Carpathian Convention COP7

Assessment of climate change risks and adaptation options for Carpathian forest ecosystems and their services

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Photo: Sergey Ryzhkov / Wikimedia Commons

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Republic of Serbia
MINISTRY OF
ENVIRONMENTAL PROTECTION

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CARPATHIAN CONVENTION

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Photo: Sabine McCallum

RATIONALE

- Forest ecosystems harbor a wealth of **ecological, economic, and cultural values in the Carpathians:**
  - representing Europe's largest concentration of virgin, quasi-virgin and natural forests with over 200 endemic species of plants,
  - providing refuge for populations of large European mammal species, such as the lynx, river otter, grey wolf, woodland bison, red deer, moose, and brown bear.
  - support rural livelihoods and critical for ecosystem services, such as wood products, flood control, and climate regulation.
- Yet, Carpathian forests bear the **legacy of a long history of intensive production-driven management** that has simplified forest structure and homogenized landscape composition, making **Carpathian forests more vulnerable** to tree mortality and dieback.
- This sets the stage for **climate change**, superimposing **additional stresses** through
  - direct effects on plant physiology, phenology, and reproductive success,
  - indirect effects through altered and often increased disturbance frequencies and severities, and
  - interlinked changes disrupting ecological processes, species interactions, and overall ecosystem dynamics.
- Management related exposure and accelerating climate change impacts already pose present significant challenges to forest ecosystems and their crucial services

MANDATE

- The Carpathian Convention Conference of the Parties at its 6th meeting (COP6, 2020) encouraged the development of an **assessment of the impacts of climate change on the Carpathian forests and their ecosystems services** by relevant Convention Working Groups and partners and with support of the Convention Secretariat

- This activity was included in the Implementation Framework 2030 accompanying the Long-term Vision towards combating climate change in the Carpathians

- The 8th meeting of the Carpathian Convention Working Group on Climate Change, held on 6 May 2021 online, called for initiating the assessment at the **Forum Carpaticum 2021.** Accordingly, a *Special Session and Workshop on Forest ecosystem vulnerabilities to climate change in the Carpathians was organized.*

- A dedicated **informal subgroup** of the Working Group on Climate Change and the Working Group on Sustainable Forest Management was established after the Forum, with experts nominated by the Focal Points of the Carpathian Convention. This group held it´s **first meeting on 16 November 2021.**

- A **subsequent survey** provided the main basis for the scope and topics covered by this draft assessment, supported by a review of European- and regional-scale scientific assessments, interviews with leading research groups, and a literature review using Web of Science.

ASSESSMENT - TOPICS

Key topics, impacts, and adaptation options derived by the survey and presented in the assessment include the following:

- Forest growth and productivity
- Biomass and Carbon Stocks
- Tree mortality
- Changes in species range, habitat shifts and abundance
- Invasion by non-native species
- Forest ecosystem services
- Forest – water interactions, including hydrologic regulation and riparian dynamics

Photo: Virgin forest in Ukrainian Carpathians © Mariia-Varvara

APPROACH

- Survey responses were coded to indicate the number of times particular risks, impacts, and adaptation options were mentioned, performed individually for each topic and then as a cross-cutting synthesis across all the topics
- This triangulation method allowed **Identification of top priorities (i.e., greatest concerns)** on key risks and impacts shared among the respondents, presented as Findings
- Significance of these issues was **validated by literature review** where the priority risks identified in survey results aligned closely with the topics of most active investigation within recently published and on-going forest science research
- **Adaptation approaches** were synthesized and presented in **Factsheets** linked to the priority topics and expanded with further information on characteristics, intended effects, and potential advantages/disadvantages
- Based on this synthesis, the assessment additionally highlights **Opportunities and Pathways** as well as **Knowledge Gaps and Research Needs**

