

Impact of applications of copper containing pesticides on earthworm communities in viticulture

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The importance of copper-containing pesticides as efficient fungicides in organic and integrated farming is beyond question, but these types of pesticides give cause for serious environmental concern. Therefore, the European Union has authorized copper as pesticide until 31. January 2018. The corresponding directive 2009/37 states: *“Member States shall initiate monitoring programmes in vulnerable areas where the contamination of the soil compartment by copper is of concern, in order to set, where appropriate, limitations such as maximum application rates.”*

In 2010, Germany has started activities to develop a *“copper minimizing strategy”* in specialty crops (grape, hop, apple). Results from quality wine regions can be summarized as follows:

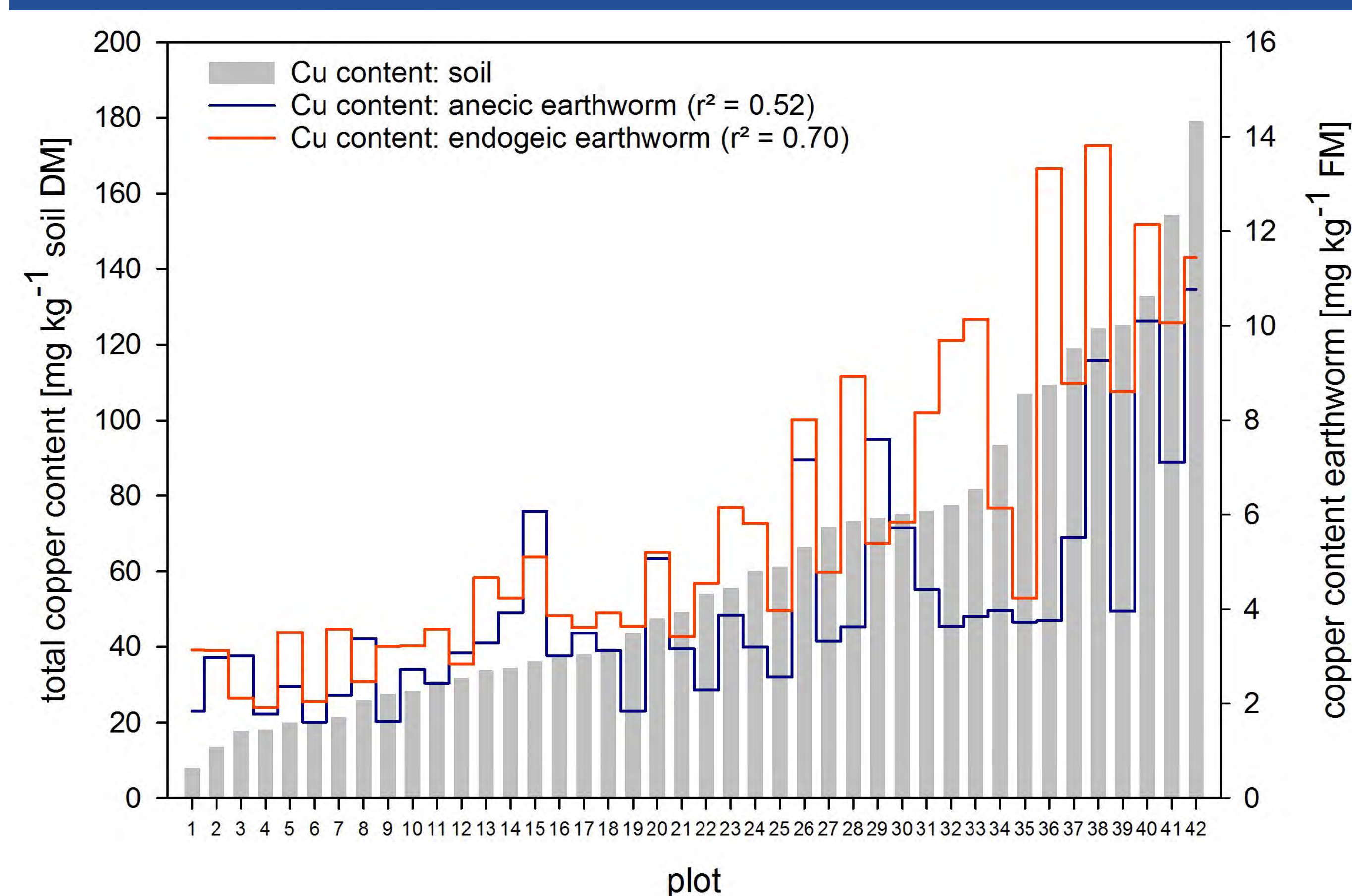


Fig. 1: Copper accumulation in earthworms in soils with different total copper content [autumn tours]

