Functional Ecology

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A new model to predict fluxes in fishes

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In many aquatic ecosystems, fishes are highly abundant and perform an important role in the cycling of elements such as carbon, nitrogen, and phosphorus through ingestion, growth, and excretion. Most current models predict fish ingestion based on energy requirements, but these models do not consider that fishes may be limited by nitrogen or phosphorus instead of carbon (i.e. energy). In fact, herbivorous fishes are often phosphorus limited, and ignoring this limitation may lead to biases in the prediction of nutrient cycling processes such as ingestion rates. In this paper, we present a new model that integrates estimates of energy requirements with the explicit consideration of either carbon, nitrogen, or phosphorus limitation. With empirically measured parameters, our model predicts elemental fluxes through ingestion, growth, excretion, respiration, and egestion. We validate our approach through a case study of three reef fishes with distinct diets. Further, we show that not accounting for nutrient limitation can result in a substantial underestimation of ingestion and excretion rates. Our model improves predictions of multiple nutrient cycling processes across all fish life stages, particularly for species that

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experience nutrient limitation. By integrating well-defined and widely accessible parameters, and including the statistical package *fishflux* to streamline our modelling approach, we provide a user-friendly path to foster a better understanding of the role of fishes in nutrient cycling.