SYNTHESIS OF RISKS AND IMPACTS	Primary Risks Identified	Convergence/Divergence of views regarding impacts
Top ranked	Disturbances	Reduced carbon storage, growth increment, and climate regulation. Accelerated shifts in species distributions. Accelerated spread of invasive species
Second ranked	Drought	Forest decline, dieback, and reduced productivity. Shifts in species distributions, exacerbation of insect and fire risks, and diminished ecosystem services
Third ranked and other	Flooding, invasive species, land use pressure	Interactions across a range of ecosystem services and habitat provisioning, including carbon sequestration, hydrologic regulation, and wood production as well as biodiversity
ADAPTATION SYNTHESIS	**Theme**	**Convergence/Divergence of Views Regarding Impacts**
Top ranked	Forest restoration	High agreement on need for restoration and climate-adapted regeneration practices
Second ranked	Sustainable management, including broader use of close to nature silviculture and continuous cover forestry	broader use of close to nature silviculture and continuous cover forestry
Third ranked and other	Landscape heterogeneity to increase resilience to disturbance and drought	High agreement on need to address altered disturbance regimes, promote future-adapted forest composition, increase landscape heterogeneity and complexity, and reduce spread of invasive species

Photo: Bessi / pixabay

FINDINGS 1/2

Altered disturbance regimes

- Most frequently mentioned risk to all key topics (forest growth, biomass, tree mortality, etc.) was the effects of climate change on natural disturbances, particularly forest fires, bark beetle outbreaks, and windstorms
- Increased disturbance risks will accelerate overall rates of forest change, exacerbating other threats such as the spread of invasive species, species range shifts, and loss of important habitats for biodiversity
- Disturbance impacts additionally create feedback loops that diminish the provisioning of critical ecosystem services, including timber and non-timber resource production, carbon storage, and hydrologic regulation

Drought risks to forest resources and services

- Second most frequently mentioned risk was drought, posing grave consequences for forest growth and productivity, regional tree mortality rates, biodiversity, and future shifts in species composition
- Drought and associated disturbance risks are increasing within the Carpathian region, esp. in the southern and eastern parts of the range where water availability is limited

