Postmigratory Body Condition and Ovarian Steroid Production Predict Breeding Decisions by Female Gray-Headed Albatrosses

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ABSTRACT

Carryover effects have been documented in many migratory bird species, but we know little about the physiological mechanisms that mediate those effects. Here we show that the energetic, endocrine, and aerobic characteristics of postmigratory female gray-headed albatrosses (Thalassarche chrysostoma) can affect their decision to breed. All females in this study, whether breeding or not, were secreting ovarian steroids when they arrived at the breeding colony at Bird Island, South Georgia, which suggests that all were responding to seasonal cues. However, deferring, nonbreeding birds were characterized by a steroid pro le of high progesterone (P4) and low testosterone (T), whereas breeding birds showed the opposite pattern. Deferring birds also had low body mass, hematocrit, and hemoglobin. These results suggest that postmigratory condition can in uence patterns of ovarian steroidogenesis and that the maintenance of high P4 without subsequent conversion to T favors breeding deferral. Whereas breeding females normally convert P4 to T, which is a key deterministic step toward 17b-estradiol synthesis, vitellogenesis, and follicle development, deferring females did not make this conversion and instead maintained high levels of P4, perhaps due to inhibition of the hydroxylase-lyase enzyme complex, thus rendering them infertile for the current season. Results are discussed within the context of the biennial breeding system of this species, and comparisons with other biennially and annually breeding albatrosses are made.

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Introduction

Migratory carryover effects have been documented in several bird species and can in uence many aspects of reproduction, including the timing of breeding (Marra et al. 1998; Norris et al. 2004; Descamps et al. 2011; Harrison et al. 2011), breeding decision (Ebbinge and Spaans 1995; Crossin et al. 2012), breeding output (Ebbinge and Spaans 1995; Sorenson et al. 2009), and breeding success (Baker et al. 2004; Inger et al. 2010; Crossin et al. 2012). However, the physiological and endocrine mechanisms that mediate carryover effects are largely unknown. Recent work in birds has shown how variable individuals are in their ability to accrue and store resources in advance of reproduction, which can then have effects that are either positive for breeding (e.g., high somatic fat leading to early timing of breeding; Prop et al. 2003; Smith and Moore 2003) or negative (e.g., low fat or poor condition leading to a trade-off between current reproduction and survival). Recent work has also linked endocrine processes to carryover effects. However, the links between prebreeding condition and endocrinology remain elusive. Despite the intuitive appeal that individual condition must play a role in hormonally mediated carryover effects, very few studies that link wintering habitat, migration, breeding activity, and carryover effects include direct measures of body condition (e.g., body mass, fat mass, or mass change), either alone or in combination with endocrine measures (Ebbinge and Spaans 1995; Marra et al. 1998; Baker et al. 2004; Harrison et al. 2011). Although the mechanisms through which condition might in uence breeding decisions are not well understood, this must surely involve integration with, and modulation of, the hypothalamic-pituitary-gonadal (HPG) axis (or other hormonal systems that interact with the HPG axis; e.g., Goutte et al. 2010a), so that reproductive readiness can be assessed before a commitment to breeding.

For the few studies that have simultaneously examined condition and endocrine effects on breeding decisions, the results have been somewhat equivocal (Harshman and Zera 2007; Williams 2012). A recent study of female black-browed albatrosses (Thalassarche melanophrys