

Final Workshop on the Project “Understanding Anthropogenic Pressures on Lake Prespa”, (2021–2025)”

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On 17 December 2025, a final workshop was held at the Monitoring Station in Stenje within the framework of the project **“Understanding Anthropogenic Pressures on Lake Prespa (2021–2025)”**, funded by PONT and implemented by the PSI Hydrobiological Institute Ohrid. The expert team of the Institute presented the main results of the four-year research period to project partners, stakeholders and donors.

The multidisciplinary team included experts from the departments of physico-chemical research, microbiology, phytoplankton, zooplankton, benthic fauna, hydrobotany, cyprinid fauna, molecular biology and fish diseases.

Key findings

The anthropogenic pressures were identified based on all physical, chemical and biological parameters.

The results confirm that eutrophication is an increasing threat to Lake Prespa, driven by intensified anthropogenic pressures in recent decades: expansion of settlements, tourism development, modern lifestyles, agricultural practices (use of herbicides, insecticides, fertilizers), water level declination and climate-related hydrological changes. These processes particularly affect the natural balance in the lake at whole, especially at the littoral zone - “hotspots” where eutrophication symptoms are most pronounced.

Golema Reka was highlighted as the largest potential pollution source, because receives untreated municipal, industrial, household and agricultural drainage waters. Elevated concentrations of total nitrogen, total phosphorus, biodegradable organic matter were noted. The presence of ammonium indicate fresh fecal contamination, confirmed by microbiological analyses (coliform bacteria). Periods of low dissolved oxygen, especially in summer low-flow conditions, pose an additional ecological risk. The river with low quality subsequently enter the final recipient - lake and increase organic and nutrient loads in the littoral zone and the lake at whole.

The anthropogenic negative effects are reflected on live faunal and floral communities in the lake, where certain changes were noted (declination in the abundance, density, etc.).

The most prominent changes were recorded for macrophytes, i.e macrophyte vegetation represents a major ecological signal.

The macrophyte survey revealed clear ecological degradation trends:

- significant decline in macrophyte diversity and cover across sites
- evidence of ecological stress due to nutrient enrichment and hydrological alteration
- decrease from 14 recorded macrophyte species in summer 2014 to only 8 in summer 2024 at the same localities
- strong dominance of *Myriophyllum spicatum* and *Ceratophyllum demersum*, species tolerant to high nutrient levels

- at certain localities (e.g. Ezerani), complete loss of entire belts such as *Phragmites*, *Typha*, *Potamogeton*, *Zannichellia*, *Vallisneria* – indicating trophic deterioration and habitat simplification and hydromorphological alteration across the entire Lake Prespa.

The four-year data provide a comprehensive evidence base for future protection measures and policy development for Lake Prespa and its catchment.

Key recommendations (based on the project “Understanding Anthropogenic Pressures on Lake Prespa (2021–2025)” for protection and monitoring of Lake Prespa

- 1. Reduction of nutrient and organic loading** - This is the most important group of measures, as it directly affects water quality and directs ecological trends observed through planktonic research, macrophyte and bottom fauna.
 - removal of excessive biomass from aquatic vegetation to reduce pressure on the lake's trophic and ecosystem
- 2. Management of waste water**
 - investment in wastewater treatment infrastructure with N and P removal
 - strict prohibition of direct discharge of untreated wastewaters
 - rehabilitation and control of septic systems
 - regular cleaning of riverbeds from solid and organic waste
- 3. Water balance and hydrological management**
 - solutions for water inflow in drought years
 - rational irrigation water use while respecting ecological (biological) minimum
 - coordinated regulation of lake outflow among North Macedonia, Greece and Albania
- 4. Sustainable agriculture**
 - establishment of 10–20 m vegetated buffer strips as natural filters
 - control and reduction of fertilizer and pesticide use
 - promotion of organic fertilization and sustainable practices
 - reduction of emissions or leakage of harmful chemicals from agriculture by implementing sustainable agricultural practices to minimize the use of fertilizers and pesticides, which contribute to phosphorus pollution.
 - pre-treatment of highly polluted tributary waters via wetlands or filter belts
- 5. Biological protection and monitoring measures**
 - strengthened monitoring and data accessibility
 - protection of key fauna and habitats
 - implementation of integrated long-term monitoring
- 6. Transparent availability of environmental data for authorities and the public**
- 7. Raising public awareness**
 - continuous education of local communities on lake protection and pollution impacts
 - promotion of responsible use of agrochemicals and irrigation practices

8. Transboundary cooperation

- enhanced collaboration between North Macedonia, Albania and Greece
- harmonization of lake protection policies and joint management actions

9. Implementation of Management Plan for Lake Prespa