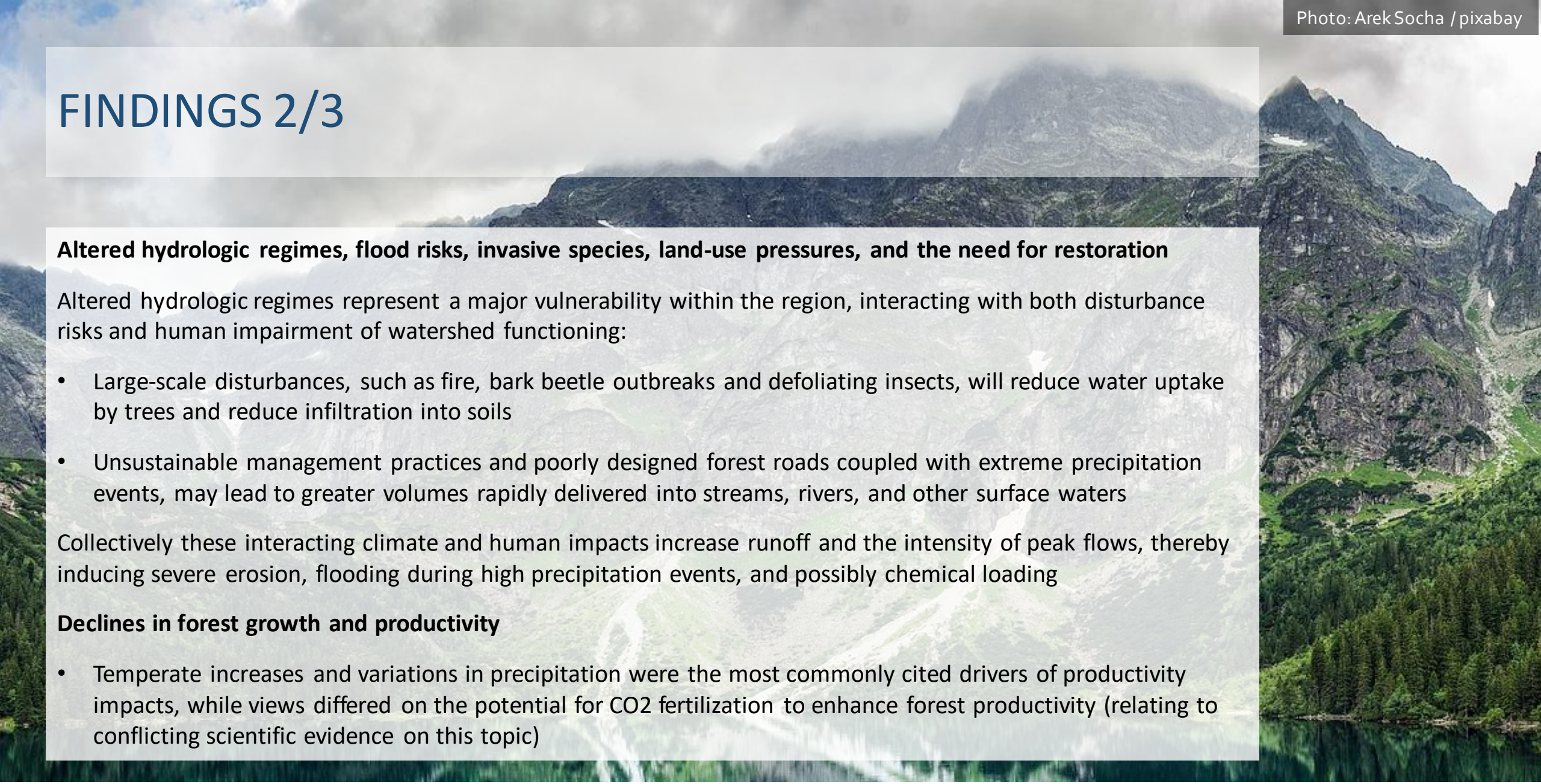


Photo: Arek Socha / pixabay

FINDINGS 2/3

Altered hydrologic regimes, flood risks, invasive species, land-use pressures, and the need for restoration

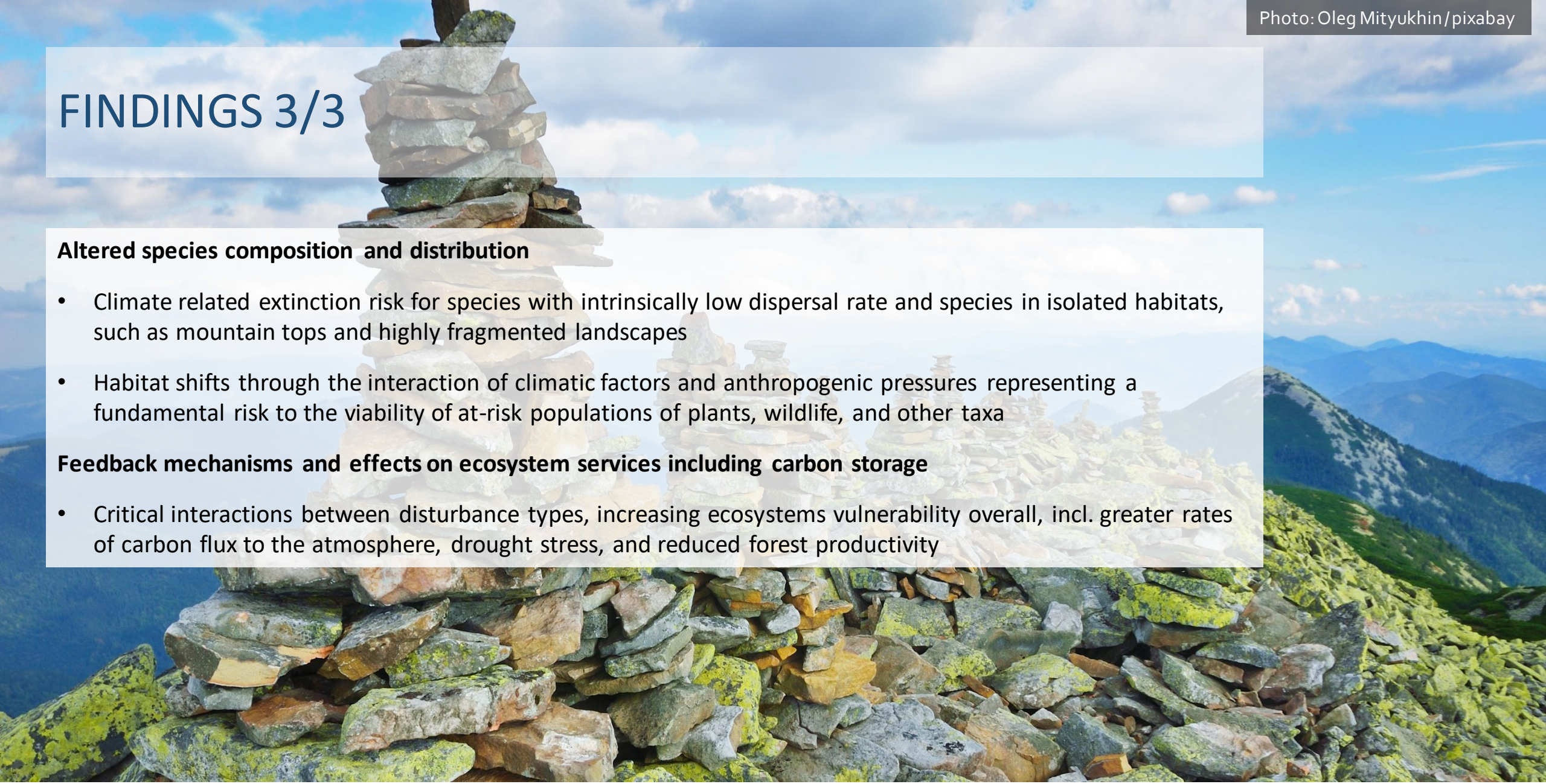
Altered hydrologic regimes represent a major vulnerability within the region, interacting with both disturbance risks and human impairment of watershed functioning:

