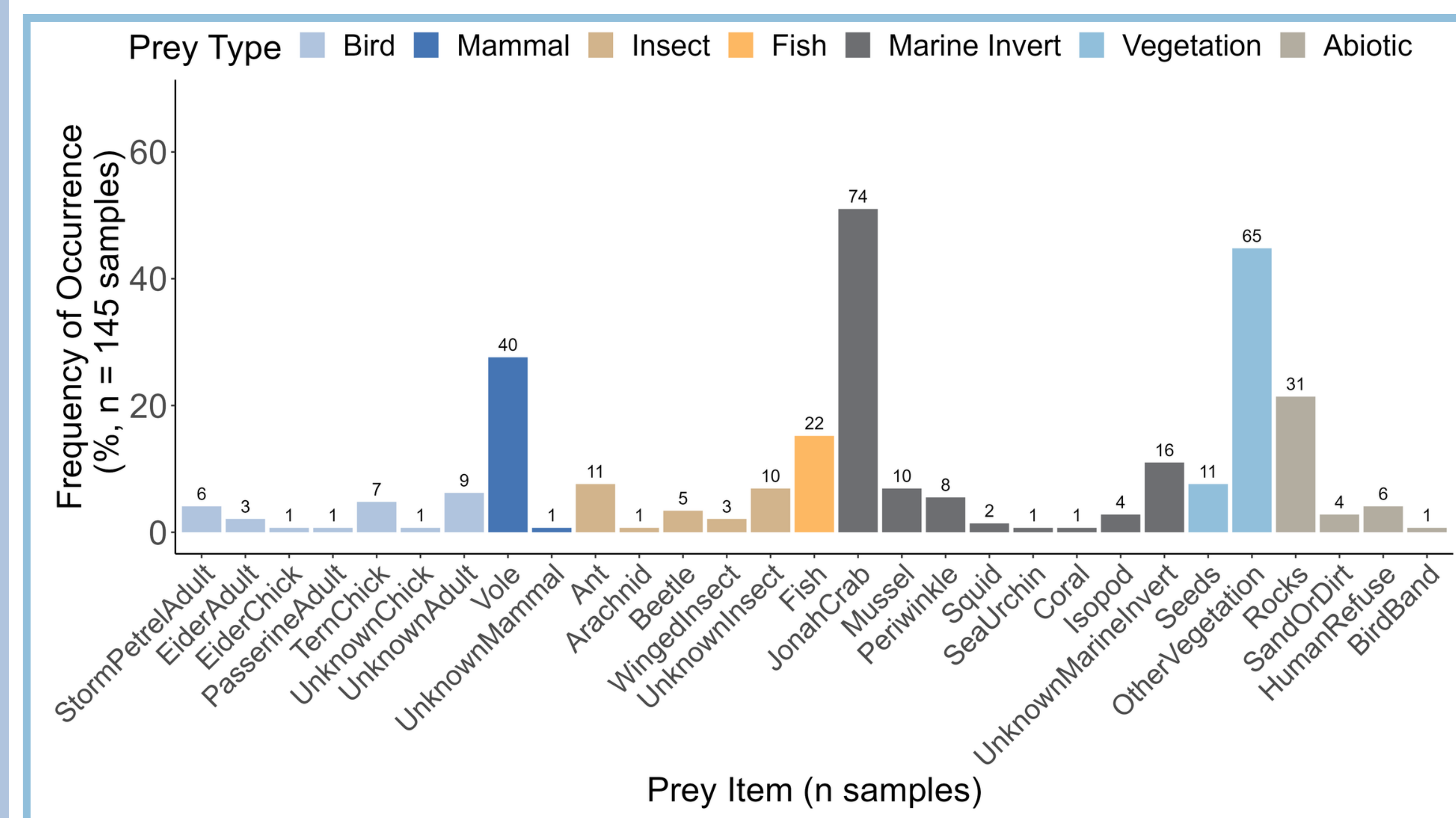
Results

Figure 3. Percent frequency of occurrence (FOO) of prey items in boluses grouped by broader prey type categories
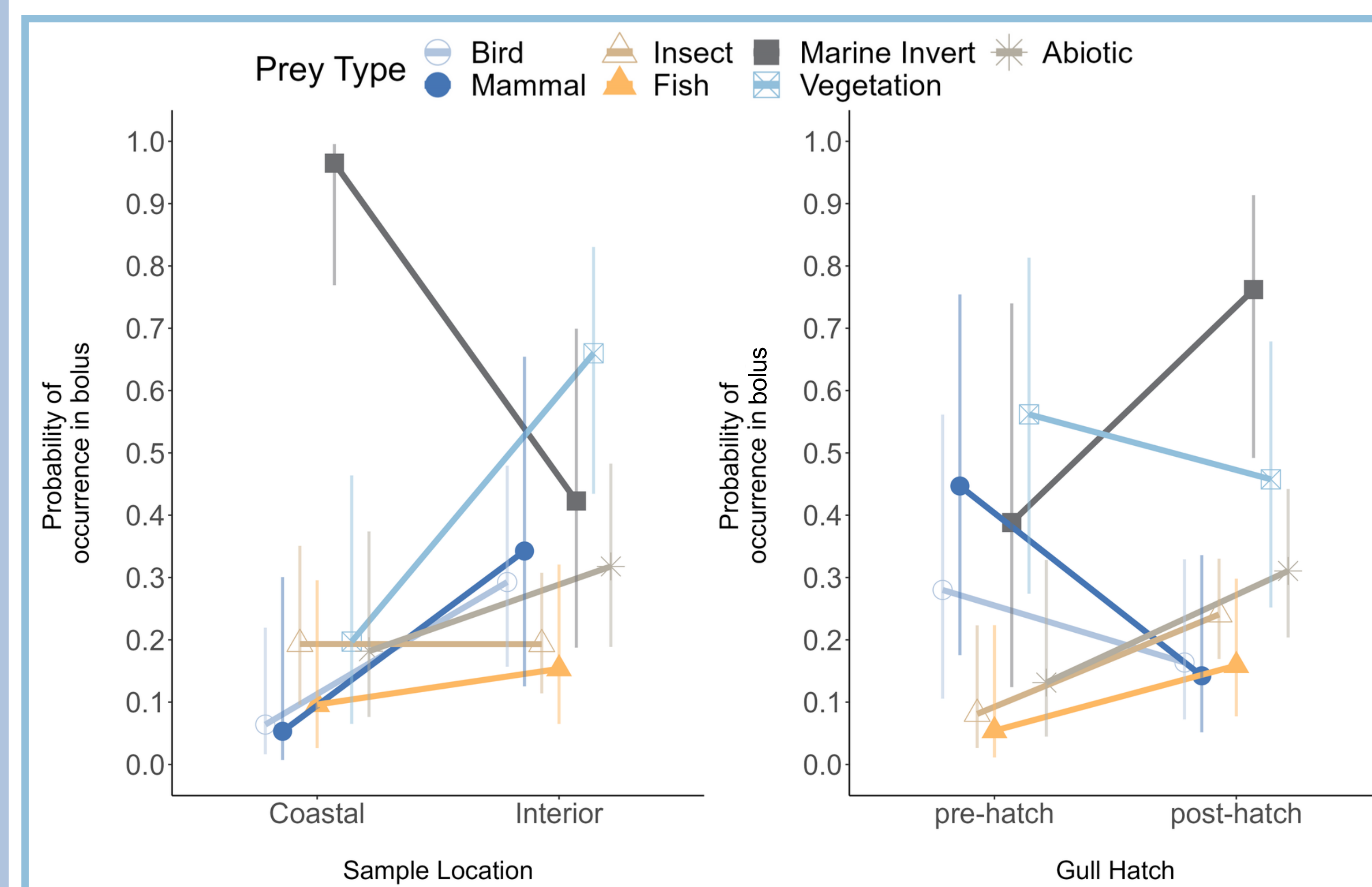

Figure 4. Predicted probabilities of occurrence of prey types in boluses by location type (left) and breeding phase (right), estimated by GLMMs. Model predictive performance was measured using the Area under the Curve (AUC) statistic and categorical predictor significance was evaluated using a Wald Chi-square test of Type III. AUC tests yielded values ranging from 0.83-1.00 for all prey types in both models. Wald Chi-square tests of Type III yielded p-values ranging from <0.001-<0.05 for all prey types in both models, with the exception of vegetation in the breeding phase model (p = 0.75).

Discussion

🐦 Adult gull diet on Country Island **consisted primarily of marine invertebrates** (68.4% of samples), with crab occurring most often (51% of samples, Figure 3).

🐦 Birds were found in boluses relatively infrequently (19.3% of samples), making them the second least likely prey type to occur (Figure 3). **Seabird species of concern appeared in 15 out of 145 samples**, with tern chicks occurring in 4.8% of samples and Leach's storm petrels occurring in 4.1% of samples (Figure 3).

