Although it is more and more common for scientists to use network approaches nowadays, representations of ecological pyramids in didactic materials do not reflect this. They typically begin with producers such as plants on the bottom and proceed through the various trophic levels: herbivores that eat plants, then carnivores that eat herbivores, then carnivores that eat those carnivores, and so on. Such pyramids not only still appear in elementary didactical materials, but even in schematic descriptions of trophic levels in the most recent texts and papers. These representations provide an oversimplified view of the functional organization of ecosystems in food networks. Furthermore, they lead many ecologists to continue to refer to low and high level organisms and top-down and bottom-up control in food-webs’ organization. In the fourth edition (2006) of the classical textbook by Begon et al. after a discussion on these topics, the authors conclude that “the elucidation of clear patterns in the predominance of top-down or bottom-up controls remains a challenge for the future”. We agree with this, but we consider that progress in that sense requires the review of some misleading ideas and, in particular, it requires abandoning the simplistic view of trophic chains which is still at the core of our reasoning.

It is well known that energy flows from primary producers to the final consumers, in decreasing amounts, because part of it is dissipated as heat. Therefore, in fact, the pyramid, or, more appropriately, the nested food-web, should be reversed. Only an ideological bias can explain the traditional view of animals like lions or eagles as being 'superior' at the top of the pyramid, and ideological biases are dangerous in science. The use of top and bottom in this context is so well established that it would be difficult to change. Nevertheless we must at least retain the concept that the energy cascade flows bottom-up in the traditional pyramid representation. This is more relevant than it might seem at a first sight, because the notion of top-consumer precludes a clear understanding of real ecosystem organization, of omnivores’ relevance and of man’s role in ecosystems. Omnivores use a high variety of energy ‘packs’ that are obtained from a large number of different flows inside the nested-hierarchy of the food-web. Earlier studies considered omnivores to be rare and destabilizing (Pimm 1982), but this was a product of the poorly detailed analyses of trophic chains. Recent work demonstrates that
omnivores are abundant and probably have stabilizing effects on food webs (Mc Cann and Hastings 1997, Dunne et al. 2002). Nevertheless, in the otherwise comprehensive and excellent *The Princeton Guide to Ecology* (Levin 2009) the word omnivory appears once in the subject index in a book of 809 pp. and the topic of omnivores’ role in trophic networks does not merit any specific treatment.

The ecological and evolutionary implications of this oversight are not trivial. If we think about energy flow cascades, it would be easier, for instance, to explain why populations of large predators must be small and therefore more vulnerable to extinction. It also explains why omnivore species (like crows, pigs or humans) or omnivore communities (like ants), using very diverse types of energy packs from different levels in the trophic network hierarchy, have been submitted to selection pressure forcing them to evolve towards increasingly better handling abilities, larger brains and/or complex social organization. The so-called top-predators are only at the half way point of the cascading energy, followed by necrophages and decomposers. Except in some cases, mostly found in aquatic ecosystems, top-predators usually have little control of the whole system. The success of some mammals and mainly man, or ants as a group, benefiting from multiple energy sources, is easily understandable considering energy flow chains. Certainly, we have an urgent need to understand the role of ‘top’ predators and ‘top-down’ cascading effects, in order to increase our capacity to preserve biodiversity. But we have also the need to understand why the success in organizing space and controlling resources has been greater for other strategists. The old discussions on top-down and bottom-up control (Hairston et al. 1960, Murdoch 1966, Oksanen 1988, Terborgh et al. 2001, 2006) have systematically forgotten that omnivore species or communities are, probably, the main organizers of ecosystems, and we argue that research has probably been blinded by trophic chain misconceptions.

REFERENCES


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