- Large-scale disturbances, such as fire, bark beetle outbreaks and defoliating insects, will reduce water uptake by trees and reduce infiltration into soils
- Unsustainable management practices and poorly designed forest roads coupled with extreme precipitation events, may lead to greater volumes rapidly delivered into streams, rivers, and other surface waters

Collectively these interacting climate and human impacts increase runoff and the intensity of peak flows, thereby inducing severe erosion, flooding during high precipitation events, and possibly chemical loading

Declines in forest growth and productivity

- Temperate increases and variations in precipitation were the most commonly cited drivers of productivity impacts, while views differed on the potential for CO2 fertilization to enhance forest productivity (relating to conflicting scientific evidence on this topic)



FINDINGS 3/3

Altered species composition and distribution

- Climate related extinction risk for species with intrinsically low dispersal rate and species in isolated habitats, such as mountain tops and highly fragmented landscapes
- Habitat shifts through the interaction of climatic factors and anthropogenic pressures representing a fundamental risk to the viability of at-risk populations of plants, wildlife, and other taxa

Feedback mechanisms and effects on ecosystem services including carbon storage

- Critical interactions between disturbance types, increasing ecosystems vulnerability overall, incl. greater rates of carbon flux to the atmosphere, drought stress, and reduced forest productivity

Photo: Max / pixabay

ADAPTATION APPROACHES

- Synthesis of adaptation response options clustered into Factsheets for priority topics identified

