

Stress Physiology of Grey-Faced Petrels: interannual measures of feather corticosterone as a conservation tool

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Seabirds are ecologically relevant top predators and ecosystem engineers, but also the most threatened group of birds globally. Seabirds face many threats, but among the most critical is overall ocean health. Monitoring ocean health is difficult and expensive, and breeding seabirds have been touted as a potential low-cost bioassay of ocean health. However, the effectiveness of that relationship remains unclear and warrants further validation. Understanding how shifts in ocean conditions influence foraging opportunities for seabirds may assist the management of populations and inform on the dynamics of ocean conditions. Changes in food supply and potential nutritional challenges are often reflected in seabird physiology. Specifically, stress hormones often show a strong link to food supply, suggesting they are useful tool for linking ocean health, foraging conditions, and seabird population demographics. In birds, corticosterone (CORT) is the predominant stress hormones, and responses to stressors are reflected in changing CORT levels, and those levels are reflected in CORT deposited in developing feathers.

Because higher CORT levels are deposited in developing feathers, measures of feather CORT (fCORT) may provide useful estimates of environmental stressors and a proxy for ocean health. However, the pattern of variation in stress hormone levels varies among species and their environmental context and require validation from intra-species studies to draw reliable conclusions. Grey-faced petrels (*Pterodroma gouldi*) are long lived, have high site-fidelity and are widespread, which provides good scope for robust validation experiments. In this study, I determined whether variation in fCORT can be used as a proxy of ocean conditions and as a monitoring tool for population breeding success (Figure 1).

By measuring chick fCORT and measures of chick quality at Ihumoana Island over four years (2017, 2019-2021), I found that chick stress levels fluctuated among seasons, but variation was not closely tied to ocean conditions. More stressful ocean conditions predicted lighter chicks, but also a decline in fCORT. I also monitored reproduction and measures of quality in adults. Increased fCORT in females and lower feather quality (brightness) in adults predicted reduced breeding success. Further, stable isotopes measured in chick feathers suggested that parental foraging distance varied annually. Potential increasing foraging distances from the colony seemed to correlate to poor feather quality and show year specific relationships with fCORT.

To my knowledge, this is the first study to examine the relationship between Grey-faced petrel physiology and measures of ocean conditions, feather quality and stable isotopes. It reveals that, taken together fCORT and feather quality measures offer a promising tool for seabird conservation. It also corroborates literature that found that fCORT should not completely replace other monitoring tools. Instead, these tools complement each other. These results highlight necessary future directions in the complex field of ecophysiology. Extending a similar examination to set of colonies in the Hauraki Gulf would contribute greatly to a more comprehensive knowledge of foraging ecology and breeding success in this species.

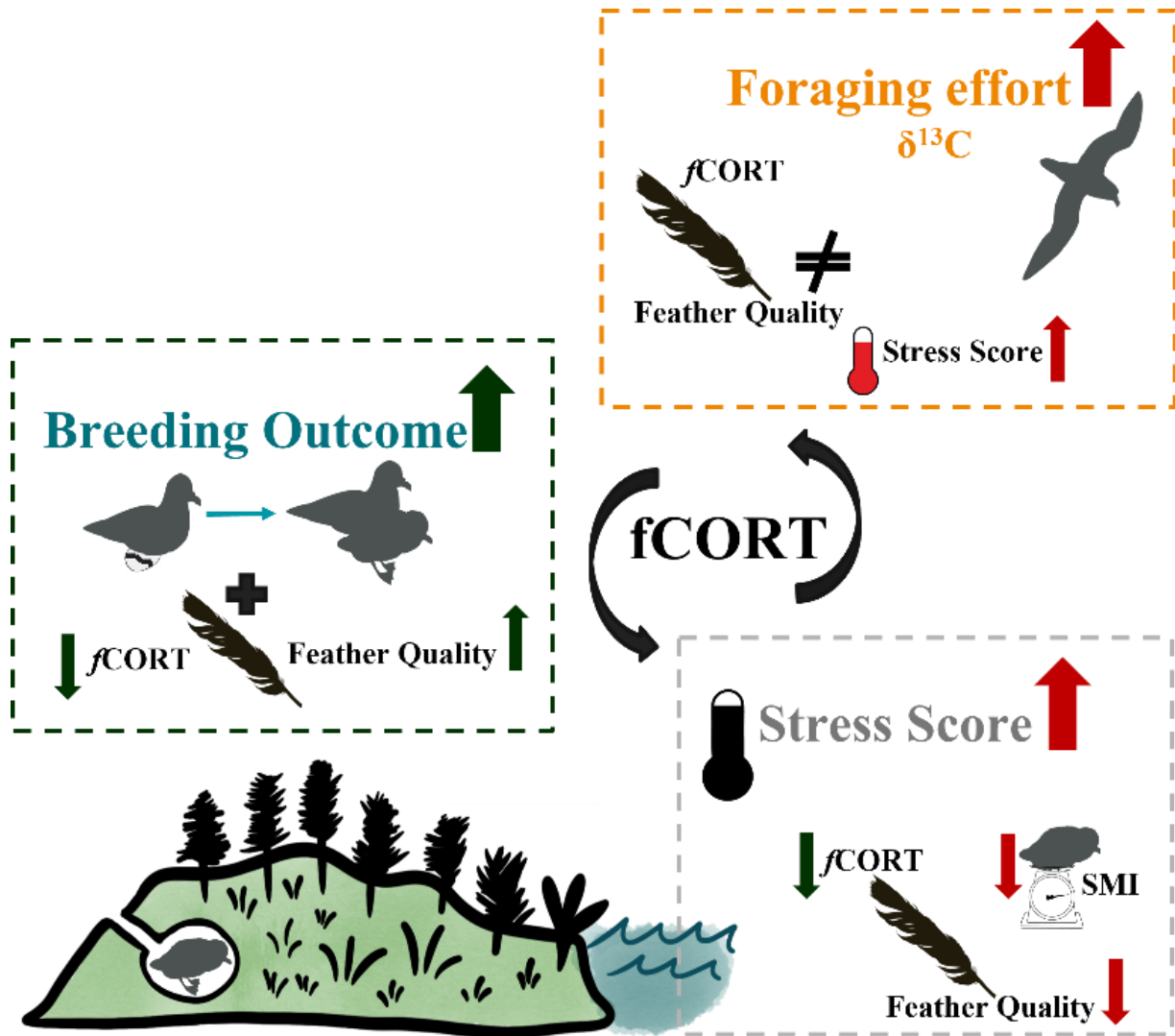


Figure 1: Summary of main findings and relationships between variables for each aim and chapter in the study: Chapter 2 is represented by stress score as an indicator of ocean conditions. Breeding outcome represents the main findings in chapter 3, where variable of body condition correlated to breeding successfully and feather quality as seen through brightness. Chapter 4 is represented by variation in foraging effort, indicated by carbon isotopic analysis, and revealing changes in stress response and body condition between years and foraging distances.