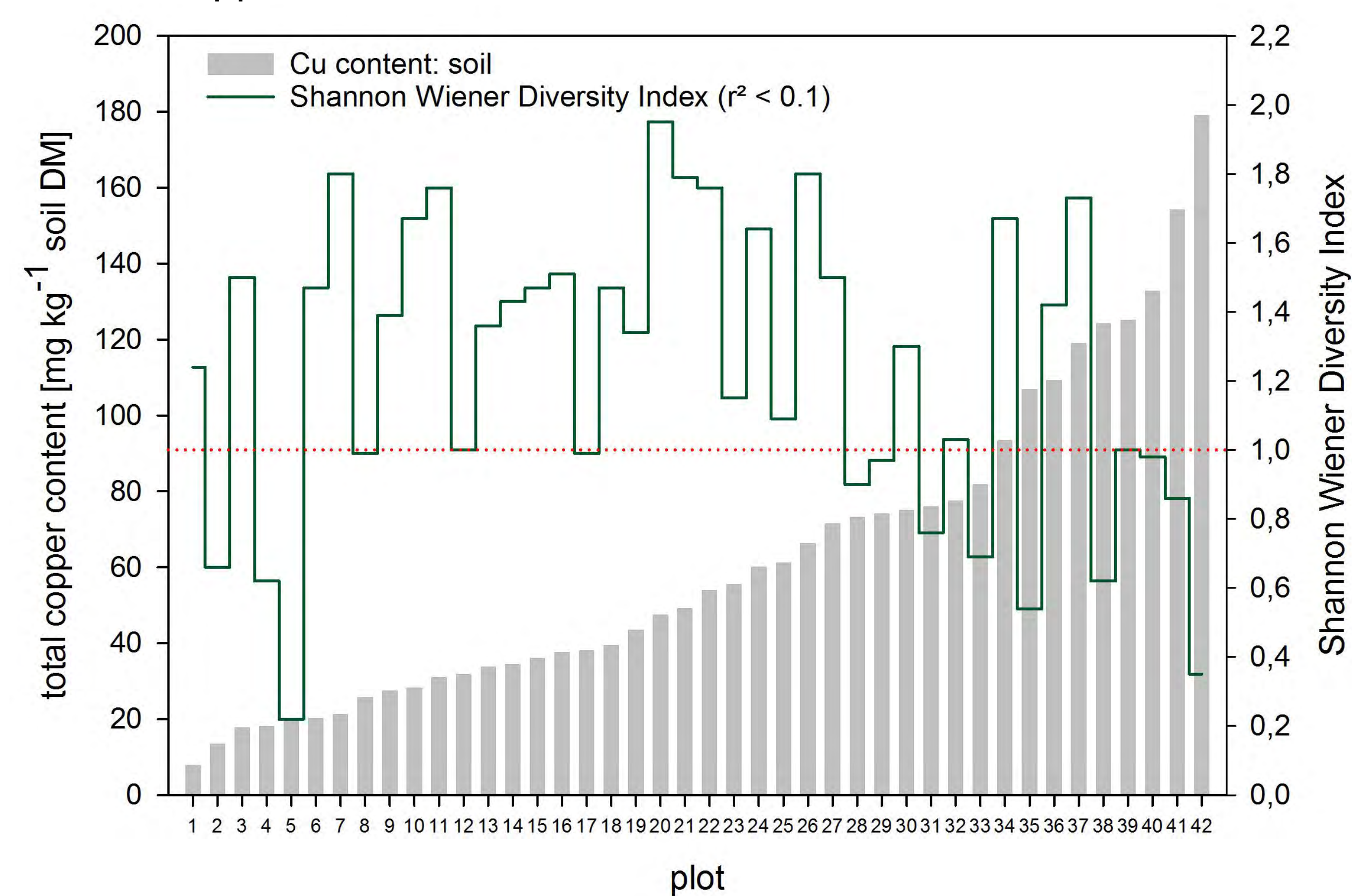


Fig. 2: Shannon Wiener Diversity Index of earthworm communities in soils with different total copper content [autumn tours]