🐦 The higher probability of finding coastal prey (marine invertebrates) near the coast and terrestrial prey (nesting birds and mammals) interiorly (near seabird colonies and forested areas, Figure 4), suggests that **gulls rest and produce boluses near their preferred foraging sites.**[2]

🐦 The decreased probability of finding high quality prey types (birds and mammals) and the increased probability of finding lower quality prey types (marine invertebrates) in boluses after gull chick hatch (Figure 4) suggests that **breeding gulls may shift their diet to provide chicks with prey of higher nutritional quality.**[3] This implies that adult gulls save lower quality prey items for their own consumption, and explains why seabirds may be underrepresented in our samples.

Conclusion

🦅 This research will aid in the conservation of Country Island's at-risk seabird species and help inform future predator management strategies.

🦅 Management strategies can be modified to prioritize gulls of higher threat (those who spend time near the seabird colonies) and reduce emphasis on gulls of lower threat (those who forage off-shore).

🦅 Future research will involve more advanced diet evaluation techniques such as eDNA and isotope analysis, and will implement gull movement data to assess the use of foraging sites on the island.

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[1] Whittam R. *et al.* 1998. Can Wildl Serv.
[2] Spelt A. *et al.* 2019. Sci Rep. 9(1): 10527–11.
[3] Alonso H. *et al.* 2015. Eur J Wildl Res. 61: 819–829.