# How to cope with nutritional (co-)limitation in variable environments - the temporal scale of diet variability matters

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## Short Version

Consumers face the challenge of satisfying their demands for nutrients with the supply of those nutrients in the environment. Nutrient supply is highly variable at the temporal scales experienced by individuals. Consumer physiology may adapt to temporal variability by mechanisms such as storage of nutrients in reserves or acclimation of nutrient assimilation. Combining theoretical and experimental approaches I will show how the characteristic time scales of such physiological mechanisms interact with the temporal scale of fluctuations in one (or two) limiting nutrients. This allows us to predict how landscape nutritional homogenization may affect herbivore performance.

## Long Version

Consumers face the challenge of satisfying their demands for nutrients with the supply of those nutrients in the environment. Yet nutrient supply is highly variable at the temporal scales experienced by individuals. Long-term individual performance is generally believed to be negatively affected when consumers experience increasing dietary variability in the supply of limiting nutrients (Jensen's inequality). However, consumer physiology may adapt to temporal variability in nutrient supply by mechanisms such as storage of nutrients in reserves or acclimation of nutrient assimilation.

Combining theoretical and experimental approaches I will show how the characteristic time scales of such physiological mechanisms interact with the temporal scale of fluctuations in one (or two) limiting nutrients. In this study, we used a two-nutrient Dynamic Energy Budget (DEB) model incorporating nutrient (co-)limited growth, reserves and acclimation of nutrient assimilation. Using the model we explored how the reserve and acclimation in isolation and in concert impact the somatic growth of a consumer across different temporal scales of nutrient fluctuation. We tested the model predictions using phosphorus and cholesterol (co-)limited Daphnia as a model organism in experiments simulating different nutrient variance or covariance scenarios across three temporal scales. We found general agreement of model predictions and experimental results, indicating that reserves and acclimation of nutrient assimilation indeed shape the response of Daphnia towards nutritional fluctuations.

Our study increases the understanding of how landscape nutritional homogenization can affect herbivore performance.