

# Long-term implications of soil fertility for soil biology in hill country pastures

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Long-term fertiliser and grazing trials yield valuable information. In this study we take a closer look at how the soil biology has changed on the long-term phosphorus fertiliser and sheep grazing study at AgResearch, Ballantrae. We sampled three farmlets, no fertility (NF) which received 156 kg/ha/y of single superphosphate (SSP) from 1975-1979 and none since then, low fertility (LF) which received 125 kg SSP/ha/y since 1980 and high fertility (HF) which received 375 kg SSP/ha/y since 1980.

Earthworm abundance was first measured in 1979 (Lambert 1986). While there was no difference in earthworm abundance between the LF (526 m<sup>-2</sup>) and HF (644 m<sup>-2</sup>) farmlets, there was a strong relationship between their abundance and pasture production. Since 1979 Olsen P values have decreased under NF, remained similar under LF and increased under HF (Mackay and Costall 2016). A survey in the spring of 2014 across the same farmlets found earthworm abundance similar under LF (440 m<sup>-2</sup>) and HF (440 m<sup>-2</sup>) and double that under NF (220 m<sup>-2</sup>). HF and LF had more epigeic *Lumbricus rubellus* and endogeic *Aporrectodea caliginosa* and fewer native earthworms than NF.

The heterogenous hill country landscape also is a major determinant of the abundance and composition of the earthworm community. Greatest earthworm abundances were found on low (430-680 m<sup>-2</sup>) compared with steeper slopes (110-240 m<sup>-2</sup>). Medium slopes contained 80% of low slope populations under HF, but only 40% under NF. The influence of aspect has changed since 1979, with southwest slopes no longer having the lowest earthworm populations. We will discuss factors influencing the abundance and diversity of earthworms under different long term soil fertility in a hill country landscape, including the changes in forage supply, and investigate the implications for soil services and the value of these services. We will also touch on the influence of changes in soil fertility on the wider soil biological community including mites, springtails and nematodes.