EC

MA NDRYSHE

Research, Assessment, and Development of Documents on Biodiversity, the Impact of Climate Change on Biodiversity, Habitat Restoration, and Long-Term Habitat Management

Climate Data Analysis And Scenario Development

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EXECUTIVE SUMMARY

This project “Research, assessment, and development of documents on biodiversity, the impact of climate change on biodiversity, habitat restoration, and long-term habitat management” offers an interdisciplinary approach by integrating spatial planning, legal frameworks, and ecological expertise alongside qualitative, scientific analysis. By combining knowledge from various fields, the aim is to create a comprehensive understanding of biodiversity challenges. The project emphasizes the importance of collaboration among environmental science, policy, and spatial design, creating a foundation for adaptive management strategies informed by both ecological data and spatial dynamics. This ensures that future actions are grounded in a well-informed, comprehensive perspective.

The project aims to identify and map key biodiversity areas at risk, focusing on Prizren, Suharekë, and the Sharr Mountains. Through field assessments, GIS data, spatial maps, spatial ecology analyses, and existing management plan reviews, critical habitats will be identified. These will be compared with historical and current climate patterns to predict future ecological changes and assess the impact of climate variability on biodiversity. Additionally, the project will evaluate the need for habitat restoration, documenting both the ecological and social benefits of restoration efforts.

This report first analyzes available climate data for Prizren, Suharekë, and the Sharr Mountains, using long-term observations from local and international sources to characterize temperature, precipitation, and seasonal patterns. By integrating environmental observations with historical climate records (and reanalyses, where available), it clarifies past variability and its implications for ecosystems and biodiversity resilience. It then evaluates regional climate projections to assess how future shifts in these variables could affect biodiversity, identify ecological vulnerabilities, and inform strategies for long-term habitat resilience.

BACKGROUND

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Kosovo's ecosystems are already experiencing climate change: rising temperatures, reduced snowfall, shifting rainfall intensity, and more frequent extremes. These shifts threaten biodiversity—especially in mountainous and ecologically sensitive areas—and also disrupt agricultural cycles, water availability, and forest resilience. Yet climate data remain fragmented and rarely integrated into local environmental assessments, while scenario-based projections are still underused in biodiversity planning. Focusing on Prizren, Suharekë, and the Sharr Mountains, this two-part analysis addresses that gap: the first part consolidates and analyzes historical observations to quantify trends in temperature, precipitation, seasonality, and extremes, clarifying recent variability and its ecological implications; the second part translates global and regional climate scenarios into locally relevant projections to evaluate plausible future impacts on species and habitats, identify ecological vulnerabilities, and inform long-term monitoring, conservation priorities, and habitat resilience strategies.

INTRODUCTION

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This report is part of a broader multi-phase initiative to strengthen the knowledge base for biodiversity monitoring, habitat restoration, and long-term ecological planning in Kosovo. While other phases address ecological impacts and policy frameworks, this document focuses on the climate drivers that underpin those decisions, providing both a rigorous baseline and a view of plausible futures for Prizren, Suharekë, and the Sharr Mountains.

Climate change refers to long-term shifts in temperatures and weather patterns driven largely by human greenhouse-gas emissions. Its impacts are global, but some regions are "hotspots" experiencing especially rapid changes; the Western Balkans, including Kosovo, is one such hotspot identified by the latest IPCC assessments. Kosovo has already witnessed more frequent extreme weather: rising average temperatures, more heatwaves, recurrent droughts, and episodes of heavy rains and flooding. Since the 1960s, summer heat extremes have increased, and devastating floods have occurred since the 1980s. These shifts are not abstract future risks—they are already affecting the environment, economy, and people. In a country where many livelihoods depend on agriculture and natural resources, warming and weather instability threaten biodiversity (the rich variety of species and ecosystems), agriculture (especially staple crops and food production), water security, and forest resilience.

The work is organized in two parts. The first compiles and analyzes available climate datasets—from local stations and international repositories and, where appropriate, reanalyses—to characterize long-term trends and variability in temperature, precipitation, humidity, wind, seasonality, and extremes across the three focus areas. Integrating these observations with historical environmental records clarifies recent and ongoing climate dynamics; rather than assessing ecological consequences in depth, this part establishes a transparent baseline to support evidence-based decision-making.

