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Boreal Ecosystems at Risk: The Role of Forest Management

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The circumpolar boreal belt comprises almost one-third of the global forest area and about one-fourth of the world's wetlands. Both are terrestrial ecosystems highly vulnerable to climate change. Moreover, there are substantive structural, ecological and management commonalities and linkages between boreal and significant parts of global mountain forests (i.e. intrazonal boreal forests). Specific features of boreal and high-elevation forest (inter alia adjustments to cold climates; dominance of coniferous species; permafrost; particular dependence of disturbance regimes on climate anomalies; availability of large remote and practically unmanaged territories; and lack of the infrastructure over vast areas) expose these landscapes to extreme pressure and risk under ongoing and future climate change. Within "tough" IPCC Scenarios (e.g. RCP6.5/8.5) high-elevation forests are considered as a potential tipping element. A particular threat to global climate mitigation efforts is generated by thawing permafrost, which contains about 1000 Pg C basically in form of methane and hydrates in frozen grounds of Northern Eurasian high latitudes only. Furthermore, forest dieback over large areas, loss of biodiversity and negative impact on social hotspots are expected in the highly populated southern (mid-latitude) ecotone of the boreal zone. Taken into account that most critical climate change on the planet are expected in continental regions of the boreal and mountainous zones, these forest and wetland landscapes require specific societal, scientific and managerial attention. Our presentation considers needs, possibilities, and risks but also opportunities of a transition to adaptive and risk-resilient sustainable forest management (ASFM). Diversity of forests, ownerships, socio-economic conditions, forest management practices and policies over the boreal and high-elevation forests is high, and so are the associated risks such as climate change impact and disturbances. This generates large differences in stakeholder preferences, importance of understanding and valuation of ecosystem services, as well as in understanding relevant strategies of ASFM implementation. Investigating socioe-cological drivers which define current and future states, resilience/vulnerability of forests, and the stability of (agro-) forest landscapes needs to be based on an integrated evaluation of major forest ecosystem services in close connection with specifics of surrounding landscapes. A key challenge is assessing vitality and ecosystem services under future climates and quantifying tradeoffs between services including their economic valuation within the paradigm of multi-functional use of forests. We show that starting points and capacity of different boreal countries to ASFM are substantially different. Cross-border analysis of national specifics and commonalities are needed to understand potentials and challenges of ASFM, as well as identifying problems which cannot be sufficiently resolved by means of ASFM (e.g. slowdown of permafrost thaw). There is no single strategy, which would allow reaching all goals of ASFM. High uncertainty of climatic predictions and lack of knowledge of behavior of boreal and high-elevation forests under new environmental conditions require new operative information and models that are able to represent diverse and robust backgrounds of decision-making within regional forest management systems.