**Additional information**

**Ecosystem services:**

1. **Social and cultural values:**

Traditions for fisheries and reed harvesting date back to centuries. It is very important to reconcile different points of view in nature conservation and economic land use inside the Ramsar area.

Recently, fisheries activity concentrates first of all on the wise use of fish community. A research project is run with the aim to analyse relations between reed management and habitat use of bird species inhabiting there (see point 29).

Lake Balaton is one of the most frequented recreation areas in Central Europe for tourists from late spring to late summer. The lake has made an imprint on the cultural traditions and values in the small villages and towns around the lake. Lake Balaton ensures the livelihood for most of the people living here.

1. **Current scientific research and facilities:**

Scientific research in the lake has a long tradition, making of Lake Balaton one of the world's best researched, lakes.

Scientific research is performed by different departments of the Academy of Sciences, Universities and the Museum of Natural Sciences. Studies include research on vegetation, limnology, zoology, avifauna and fauna in general.

The Balaton Limnological Institute Ecological Research Centre of the Hungarian Academy of Sciences was the first research center in the country the primary function of which was research.

Monitoring has been developed for counting waterbird species on the whole lake and linking wetlands, first of all on Kis-Balaton (Ramsar site, site no. 3HU004). Changes in use of feeding and staging sites have been analysed. Bird assemblages in reedbeds are examined according to their habitat preferences in relation to reedbed modification and management.

There is permanent Bird Ringing Station next to the lake (Fenékpuszta) managed by Birdlife Hungary.

**Physical features of the site:**

Lake Balaton lies in a tectonic depression. It is about 15,000 -18,000 years old. The Balaton Uplands are part of the Bakony and Keszthely Hills. They are tablelands, with hills rising to 450 m. The main inflow comes from the River Zala, and there are many brooks and rivulets running towards Lake Balaton. Two typical volcanic areas are situated on the northern shore of the lake. The length of the shore is 235 km, of which a stretch of 107 km has been artificially built. The rest of the shore has been left in original condition.

It is the largest lake in Central Europe. According to earlier estimations the age of Balaton is 18-22 thousand years. In the place of Lake Balaton several shallow, clear- and cold-water lakes emerged at the end of the Pleistocene, about 15000 years ago. They developed one after another, from the west to the east. As a result of the rising temperature and evolving wet climate, the water level rose and a unified water surface formed. After that the water level alternated (between +6 m and -1 m compared to the present one), depending on changes in the climate. Vegetation gradually increased in the originally clear water. In the surroundings until the Holocene coniferous gallery, then deciduous forests were characteristic, depending on the prevailing climate.

The average annual growth of the thickness of the lake sediment is 0.4 mm. However, it depends on the mud-moving effect of underwater streams, the depth of the lake, the extent of the lake-surface, the climate and the offshore vegetation cover. The present amount (2.5–3.0 km3) of lake-mud in the bed of Lake Balaton is approximately 1.5 times as much as the water content (2 km3). In line with the latest research results, the present form of the lake developed 5-7 thousand years ago, in the Holocene age. Thus, Lake Balaton is a fairly young formation, not only in geological terms, but also limnologically.

The lake itself is divided into four basins (Keszthely, Szigliget, Szemes and Siófok basins). The lake surface at medium water level is 594 km2, its water volume is 2 billion m3, the average depth is around 3 m and the maximum depth is 11 m. In earlier ages, natural changes in water level were more significant but recently it has been controlled artificially between +70 and +110 cm since 1997. The sluice at Siófok is designated for standard “0” point to determine water level actually. This standard is in compliance with 103.41 m level according to Baltic sea. To regulate the water level between this interval the excess is released into Sió canal flowing to Danube river.

The length of the lake, situated in a flat, rift valley-like dip that runs long from southwest to northeast is 77 km, with its greatest width between Balatonaliga and Balatonalmádi is over 12 km. Due to the narrowing shoreline the distance between Tihany and Szántód is only 1.5 km.

The high degree of the lake’s instability can be explained by the fact that certain characteristics of the lake can be easily and quickly altered by hydrometeorological effects. The water rich in calcium-magnesium hydrocarbonate and oxygen gains the temperature of the air quickly due to its shallow depth. The pH value of the water of the lake is 7.8-8.8. The central part of the lake reaches drinking water standards. 75% of the reedbed vegetation is located alongside the northern shore (see point 14).