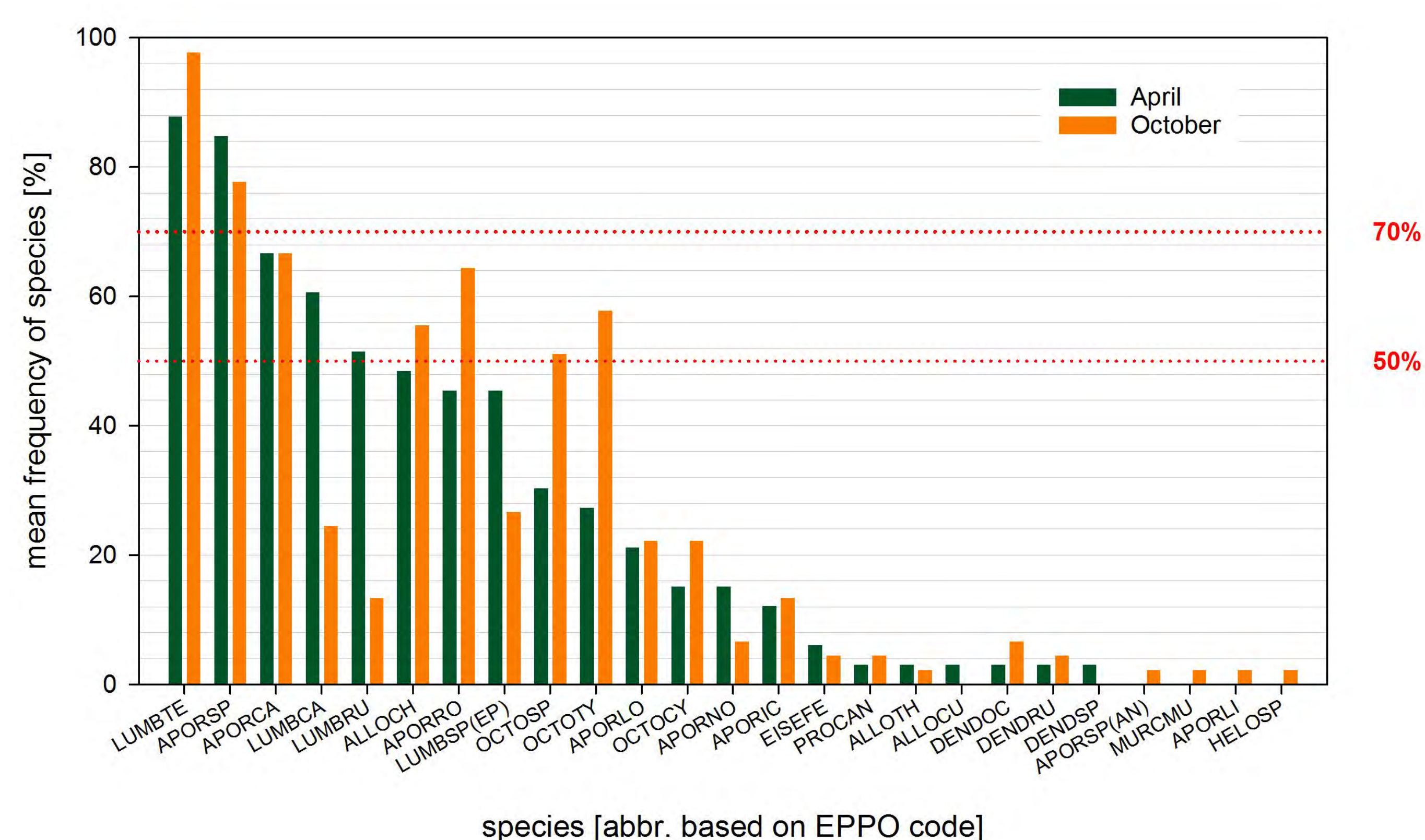


Fig. 3: Frequency of single earthworm species in German vineyards [$> 70\%$ = high, $50-70\%$ = medium level of steadiness]

Tab. 1: Correlation between mobile copper content (CaCl_2 extract) and different main soil features

soil feature	correlation coefficient	significance level
Cu total content	0.7256	<0.01
cultivation duration	0.3287	<0.01
pH scale	-0.3219	<0.01
organic matter	0.1600	<0.01

THE RESULTS demonstrate that soils' total copper content ranges from 10 to 325 mg kg^{-1} soil dry matter, nevertheless the mobile or active content is less than 1%. This mobile copper content depends on main soil features (Tab. 1). Copper accumulation in earthworms seems limited (Fig. 1). A trend that high mobile copper compounds take negatively influence on earthworm communities was found (Fig. 2). Only less species can be found frequently in vineyards. There are more species in autumn than in spring (Fig. 3).



IN SUMMARY, effects on earthworm communities could be strengthened or weakened by other environmental influences, e.g. pH scale, organic matter, texture or agricultural management measures. There are fields with high copper contents where earthworm communities are well developed and *vice versa*. Their benefits to ecosystem services in viticulture will be investigated subsequently.