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## CORRESPONDENCE

# The essence of soil biodiversity

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## Abstract

Soil ecologists and conservationists should focus on raising people's awareness of the essence of soil biodiversity: its complex ecological webs and emergent ecosystem services that support aboveground life and human well-being. Conservation and communication efforts regarding soil biodiversity must consider local-scale ecological contexts and different audiences. Engaging educational and outreach materials and methods should be prioritized to advance preservation of soil systems and their biodiversity.

## KEYWORDS

conservation policy, ecosystem services, environmental education, soil biodiversity, soil education, soil systems

Soils are complex ecosystems that provide homes for innumerable species. Thus, describing “soil biodiversity” is challenging and worthy of critical analysis, as highlighted by Orgiazzi (2022). However, I think he overemphasized the definitional problem, which distracts from more important discussions about communicating soil biodiversity's essential meaning and relevance to conservationists, policymakers, and the public. Rather than pursue an unattainable goal of an “official and common definition,” we should focus on raising people's awareness and care for soil systems, which will have more direct impacts on conservation decisions.

Soil ecologists know what soil biodiversity is: the full spectrum of organisms inhabiting the soil matrix in all Earth's biomes, including the genetic, morphological, and functional variation among populations and species, and their different combinations and ecological relationships. A holistic and flexible definition like this is amenable to use in a variety of conservation and social contexts across scales. Orgiazzi's (2022) reference to such definitions as “vague” risks causing confusion and undermining scientists' credibility and misses a main point: nonscientists are unlikely to care about nuanced differences among aca-

demically defined. Instead they need to know why they should care about soil organisms and conserve them. For this, scientists should help people better appreciate the “essence of soil biodiversity”: its complex ecological webs and emergent ecosystem services that support aboveground life and human well-being.

Orgiazzi (2022) wonders whether specific organisms are part of soil biodiversity based on how long they inhabit the soil (e.g., soil-nesting bees). This question is not unique to soils (many organisms need multiple habitats, e.g., dragonflies, penguins), and emphasizing such debatable details is tangential to motivating people to take conservation action. If a species lives in the soil—even briefly—conservation plans must integrate soil to succeed. That is the main issue for conservationists and policymakers, not whether such organisms are part of anyone's definition of soil biodiversity.

Further, conservation and communication efforts regarding soil biodiversity must consider local-scale ecological contexts. Some soil-dwelling organisms (e.g., burrowing owls, caecilians) have restricted global ranges and are thus irrelevant to conservation in many places. In contrast, including species in the definition of soil

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biodiversity does not mean that they are “good” to conserve, such as nonnative earthworms that harm native species (e.g., Gundale, 2002). This points to the value of emphasizing broad, adaptable descriptions of soil biodiversity, and generic “membership lists” (Table S1) that can be operationalized for specific management, policymaking, and educational goals. Focal soil organisms and their value for different stakeholder groups shift across time, places and sociocultural setting (e.g., foci for soil restoration will differ between agricultural fields and urban landscapes; Setälä et al., 2014). Inasmuch as the scientific community should develop common definitions for soil biodiversity, they should be used as starting points for crafting soil-conservation messages that are tailored for a given situation. For instance, different vocabulary should be used for policymakers than for elementary school students. This contrasts with Orgiazzi’s (2022) hope for a universal definition of soil biodiversity, which ignores the need for varied descriptions for diverse audiences.

Rather than debating ever-more nuanced definitions of soil biodiversity, I suggest that ecologists and conservationists focus on creating engaging educational and outreach materials and methods to advance preservation of soil systems and their biodiversity. This effort, referred to as “pedagogy for the pedosphere” (Byrne et al., 2016), is critical for ensuring that soil life receives the policy and conservation attention it deserves (Parker, 2010). We know enough about soil biodiversity to recognize that it is essential for human health and well-being (Bach et al., 2020). This essence is what everyone around the world needs to understand for a future in which the amazing breadth of soil biodiversity is conserved from local through global scales.

#### DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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#### SUPPORTING INFORMATION

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