EXAMPLE: TREE MORTALITY

INCREASE RESILIENCE TO DISTURBANCE	
Characteristics	Approaches to enhance resilience include: • → Enhancing and maintaining species, structural and genetic diversity by favoring existing genotypes that are better adapted to future conditions, incorporating genetic diversity from a greater range of population sources and including pest- or drought-resistant varieties where appropriate. • → More intensive thinning practices and care of forest stand edges. • → Promoting redundancy of ecological representation within core protected areas. Also "functional redundancy," which means having multiple species or ecological components that perform similar functions, providing compensatory capacity if one species declines or is adversely affected by climate change. This functional diversity ensures that multiple ecological processes and services are maintained, even if some species or functional groups are lost or impacted. • → Establishing ecological corridors and maintaining landscape connectivity to facilitate the species' range shifts, dispersal and genetic interchange among populations, and continuation of ecological processes. Connected landscapes allow for the dispersal of species, enabling recolonization and gene flow following disturbances. Corridors can also help species adapt to shifting environmental conditions caused by climate change.
Main Impact/Risk addressed	Increasing soil moisture deficits and prolonged drought due to reduced precipitation and higher temperatures likely in some areas.
Intended effects	Enhanced diversity in forests exhibits a higher variability in resistance to pests, drought and access heat. Reducing stand densities, for instance in intensively managed coniferous forests, will lower competition and thus the probability of drought-related tree mortality. Enhanced complexity and diversity of patch mosaics (e.g., different types and ages of vegetative communities) across the landscape helps limit contagion and spread of insects and plant diseases.
Pros and cons (if any)	N/A depending on approaches to increase resilience

EXAMPLE: INVASION BY NON-NATIVE SPECIES

MANAGEMENT PRACTICES TO MAINTAIN OR IMPROVE THE ABILITY OF FORESTS TO RESIST PESTS AND PATHOGENS	
Characteristics	Forest management practices that manipulate the density, structure, or species composition of a forest may reduce susceptibility to some pests and pathogens, inter alia: • → Thinning to reduce the density of a pest's host species in order to discourage infestation, based on the knowledge that species are especially susceptible to pests and pathogens at particular stocking levels. • → Adjusting rotation length to decrease the period of time that a stand is vulnerable to insect pests and pathogens, based on the knowledge that species are especially susceptible to pests and pathogens at particular ages. • → Creating a diverse mix of forest or community types, age classes, and stand structures to reduce the availability of host species for pests and pathogens. • → Managing canopy conditions depending on types of invasive species, e.g., maintaining closed-canopy conditions to reduce the ability of light-loving invasive species to enter the understory or keeping canopy more open to reduce spreading of species (e.g., Pinus strobus) or pathogens that prefer conditions of shade, less wind, and higher humidity. • → Using biological control methods to manage pest populations in heavily infested areas. • → Restricting harvest and transportation of logs near stands already heavily infested with known pests or pathogens. • → Using impact models and monitoring data to anticipate the arrival of pests and pathogens and prioritize management actions.
Main Impact/Risk addressed	Invasion by non-native (alien) species may result in biome shifts, with consequent changes in the spectrum of forest ecosystem services provided.
Intended effects	Improved non-native species management with dedicated measures for prevention, early detection, control management, including rapid response and rehabilitation and restoration.
Pros and cons (if any)	N/A depending on management practices

OPPORTUNITIES AND PATHWAYS

Building on the Findings for key concerns and adaptation options, the assessment highlights several key pathways to further consider for climate-resilient forest management practices, including

- **Forest restoration** and **reforestation efforts**
  Diversifying landscapes to reduce disturbance risks and restoring site-specific endemic species
- **Protecting and conserving natural forests**
  Establishing and effectively managing protected areas, national parks, and nature reserves, also contributing to carbon sequestration and storage
- **Enhancing forest landscape connectivity**
  Vital for allowing species to migrate and adapt to changing climate conditions
- **Forest fire management and prevention**
  Developing national and regional early warning systems, improving fire suppression capabilities, and promoting community-based fire management approaches
- **Sustainable wood utilization** and **value chains for forest products**
  ***E**ncouraging responsible harvesting practices, supporting local processing industries, and promoting the use of sustainably sourced wood products to enhance economic viability of forests while supporting climate change adaptation*

Photo: Falco / pixabay

KNOWLEDGE GAPS / RESEARCH NEEDS

Research needs relate to

- Improved **regional-scale forest monitoring**, i.e. harmonizing monitoring programs and sharing data across borders to facilitate coordinated adaptation and enable comparison of research results across the region
  - could include an additional layer for forest ecosystem dynamics under climate change, e.g. changes in forest structure, species distribution patterns, and ecosystem functioning
  - could monitor physiological and phenological responses of trees to climate change over time, as well as the interactions between species and their environment as baselines for adaptive capacity assessments
- Further knowledge generation on the importance of **genetic diversity in forest ecosystems** for adaptation, e.g. studying the genetic characteristics of tree species, assessing the adaptive potential of different genetic lineages, and investigating how genetic diversity influences ecosystem resilience and productivity
- Assessing the **effectiveness of various adaptive silviculture practices** in Carpathian forests. Long-term monitoring of adaptive practices will also be important to continuously (re-)evaluate their success
- Assessing the **economic viability and costs** associated with different adaptation approaches, understanding the social acceptability and equity implications, and considering the impacts of adaptation on local communities and livelihoods