The second part examines future climate projections for Kosovo using internationally recognized modeling frameworks, primarily the CMIP6 multi-model ensemble, with emphasis on SSP1-2.6 (low-emissions) and SSP5-8.5 (high-emissions) pathways. It translates global and regional scenarios into locally relevant projections for near-, mid-, and longer-term horizons, including an outlook to 2050, to show how temperature, precipitation, and seasonality may diverge under different mitigation trajectories. In addition to framing these trajectories, the report outlines the expected directions of impact on biodiversity and agriculture—with particular attention to crop production—so that subsequent phases can develop detailed vulnerability analyses, scenario development, adaptation options, conservation priorities, and long-term habitat resilience strategies.

CLIMATE CHANGE HAS ALREADY AFFECTED THE REGION

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KOSOVO HAS WARMED BY ABOUT 1 °C SINCE PRE-INDUSTRIAL TIMES, WITH SHARP INCREASES AFTER 2000, MAKING IT PART OF A REGIONAL CLIMATE "HOTSPOT." SUMMERS ARE HOTTER, WINTERS MILDER, AND EXTREME EVENTS LIKE WILDFIRES, FLOODS, AND DROUGHTS MORE FREQUENT. WHILE PRECIPITATION SHOWS NO LONG-TERM TREND, RAINFALL HAS BECOME INCREASINGLY ERRATIC, CLUSTERING INTO VERY WET OR VERY DRY YEARS. TOGETHER, THESE SHIFTS ARE STRAINING ECOSYSTEMS, AGRICULTURE, FORESTS, AND WATER RESOURCES.

4. CURRENT CLIMATE POLICY FRAMEWORK

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KOSOVO HAS ESTABLISHED ITS FIRST CLIMATE CHANGE LAW (2023) AND ALIGNED WITH EU AND REGIONAL FRAMEWORKS, SETTING TARGETS FOR DECARBONIZATION, ADAPTATION, AND SUSTAINABILITY. HOWEVER, IMPLEMENTATION IS SLOW, INSTITUTIONS LACK CAPACITY, AND PROGRESS REMAINS LIMITED. THOUGH NOT A UNFCCC SIGNATORY, KOSOVO HAS PLEDGED VOLUNTARY TARGETS; THE KEY CHALLENGE NOW IS SHIFTING FROM LAWS AND PLANS TO EFFECTIVE ACTION THROUGH STRONGER INSTITUTIONS AND FINANCING.

LIKELY EFFECTS OF OBSERVED CLIMATE CHANGE ON BIODIVERSITY IN KOSOVO

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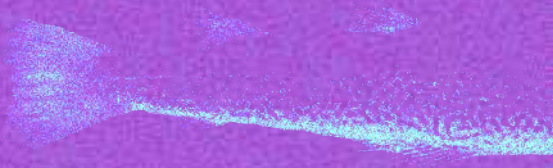

BY 2100, KOSOVO'S CLIMATE IS PROJECTED TO WARM BY +1.5–2 °C UNDER LOW EMISSIONS BUT UP TO +6.5 °C UNDER HIGH EMISSIONS, WITH SUMMERS HEATING THE MOST. PRECIPITATION WILL LIKELY DECREASE IN SUMMER AND INCREASE IN WINTER, RAISING DROUGHT AND FLOOD RISKS. MORE FREQUENT HEATWAVES AND SEVERE LOSS OF SNOW COVER WILL FURTHER STRAIN BIODIVERSITY, WATER RESOURCES, AND ECOSYSTEMS.

OVERVIEW OF CLIMATE MODELS AND DATA SOURCES

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KOSOVO'S CLIMATE MODELS (CMIP6, EURO-CORDEX, KÖPPEN–GEIGER) PROJECT STRONG WARMING OF +1.5–2 °C UNDER LOW EMISSIONS AND UP TO +6.5–7 °C UNDER HIGH EMISSIONS BY 2100, WITH HOTTER SUMMERS, MILDER WINTERS, AND MAJOR SNOW LOSS. PRECIPITATION IS EXPECTED TO DROP IN SUMMER AND RISE IN WINTER, HEIGHTENING DROUGHT AND FLOOD RISKS. KÖPPEN–GEIGER MAPS SHOW A SHIFT FROM CONTINENTAL-MOUNTAIN TO MEDITERRANEAN-TEMPERATE AND STEPPE REGIMES, LEAVING ALPINE CLIMATES CONFINED TO HIGH PEAKS—POSING SERIOUS CHALLENGES FOR ECOSYSTEMS, WATER, AND LAND USE.

