**Omnivory as a Dynamic Response to Changing Conditions**

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**Example Abstract (words 240)**

While ecology has long been interested in omnivory, much of the historical data has often been presented from a static viewpoint with researchers often looking at patterns in trophic position (a surrogate for omnivory) and the degree of omnivory within and across ecosystems.

* Here, we briefly review this aspect of omnivory before arguing that omnivory is better considered a dynamic response to changing conditions (e.g., seasonality; ENSO) and that omnivory is highly context dependent.
* With this dynamic perspective in mind, we then synthesize existing omnivory theory to argue that there are two general categories of mechanisms promoting omnivorous responses by organisms, both of which enhance stability in the face of environmental variation.
* First, there are bottom-up driven conditions in which environmental conditions spatially or temporally alter the production of plants or animals in a manner that pushes predators to optimally forage more on lower level prey (**bottom-up omnivory**). Second, there are cases where environmental conditions (e.g., high productivity, small ecosystems) and organismal traits (e.g. high interaction strengths) can generate strong cascading predator influences that implicitly drive conditions that promote omnivory (**top-down omnivory**).
* We end by reviewing the recent literature on omnivory pointing out that there appears to be cases that fall into the two categories although that much further work is needed. This dynamic understanding of omnivory to changing conditions, importantly, allows us to begin to consider how global change will alter carbon transfer, stability and production in whole food webs.

**Proposal**

We are in a period of rapid global change that threatens the resilience of global ecosystems through the rearrangement of species interactions across space and time (ref). This rearrangement of species asymmetrically rewires entire food webs (Bartley et al., 2018), and ultimately influences food web stability. Understanding mechanisms that drive dynamic processes within food webs that promote stability are thus imperative to helping predict consequences of global change. Omnivory, the feeding at multiple trophic levels by predators, is one such dynamic process within food webs that has the potential to enhance stability under changing conditions. While a large amount of research has focused on whether omnivory promotes stability within food webs, omnivory has largely been considered a static quality within food webs. Recent empirical work has begun to document changing degrees of omnivory across space and time (Kratina et al., 2012), however the mechanisms that drive these changes in omnivory have yet to be elucidated. To fully understand how omnivory influences food web stability in the face of global change, we need to know the underlying mechanisms that drive changes in omnivory across space and time. Here, we use a combination of theoretical and empirical approaches to show that omnivory is a dynamic process driven by two general categories of mechanisms, bottom-up and top-down, both of which enhance stability in the face of environmental variation and are ubiquitous throughout ecosystems.

We expand on the classic tri-trophic omnivory module from McCann & Hastings (1997) to incorporate two types of omnivory, passive and responsive, and understand stability outcomes of different mechanisms that drive omnivory in the face of environmental variation. First, we identify and define two types of omnivory exhibited by species: **passive omnivory** in which omnivores have a fixed preference on the resource versus the consumer, and **responsive omnivory** in which the omnivore’s preference for the resource increases with increased resource densities relative to consumer densities. Second, we identify and define 2 general categories of environmental mechanisms that drive omnivory: **bottom-up omnivory**, in which spatial or temporal changes in environmental conditions alter the production of plants or animals in a manner that pushes predators to optimally forage more on lower level prey; and top-down omnivory, where physical environmental conditions (e.g., high productivity, small ecosystems) and organismal traits (e.g. high interaction strengths) can generate strong cascading predator influences that implicitly drive conditions that promote omnivory. We argue that dynamic omnivory is a combination of these mechanisms operating at different spatial and temporal scales. Through series of experimental simulations, we show how different conditions drive bottom-up and top-down mechanisms, and how omnivory promotes stability in the face of these changing conditions.

We then demonstrate that dynamic omnivory is ubiquitous across ecosystems and how bottom-up and top-down mechanisms manifest themselves in the real world by putting well studied food webs into this dynamic omnivory framework. We describe key examples from aquatic and terrestrial systems to demonstrate passive and responsive omnivory, and examples of how bottom-up, top-down, and a combination of these mechanisms promote omnivory in natural systems. Additionally, we provide extensive empirical examples across ecosystem types, trophic levels, and spatial/temporal scales in a table to demonstrate the ubiquity of dynamic omnivory, despite not being considered in this dynamic framework. Considering omnivory in this dynamic framework can help us begin to understand how species respond to global changes, and how this ultimately influences ecosystem stability and function.