METABOLIC ROUTING OF MACRONUTRIENTS IN MIGRATORY SONGBIRDS: EFFECTS OF DIET QUALITY AND MACRONUTRIENT COMPOSITION REVEALED USING STABLE ISOTOPES

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

ENVIRONMENTAL SCIENCES

UNIVERSITY OF RHODE ISLAND

2004

ABSTRACT

Animals metabolically route specific macronutrients from their diet to build and maintain tissue and researchers generally assume that the isotopic composition of an animal's tissues resembles the isotopic composition of their diet. However, animals regularly change diets and they may route dietary macronutrients differently to specific tissues. Thus, I studied metabolic routing of dietary macronutrients into animal tissue because it is fundamentally important for understanding the nutritional ecology of wild vertebrates and because such knowledge is essential for accurate interpretation of stable isotope patterns in consumers and consumed.

Songbirds that routinely switch their diets during migration provide a particularly interesting system in which to study these fundamental issues. Fruits with more carbohydrates and less protein may be sufficient to rebuild expended fat stores, but such fruits may be inadequate to replace protein stores catabolized during migration. I used differences between the isotopic signatures of breath, blood and feathers sampled from free-living birds to identify changes in their diet during fall migration. I also used stable isotopes of carbon and nitrogen to investigate macronutrient routing in Yellow-rumped Warblers (*Dendroica coronata*), a common migratory songbird in coastal New England.

Using feeding trials combined with concentration-dependent mixing models, I determined that birds fed high- or low-protein diets metabolically routed carbon from multiple dietary macronutrients into proteinaceous tissue, whereas birds metabolically routed nitrogen only from dietary protein sources into proteinaceous tissue. I also determined that $\delta^{13}C$ of depot fat in birds depended on the concentration and isotopic

signatures of the dietary lipid and carbohydrate. $\delta^{13}C$ of depot fat in birds synthesized from dietary carbohydrate was 4‰ depleted relative to $\delta^{13}C$ of dietary carbohydrate, whereas $\delta^{13}C$ of depot fat in birds synthesized from dietary lipid was similar to $\delta^{13}C$ of dietary lipid. These experiments showed that combining stable isotopic analysis of macronutrients in the diet of animals combined with estimates of the effects of diet composition on the isotopic signature of tissues in animals offer a method to identify the relative importance of nutritional resource(s) utilized by animals to build and maintain tissue.