The adjacent marshes are in relatively good state, but the effects of human activities and droughts pose threats.

The soft, mildly alkaline water of the lake can be regarded as mineral water. Being a shallow lake, the fine mud floating in the water affects its clarity.

**Hydrological Values:**

The length of the shoreline is 235 km, of which 107 km is artificially built (concrete). The rest of the shore has been left in near-natural conditions. There is a 12 km2 area of reed stands in the bed of the lake. Significant part of the existing reed stands can adequately filter the suspended matter delivered by the tributaries, and helps turning the incoming water to “Balaton-water”.

The lake volume is influenced by the sum of evaporation and outflow, the sum of precipitation on and inflow to the lake. Direct use of lake water is negligible. The long-term average values of precipitation and evaporation are 626 and 914 mm respectively. Related to the entire lake surface, the inflow and outflow correspond to 968 and 680 mm respectively.

In the Lake Balaton region the normal mean air temperature is 10.7 ºC, the coldest month being January, the warmest July with –1 and 21 ºC mean temperatures, respectively.

The normal duration of the winter ice cover is two months, the average cover thickness being 20-25 cm but as thick as 75 cm has also been observed.

The composition of lake water is controlled by the inflowing waters and the biogeochemical processes taking place within the lake. Limestone and dolomite rocks predominate in the catchment area, therefore the waters discharged into the lake carry Ca2+, Mg2+ and HCO3- in high concentrations. Owing to CO2 exchange with the atmosphere and to photosynthesis, large volumes of CaCO3 are present in the lake mostly in the first, i. e. the westernmost basin. Proceeding along the longitudinal axis towards the outlet, the concentrations of Ca2+ and HCO3- gradually decrease while those of , Na+, K+, SO42- and Cl- increase. Continued lime precipitation may be offered as an explanation for the reduction of the Ca2+ and HCO3- levels whereas the growing concentration of the other ions is attributable to evaporation since the loss caused thereby is higher than the precipitation over the lake area.

The sediment in Lake Balaton is composed of the sediments discharged by the Zala river and the other tributaries, the lime and other substances precipitating in the lake, the soil eroded from the shores and the airborne dust settling into the lake. The Zala river alone discharges suspended sediment at the rate of 10000 tonnes per year into the lake. The lime precipitation in the lake is estimated 118000 tonnes annually. From the results of pollen analysis an average silting rate of 0.7 mm per year has been estimated. In the Keszthely Basin the silting rate is several times higher.

Records from the last few centuries suggest at least 1 m of annual water level ﬂuctuation, and 2–3 m on a decadal scale. According to archaeological evidence, the mean water levels were relatively close to the present-day situation throughout history, controlled by the sandbank across the outlet of the Sió river, which probably resulted in periodic ﬂoods and outﬂow events.

The railway line along the southern shore was built during an extremely dry period in the mid-19th century. It was sited along the sandbar between the lake and the agricultural areas of the shore. The sluice and lock system at the outﬂow of the Sió river from the lake was opened in 1863, introducing an artiﬁcial water regime of the lake.

Anthropogenic eutrophication of Lake Balaton became well recognized in the early 1960's, and serious algae blooms were recorded in the next 3 decades. Serious control measures targeting the radical reduction of phosphorus (and nitrogen) load first helped to avoid further (potentially disastrous) deterioration of water quality, and then resulted in improvement since the middle of the 1990s. However, reduced water levels and the lack of outflow for many of the last 12 years have rose concerns of the effects of climate change on water quality.

The steps of the control measures:

In the Zala River at the southwest end of the lake are retained in a series of reservoirs comprising a wetland complex of almost 15,000 hectares of open water, reedbeds and Salix scrub, 1,400 hectares of Other provisions for improving water quality in the lake include: The establishment of reservoirs on other major tributaries feeding the lake.

Diversion away from the lake of treated effluent produced in recreational areas. Selected removal of phosphorus-rich lake sediment. The control of wastes from large stock-rearing units.

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