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Thoughts of a Travelling Ecologist, 3

There are no empty niches



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One of the oldest concepts in ecology is that of the niche. The word is borrowed from architecture, more exactly church architecture, where builders created different "boxes" — usually square-shaped, sometimes with an arched top — in thick church walls by leaving out some bricks, to place objects of decoration into these "niches". Controversy surrounded the concept since its introduction into ecology. The American ornithologist Joseph Grinnell, who first used the word, used it to mean "microhabitat", the special place where a species can be found (Grinnell, 1917). The alternative view of niche, by Charles Elton, emphasises also the ecological role of the species (Elton, 1927). In Elton's analogy, when in the outdoors, seeing a badger, we say "there goes a badger", it is as if we said, walking in the village: "there goes the vicar". We know where the vicar lives, and inseparably from this, we also know what he does, what is his role. A species has its place, including function, in nature. Its niche encompasses both.

An important weakness of these viewpoints remained hidden for quite some time — namely, that both include a passive view of the concept. The Grinnellian view divides the world into special shoe-boxes, little or big. Within these boxes, special sets of conditions exist, and into this an organism, requiring certain conditions, either fits or it does not. The Eltonian view is little different in this respect: the organism "can play this role", and it either fits into the environment, or it doesn't. Either

the toolkit is there to play its "evolutionary play", or the toolkit is not there, and thus — no play. In both cases, the role of the organism with respect to its environment is next to nil: it has to fit. This may be a Procrustes fit — but this passive view of species and their environment is still prevalent, in spite of the occasional warning (Laland *et al.*, 1999).

It is not difficult to find fault with this view: organisms not only seek favourable combinations of the required conditions — many actively create them. Everyone recalls the example of the beaver that, by complex "engineering", creates suitable habitat for itself by building dams on creeks, which become ponds. However, not many spend much time pondering this situation, and its generality. Yet the relationship between an organism and its environment is one of mutual, and dynamic. If an organism can modify its environment to make it more favourable for itself, it will do so. Elephants will uproot trees to get to the otherwise unattainable fruits or tender leaves. By doing this, they actually destroy their resource base, and grassland without trees will develop, until the elephant numbers decrease (Dublin *et al.*, 1990). Beavers divert watercourses. Many insects create their own favourable micro-environments. Even bacteria modify their immediate surroundings. Therefore, "niche construction" is ubiquitous.

However, old favourite concepts die hard. This passive view of the organism-environment relationship has become very widespread in the invasion literature. This is in

the background when the key to the success of an invader is attributed to the fact that "there is no similar species" in the new area of distribution, jumping to the conclusion that "there was an empty niche", and this explains the success of the invader. As if there were an empty box in that environment, waiting for organism X to fill.

The Romans spoke of "horror vacui" (fear of the vacuum, meaning unfilled space) in nature, realising that resources are used by living organisms, and do not go wasted. And indeed it is so. It is probably no resource used in its entirety, but nor is it totally unused. The difference is in the spectrum of organisms that use the resource. It is very problematic to introduce a hierarchy here. Can we say a resource is more efficiently used, if it is used by a bird vs. a microbe? Probably not, even the opposite is likely. Like many ecologists, I am a confessed birdwatcher. I do not make lists, but show me any bird, anywhere (not in a cage, please), and you made my day shine. So I like to take my examples from birds, even if I admit that we would be better off if not so much of our ecological knowledge would have arisen from bird studies. Having worked previously in several Old World wetlands, when I first saw them, the reedbeds of New Zealand seemed eerily empty. Hardly any birds. Mind you, the ones that live there are fantastic, just as New Zealand itself is fascinating for a naturalist. But still — this is nowhere near the richness of birdlife in Old World reedbeds. If one would introduce species from the Old World — as it was so frequently done in New Zealand, with plants, mammals, and (other) birds-, they would plausibly become naturalised. Are there "empty niches" there? I do not think so. I think an empty niche assumes that some available resource is not used. And this is not very much so. Consider food, for example. Birds are secondary consumers, so they need other organisms: seeds, fruit, arthropods, and other animals. If these are not eaten by birds, which are not there, they are eaten by other species, or feeding decomposers when they die. So the resource is not wasted at all. If birds were to arrive, they possibly could carve a niche for themselves, as the expense of the other organisms that previously used the same resource. This may or may not be possible. For example, arthropods may accumulate plant toxins, or a microbial symbiont may synthesise a compound that is toxic to the birds, but does not hinder the decomposers. This is quite a plausible idea. So what happened here is that before, a resource

was used by a particular combination of species, and it is now used in a new way. This will inevitably cause ripple changes in the ecosystem/s. I think if there was an empty niche, no such ripple would arise — then the empty box would only be not empty anymore. No ripples: the niche was there before, only empty. Everyday experience in nature shows plenty of evidence that the arrival of a new species generates large changes in its new environment. This is why invasive species are such a big problem. All the cards are distributed, always — only a new arrivee is often able to seize some of these for itself. And these will have to be taken from others.

I believe that if the empty niche term would be abandoned, it would usefully focus on the fact that an organism and its environment are in a dynamic, mutually active relationship with each other. The environment influences the organism, and the organism influences its environment. There are limits set for most organisms — but there are plenty of very sophisticated ways by which organisms actively manipulate, even construct their environment. They not only passively search for conditions that fit them, and avoid ones that do not fit. That would be a very simplistic picture of the world. Humans have famously, and evidently, modified their environment — even to the tragic detriment of mostly all other life. Maybe this view, that humans are commonly acknowledged as master modifiers of their environment, while other organisms are rarely acknowledged as such, survives because of our desperate search for a criterion that will separate humans from other species? We do best if we abandon this futile quest, and realise that humans cannot be separated in any absolute sense from other animals. That would open another way of looking at the world, and making it easier for us to coexist with other living organisms, because this is our universal duty.

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