Photo: W.S. Keeton

HARNESSING ON-GOING INITIATIVES

FoRISK Concept paper - version 1

Workstream 2 - pan-European forest risk knowledge mechanism

Forest Europe growing life

In preparation of the Expert Group meeting on 31 May and 1 June 2022

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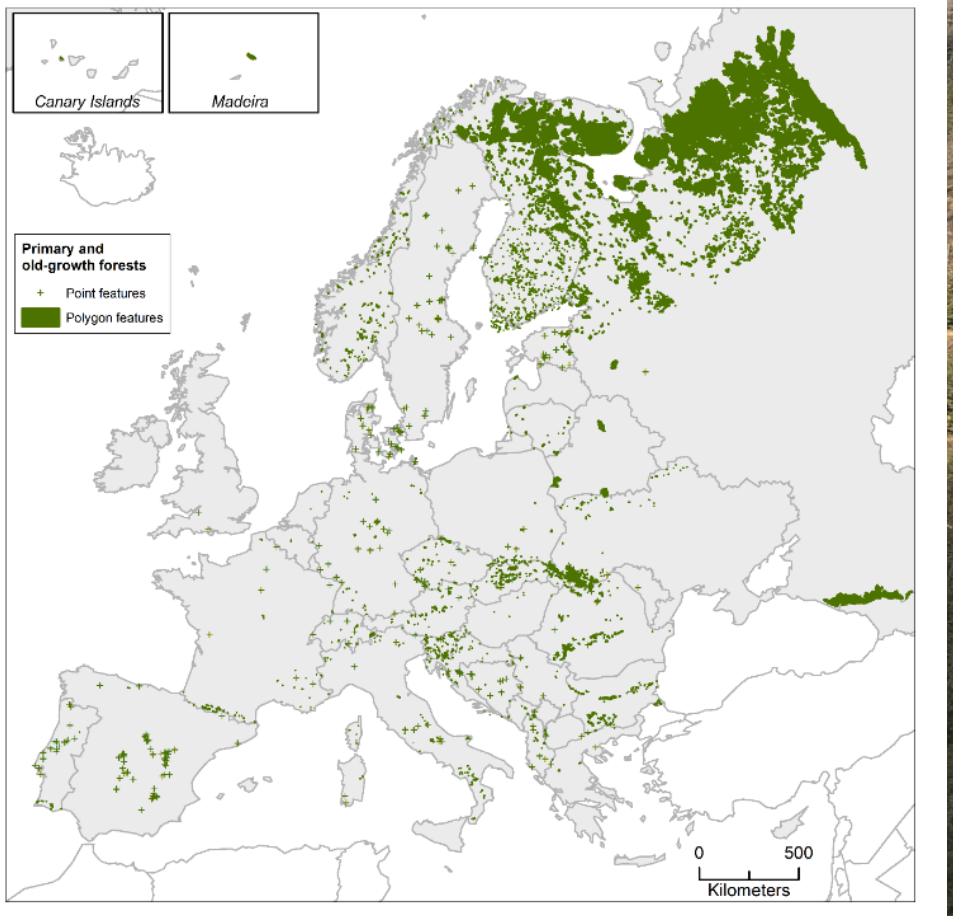
Figure 2. Documented primary and old-growth forests in Europe according to the European Primary Forest Database (EPFD v2.0) of Sabatini et al. (2020a) and UNESCO's Primeval Beech Forests of the Carpathians and Other Regions of Europe (UNEP-WCMC 2021). Note that the boundary of the polygons was highlighted for better readability.



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Thank you for your attention!

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