

****A Framework for Using Cort as a Physiological Biomarker**

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Corticosterone (CORT) is an increasingly utilized biomarker in wildlife conservation yet debates over the most relevant measures often cloud its utility. This study employs structural equation modeling (SEM) to evaluate relationships between CORT physiology, energetic variables, and environmental factors within the total hormone, free hormone, and corticosteroid-binding globulin (CBG) profile hypotheses using a 14-year dataset on mountain white-crowned sparrows. The Total Hormone model showed limited power in correlating environmental and energetic variables with CORT levels. In contrast, the Free Hormone model demonstrated strong relationships between free CORT and the El Niño-Southern Oscillation (ENSO), suggesting that sparrows modulate hormone availability contextually. The CBG Profile model provided the most nuanced understanding, uncovering sex-specific strategies in hormone regulation, with males and females exhibiting different mechanisms for altering free CORT. While sex-specific patterns are complex, higher energy stores generally lower baseline and total CORT, but also lower CBG, so free CORT levels increase with increasing energy stores. Additionally, wetter years (higher ENSO values) either lower baseline CORT or increase CBG (depending on the sex), so wetter years lower free CORT in both sexes. This research offers a framework for more accurate interpretations of physiological responses to environmental changes and demonstrates the importance of selecting appropriate CORT measures. These insights can improve wildlife health assessments and inform conservation strategies, advancing the integration of physiological tools into conservation practice.