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Predator-prey models are a favorite starting point for studying population models. Models typically keep track of a single currency, such as biomass or a nutrient. This implicitly assumes that the stoichiometric ratios of nutrient to biomass, and nutrient to nutrient, are the same in all populations. If these ratios are allowed to vary, the models are forced to be higher dimensional - one compartment for each nutrient in each population. Further, especially in terrestrial systems, the nutrient cycling process suggests the addition of at least one sediment (detritus) class. We construct models with two nutrients - such as carbon and nitrogen - and three compartments for each nutrient - producer, consumer, and sediment. The starting model is thus six-dimensional. Various assumptions allow us to reduce the dimension. Our work generalizes results of a 2000 paper by Loladze, Kuang and Elser ("Stoichiometry in Producer-Grazer Systems" in the *Bulletin of Mathematical Biology*). We compare the new models with the prior models via a bifurcation analysis. (Received February 27, 2007)