Chronically understudied, fences hold grave ecological threats

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Fences are one of humanity's most frequent landscape alterations, with their combined length exceeding even that of roads by an order of magnitude. Despite their ubiquity, they have received far less research scrutiny than many human-built structures. Writing in *BioScience* , Alex McIntuff, who was at the University of California (UC), Berkeley, at the time of this research and is now with UC Santa Barbara, and a global team characterize the current state of fence research and generate a typology to guide future efforts.

The authors argue that fences are a particularly difficult to study feature: "Fences have eluded systematic study for so long for good reason. Fences are both difficult to detect, and, at an even more basic level, difficult to define." For instance, definitions that might distinguish fences from walls are ever shifting. Compounding these challenges, McInturff and colleagues say, is the fact that "invasive species rapidly discover and exploit breaks in fences," and therefore, "even where fences can be mapped, either remotely or via ground surveys, characterizing their intactness or functionality requires a closer, and often infeasible, form of evaluation."

Despite the difficulty in studying these structures, the movement-restricting effects of fences have profound ecosystem consequences. "To put it simply, in a fenced world, there are winners and there are losers," say the authors. Generalist and disturbance specialist species fare well, whereas specialist species often struggle with restricted access to habitat, altered community composition, and changes to the ecosystems on which

they depend. As an example of the potential "losers," the authors highlight research indicating that "a planned US-Mexico border fence would dangerously restrict gene flow among desert bighorn sheep, isolating populations across the border."

Despite the clear effects of fences on some species, many other interactions remain unexplored, and surprises abound. For instance, the authors describe an Australian conservation fence erected to protect an enclosed nature reserve. Despite performing its intended role well, the fence "was found to have unintended negative consequences for native reptile populations around the enclosure, especially for eastern longnecked turtles. The fence disrupted turtle movement patterns, isolated populations, and led to high mortality rates."

The authors' review of existing literature sheds light on similar knowledge shortfalls, with fences' effects on nontarget being particularly poorly studied. They found that "64% (285 of 446) of the studies were focused exclusively on the effects of fencing on target species—that is, species for which a fence was built. Only 24% of the studies included both target and nontarget species, and in a mere 12% were nontargeted species studied exclusively."

To better address fences' ecological effects, the authors advocate an increased focus on "fence design and placement and fence construction and removal." Only through such efforts, they say, can the field of fence ecology be well positioned to "provide the science to manage and mitigate one of humankind's most pervasive alterations of our planet."

More information: Alex McInturff et al, Fence Ecology: Frameworks for Understanding the Ecological Effects of Fences, *BioScience* (2020). DOI: 10.1093/biosci/biaa103