Submitted Abstract

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Abstract

Monitoring ecosystem condition is critical for informing sustainable nature and area management, and is an important element in ecosystem accounting. A sound assessment of ecological condition requires the integration of various data that cover the functional characteristics of the respective ecosystem. In 2021, we performed the first national assessment of ecological condition for mountain ecosystems in Norway applying the Index-Based Ecological Condition Assessment (IBECA) framework. IBECA follows an approach similar to the EU Water Framework Directive, aggregating indicators into an index separated into condition classes, and distinguishes the classes good and reduced ecological condition. The method is compatible with the UN framework for ecosystem accounting and can be applied at various spatial scales, all depending on the data available. Our assessment covered the national and regional spatial levels and thus had a substantial spatial extent as approximately a third of Norway's mainland surface represents mountain ecosystems. Our analysis is based on 19 indicators, spanning data on species, communities, remote sensing, and infrastructure, aggregated into indices for functional ecosystem characteristics, ecosystem pressures, and the overall ecological condition. The indicator data were required to i) be area-representative, ii) address some functional characteristic of an ecosystem, iii) be sensitive to one of the five major environmental pressures, and iv) be comparable to a quantifiable reference condition. Our results indicate good ecological condition for Norwegian mountain ecosystems with an index just above the threshold to reduced condition. Keystone organisms like small rodents and the mammal predators arctic fox and wolverine scored very low due to strongly reduced population levels. Also, the vegetation's signal on heat requirement was below the threshold, indicating a dominance shift in the vegetation in favour of warmer-loving species. In contrast, physical indicators of climate change, such as the spatial extent of glaciers, snow depth and snow cover scored above the threshold for reduced condition, but with large variability. Related to human land use, area without human infrastructure scored high, but mountain area connectivity was at the border to reduced condition. Our assessment indicates that the largest pressures on Norwegian mountain ecosystems to date relate to population management, followed by climate change and land use, the latter two still scoring just above the threshold for reduced ecological condition. Due to continued climate warming and development of cabins and roads we thus expect a negative future trend for these pressures and consequently for the overall ecological condition in Norwegian mountains.