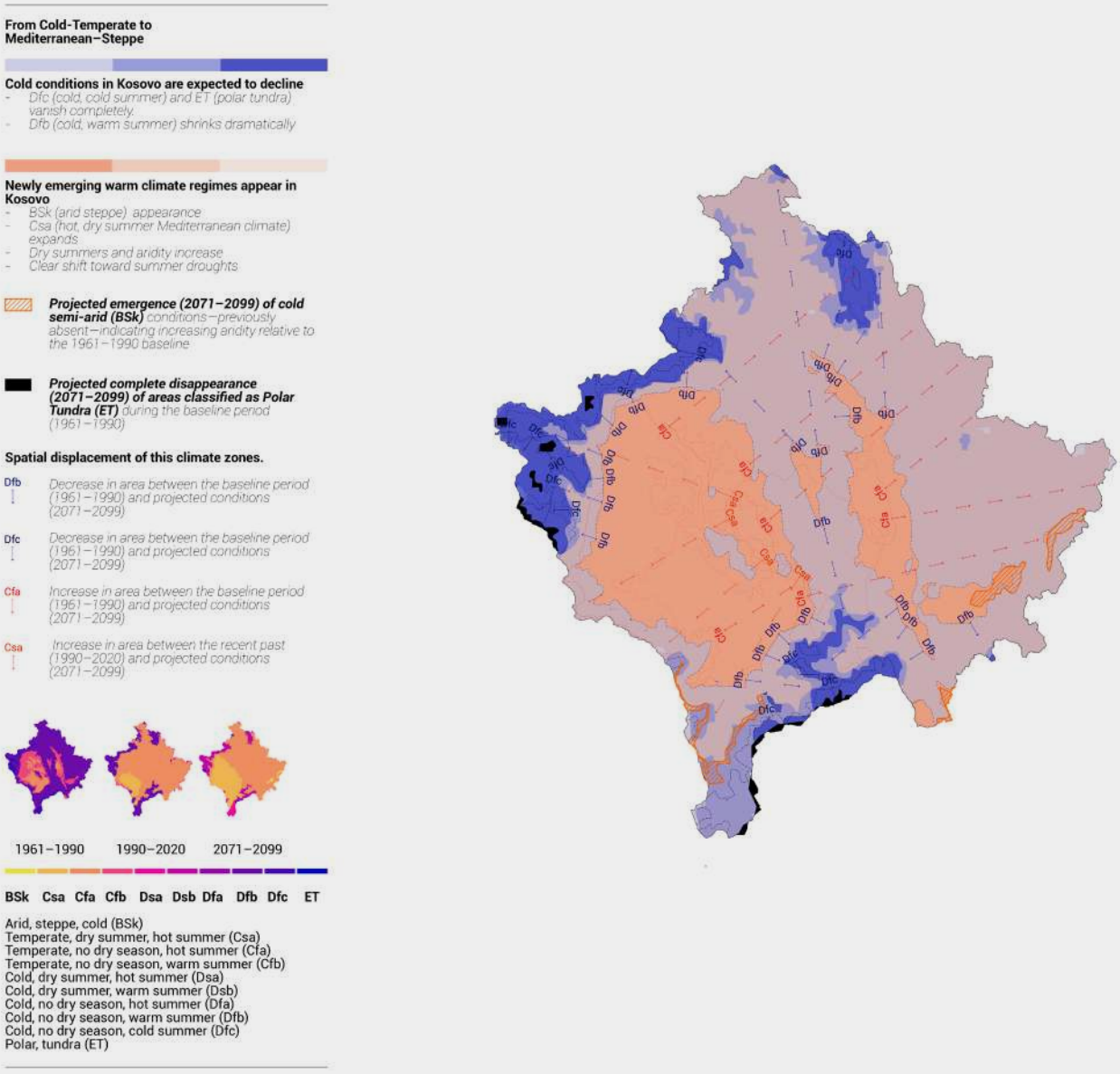

Figure 25 — Spatial Displacement of Climate Zones in Kosovo under Historical, Recent, and Future Conditions

