From niche construction to the destruction of ecosystems

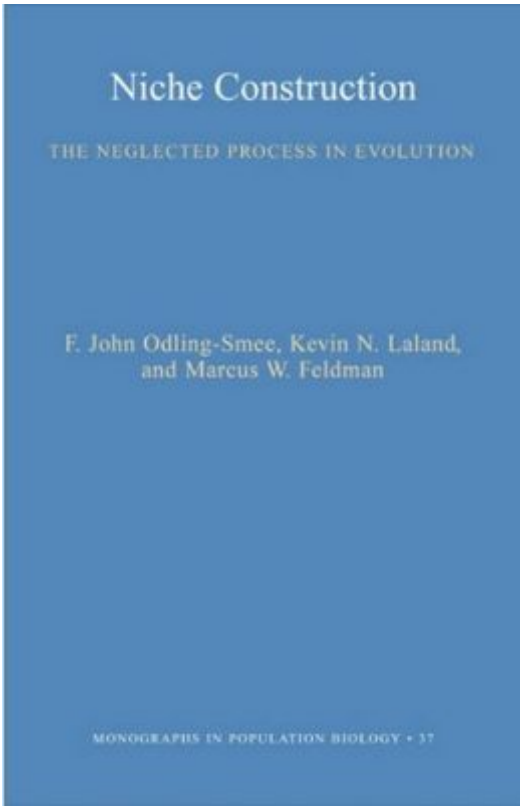

Figure 1. Cover of the book by ecologists F. Odlin-Smee, K. Laland and W. Feldman. Feldman.

In their 2003 book "Niche construction" [1], ecologists F. Odlin-Smee, K. Laland and W. Feldman pointed out that, through its multiple activities and interactions with its physical and biological environment, each species participates not only in the modifications of this environment but also in the evolution - and therefore the construction - of its own ecological niche. In short: the **short-term impacts** of any **species** or **population** on its physical and biological environment **exert in return** a **selection pressure** on the species' adaptation to these impacts.

For example, when a butterfly forages for a flower, it takes the nutritious nectar (which will no longer be available to itself or to other insects on that day) and also collects pollen grains which it may deposit on the pistil of another flower of the same species, thus favouring its fertilization: these are two short-term impacts of this activity, on its habitat and its ecological network

Figure 2. Lemon butterfly foraging. [Source : © Jacques Joyard]

In the longer term, being beneficial to both foraging butterflies and foraged plants, this behaviour exerts a selection pressure on the efficiency of the interaction, in both parties: on nectar production and flower signalling (by characteristic odours, shapes or/and colours) by plants, for example, and on the localisation abilities (by visual or/and olfactory recognition) of flowers by butterflies, as well as on the morphological adjustment of one to the other (coevolution of the proboscis of foragers and the corolla of foraged flowers).

Although the short-term impact of each species - and *a fortiori*, of each individual - on its environment is generally modest and affects only a small number of organisms, certain species known as "**structuring**" or "**ecosystem engineers**" have developed, over generations, high-impact methods and techniques - for feeding, defence against predators or bad weather, reproduction, care of young, etc. - that shape their environment. - some examples from near and far are the following. A few examples closer or less close to home:

Figure 3: Coral reef, Mayotte. [Source: Frédéric Ducarme, CC BY-SA 4.0, via Wikimedia Commons]

- the construction and maintenance of limestone reefs by coral polyps (cnidarians) in the clear, shallow waters of tropical regions, reefs that host and feed a multitude of species dependent on these habitats.

- the felling of trees and the building of dams on rivers by beavers, which radically alter the living conditions and habitat of local species
- in the non-concrete plains and valleys, the construction of galleries and the displacement of organic and mineral matter in the soil by earthworms and other worms, which transform (*through* their feeding) compact and sterile soils into fertile aerated soils.

Figure 4. large beaver dam on a Swedish river (Olden, Jämtland). [Source: Lars Falkdalen Lindahl, CC BY-SA 4.0, via Wikimedia Commons]

Of all the "ecosystem engineer" species, one stands out for the **diversity of its impacts** on the environment [2], as well as **the acceleration** and **increasing scale** of these impacts over the last few centuries [3] : **our own**. More precisely, the demographic and technological expansion of so-called "modern" societies on all the continents and seas of the world has resulted in a constant increase in their pressures and impacts on all terrestrial and aquatic ecosystems, which are now massively transformed, fragmented, polluted or destroyed [4], with increasing risks of tipping over on a global scale by exceeding thresholds [5].

Figure 5. Remnant of the Aral Sea. The diversion for agriculture of all the rivers feeding the Aral Sea, from the 1970s onwards, has transformed this fishy sea of more than 66,000 km2 into a desert area punctuated by a few salt lakes. [Source: User:Staecker, Public domain, via Wikimedia Commons]

Moreover, the massive and rapid transformation of ecosystems is accompanied by a **homogenization of ecological communities** with a simplification of local ecological networks and an erosion of animal and plant species on a global scale [6], [7],[8],[9], to the detriment not only of the declining species but also of indigenous human peoples and a growing fraction of "modern" populations, dismayed by the magnitude of environmental changes, inequalities and associated risks [10].

Notes and references

Cover image. Bleaching of a coral (acropod), in a coral reef, under the combined effect of chemical pollution, global warming and overfishing. [Source: Wikimedia commons, CC BY 3.0]

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