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[All Publications](#) > [Ecology](#) > [January 2012](#) > Cascading effects of long-term land-use changes on plant traits and ec...

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Volume 93, Issue 1 (January)

[< Previous](#) [Next >](#)



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Volume 93, Issue 1 (January 2012)

[Next Article >](#)

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Articles

### Cascading effects of long-term land-use changes on plant traits and ecosystem functioning

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There is much concern that the functioning of ecosystems will be affected by human-induced changes in biodiversity, of which land-use change is the most important driver. However, changes in biodiversity may be only one of many pathways through which land use alters ecosystem functioning, and its importance relative to other pathways remains unclear. In particular, although biodiversity–ecosystem function research has focused primarily on grasslands, the increases in agricultural inputs (e.g., fertilization, irrigation) and grazing pressure that drive change in grasslands worldwide have been largely ignored. Here we show that long-term (27-year) manipulations of soil resource availability and sheep grazing intensity caused marked, consistent shifts in grassland plant functional composition and diversity, with cascading (i.e., causal chains of) direct, indirect, and interactive effects on multiple ecosystem functions. Resource availability exerted dominant control over aboveground net primary production (ANPP), both directly and indirectly via shifts in plant functional composition. Importantly, the effects of plant functional diversity and grazing intensity on ANPP shifted from negative to positive as agricultural inputs increased, providing strong evidence that soil resource availability modulates the impacts of plant diversity and herbivory on primary production. These changes in turn altered litter decomposition and, ultimately, soil carbon sequestration, highlighting the relevance of ANPP as a key integrator of ecosystem functioning. Our study reveals how human alterations of bottom-up (resources) and top-down (herbivory) forces together interact to control the functioning of grazing systems, the most extensive land use on Earth.

Key words: [biodiversity](#), [carbon sequestration](#), [ecosystem services](#), [functional diversity](#), [grasslands](#), [grazing intensity](#), [litter decomposition](#), [long-term experiment](#), [Mackenzie Basin](#), [South Island](#), [New Zealand](#), [primary production](#), [resource availability](#), [structural equation modeling](#)

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