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Anthropogenic noise's first reverberation into community ecology

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Commentary

Anthropogenic noise's first reverberation into community ecology

Humans are noisy. Indeed anthropogenic sounds are now almost ubiquitous throughout the land and seas [1]. Much recent work has focused on how noise affects the presence, abundance and behaviour of animals, either through directly harming animals or by making it difficult for them to communicate (e.g. [2]). A recently published study of Francis *et al.* [3] shows that anthropogenic noises may modify critical ecological services in a woodland ecosystem and by doing so, expands the impact of noise into a new discipline—community ecology.

Through a series of experiments, Francis *et al.* investigated the effect of noisy well compressors (which produce loud and continuous low-frequency noise) on the ecology of the surrounding ecosystem. Their goal was to determine if noise pollution modified three critical ecological processes: pollination, seed dispersal and seed predation. The generalized hypothesis was that anthropogenic sound will repel or attract animals that provide these ecological services and the subsequent change in access to them will influence the surrounding flora.

Results from the first experiment showed that the hummingbird pollinated plant *Ipomopsis aggregata* probably experienced increased rates of pollination near anthropogenic sound because hummingbird pollinators (*Archilochus alexandri*) were more frequent around artificial flowers at sites with compressor noise than those without, and that treatment sites had more pollen transfer. This demonstrated that the pollination of a plant could be affected indirectly if human noises increase the density of pollinators.

The following two experiments investigated the effect of anthropogenic noise on piñon pines (*Pinus edulis*), a dominant and an important tree in the New Mexico community in which they worked. Seedling surveys showed that pine seedling recruitment was four times as abundant in quiet areas than those with noisy well compressors. They identified two mechanisms to explain this. First, they found that compressor noise repelled scrub jays (*Aphelocoma californica*), a key seed disperser. Second, they found that compressor noise raised *Peromyscus* mice densities, effective seed predators. Together, this unsurprisingly led to evidence of higher seed consumption around the noisy well compressors. They conclude that anthropogenic sound indirectly affected the seedling recruitment of a dominant primary producer, and thus could ultimately change the community structure. Taken together, these results are novel in two ways.

First, we traditionally have observed humans altering the distribution of primary producers via changing consumer density (e.g. consumer removal [4]), by changing the distribution or abundance of resources (e.g. eutrophication [5]), or by directly manipulating their communities (e.g. overharvesting [6]). A prototypical example is that overharvesting of herbivores causes shifts from coral to algal dominance in coral reef ecosystems [4]. However, Francis *et al.* demonstrated that an extraneous unnatural stimulus, rather than the manipulation of natural processes, can change the distribution of a primary producer. Therefore, the study raises additional questions ripe for study. For instance, do other human-produced stimuli in other modalities (e.g. light, olfactory) unknowingly affect the community structure of primary producers? We can easily imagine that light does but identifying how it works is an area that is wide open for the study.

Second, while we have studied extensively the effect of anthropogenic noise on animals, because it interferes with their communication (e.g. call rate [7]), cognition (e.g. attention [8]) and exposure to predators (e.g. foraging efficiency [9]), Francis *et al.* have shown us that noise may modulate ecosystem services provided by animals and thus may influence plant distribution and community structure. This is a compelling finding because it shows that our stimuli can have a cascading effect, rather than simply a singular one within an ecosystem, from the animals that perceive it directly to their primary producing communities.

Ultimately, Francis *et al.* showed that we must continue to analyse and investigate secondary effects of anthropogenic stimuli because they may be more wide-reaching than previously anticipated. It is important that we understand how our activities alter surrounding ecosystems, so that we can then better predict and manage the myriad unintended effects of a large and noisy human population.

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