This map illustrates the spatial displacement and evolution of Köppen–Geiger climate zones in Kosovo across three time periods: the baseline (1961–1990), recent past (1990–2020), and future projections (2071–2099). Cold-temperate climates (Dfc, Dfb, ET) are retreating toward higher elevations, with polar tundra (ET) projected to disappear entirely. Simultaneously, warm and dry climates (Csa, BSk, Dsa) are expanding into lower-lying regions, reflecting increasing temperatures, intensifying summer droughts, and rising aridity. Arrows indicate the direction of climate zone movement, highlighting a general shift from cold, humid conditions toward Mediterranean–steppe regimes, with implications for ecosystems, water resources, and agricultural suitability.

Source: Beck, H. E., McVicar, T. R., Vergopolan, N., Berg, A., Lutsko, N. J., Dufour, A., Zeng, Z., Jiang, X., van Dijk, A. I. J. M., & Miralles, D. G. (2023). High-resolution (1 km) Köppen–Geiger maps for 1901–2099 based on constrained CMIP6 projections.

CLIMATE CHANGE HOTSPOT

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KOSOVO IS A CLIMATE HOTSPOT, WARMING FASTER THAN THE GLOBAL AVERAGE WITH HOTTER, DRIER SUMMERS, WETTER WINTERS, SHRINKING SNOW COVER, AND SHIFTING CLIMATE ZONES. THESE CHANGES HEIGHTEN RISKS TO WATER, AGRICULTURE, FORESTS, AND BIODIVERSITY, WHILE LIMITED ADAPTIVE CAPACITY AND CROSS-BORDER DEPENDENCIES MAKE WATER-FOCUSED ADAPTATION AND REGIONAL COOPERATION URGENT.

CONCLUSIONS

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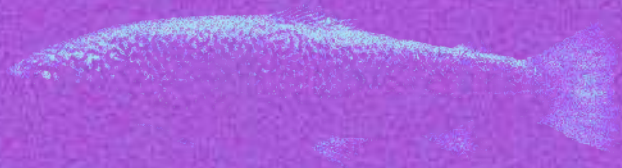

PROJECTIONS CONSISTENTLY SHOW KOSOVO WARMING SUBSTANTIALLY, WITH SUMMER HEAT INTENSIFYING AND WINTERS BECOMING MILDER, ALONGSIDE WETTER COOL SEASONS AND DRIER SUMMERS. THESE CHANGES DRIVE A PRONOUNCED SHIFT FROM COLD-TEMPERATE TO MEDITERRANEAN–STEPPE CLIMATES, WITH ALPINE ZONES RETREATING TO THE HIGHEST PEAKS. THE RESULTING PATTERNS HEIGHTEN RISKS OF HEAT STRESS, DROUGHT, AND FLOODS, WITH PROFOUND IMPLICATIONS FOR BIODIVERSITY, AGRICULTURE, AND WATER SYSTEMS. ADAPTATION WILL DEPEND ON TARGETED MONITORING, CLIMATE-RESILIENT LAND MANAGEMENT, AND PROACTIVE WATER AND HAZARD PLANNING.

About EC

EC Ma Ndryshe is a community-based organization, established in 2006, committed to sustainable development through an inclusive approach.

EC's activism envisions a Kosovo where democratic governance is participatory, transparent, and accountable, ensuring that institutions, communities, and stakeholders work together towards sustainable development.

This vision promotes inclusive decision-making, stronger policies, and greater public participation, ensuring that sustainability is an integral part of governance at both local and national levels.

Through better institutional coordination, evidence-based policymaking, and citizen engagement, EC's work aims to bridge the gap between communities and institutions, ensuring that good governance leads to tangible and lasting change.

Vision statement

"Empowering a resilient and inclusive Kosovo, where communities actively shape sustainable, digitalized, and conscientious institutions."

Mission statement

"EC Ma Ndryshe supports democratic governance and sustainable development in Kosovo by fostering sustainable socioeconomic, cultural, and green growth through digital education, environmental stewardship, community mobilization, advocacy for participatory public decision-making, and the cultivation of strategic partnerships."

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