



Soil nutrients dynamics and the evolution of multi-decadal degradation in alpine wetlands of the Qinghai-Tibetan Plateau

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The Qinghai-Tibetan Plateau (QTP) is the highest plateau on earth and has a large area of alpine swampy meadows. In the past few decades, overgrazing and climate change have caused severe desiccation and degradation of the alpine wetlands. The remote sensing technology has been used to assess the wetland shrinkage. However, changes in soil nutrients associated with the duration of alpine wetland degradation are poorly known. We took soil samples in three swampy meadows of the QTP, one terrain was relatively flat and the other two were with hummocks and hollows. Decadal gradients of degradation from nondegraded swampy meadows to degraded meadows were selected. The contents of soil organic carbon (SOC), total nitrogen (TN) and total phosphorus (TP) were analyzed. The SOC, TN, and TP contents loss in degraded swampy meadows occurred mainly during the first decade. The soil nutrients loss was highly affected by the geomorphic characteristics of the wetland area. After degradation, the SOC, TN, and TP contents decreased at exponential rates on the flat terrain site. The top layer SOC, TN, and TP contents of the degraded about 30 years area were 24.76 ± 0.91 , 2.22 ± 0.07 and 0.45 ± 0.01 (mean \pm SE) g kg^{-1} , respectively; and the SOC, TN, and TP contents decrease were 75%, 72% and 56% that of the nondegraded swampy meadows, respectively. On one hummock-hollow sites the top layer SOC, TN, and TP contents of the degraded for about 30 years area were 61.22 ± 11.94 , 4.09 ± 0.73 and 0.44 ± 0.05 (mean \pm SE) g kg^{-1} , respectively; and the SOC, TN, and TP contents decrease were 45%, 52% and 46% that of the nondegraded swampy meadows, respectively. The soil nutrients decomposition rate of hummock-hollow sites was much lower than the flat terrain site. Large and tough hummocks in swampy meadow degradation sites can resist environment erosion and stabilize soil nutrients content at high levels.