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# Climate change resilient lake-wetland management: lessons from the Prespa Waterbirds project

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Lake-wetland systems throughout the Mediterranean experience significant water stress and are highly vulnerable to future climate change. The growing imbalance between water availability and demand is creating unprecedented ecological problems. The transboundary Prespa Lakes (Greece, Albania, North-Macedonia) experience climatic changes that directly affect water level (variability), -volume and -temperature. Land-use intensification and water abstraction amplify climate-driven impacts that influence lake-ecology, habitats and water quality. Long-term wetland conservation management should incorporate future climate change impacts in the design of any actions for them to be sustainable.

The LIFE Prespa Waterbirds project (LIFE15 NAT/GR/000936) developed guidelines to make wetland management actions “climate proof” – that is, sustainable and effective under future climate change scenarios. Reedbeds along Lake Lesser Prespa offer crucial bird nesting sites, whereas seasonally flooded “wet meadows” constitute important fish spawning grounds and bird foraging areas. Major threats concern food constraints due to the decreasing availability of “wet meadow” foraging areas, and low breeding output due to reedbed wildfires destroying nests. These threats are directly affected by climatic variability. During droughts, lake levels retreat to within the reed-belt surrounding the lake and do not flood the topographically higher wet-meadows, thus impeding foraging and fish spawning. Droughts also increase fire-risk, with simultaneous low lake levels facilitating wildfire access to the reedbeds.

Future climate change projections indicate less overall precipitation but higher inter-annual variability, more lake surface evaporation, and an increase in the magnitude/frequency of droughts. These changes will force larger inter-annual water level fluctuations; extremely low water levels (not flooding any wet meadows) will also become more common, while reedbed fire-risk amplifies. Projected future climate change will thus increase the threats to critical lakeshore habitats. Additionally, climate change intensifies and speeds up eutrophication processes. Higher average lake temperatures favour the release of stored nutrients. Furthermore, the decrease in lake water volume will increase relative nutrient concentrations. Higher temperatures also induce

higher absorption rates by plants thus increasing populations of both phytoplankton and aquatic macrophytes.

Conservation management actions in the context of the Prespa Waterbirds project enhanced lake ecosystem resilience to climate change. Specifically, guidelines were devised for shoreline vegetation management, protecting the availability of foraging/fish-spawning areas and nesting sites of targeted bird species under (i) the lowest projected future water levels and (ii) intensive future drought/fire conditions. Mowing of reedbeds in specifically identified areas, up to 30cm below seasonal lowstand water levels, will achieve the presence of wet meadows under all projected future water levels. Fire-risk control is integrated in shoreline vegetation management: cleared shoreline areas and wet meadows double as firebreaks to stop the spread of wildfires to the reedbed nesting sites. Finally, part of the vegetation management encompasses removal of large quantities of green plant material through summer mowing. Thus, large amounts of nutrients contained in the green reeds are removed from the lake-system, reducing substantially its nutrient load, and assisting the lake ecosystem to cope with the burdening impacts of climate change.