

Lake Profile Brief

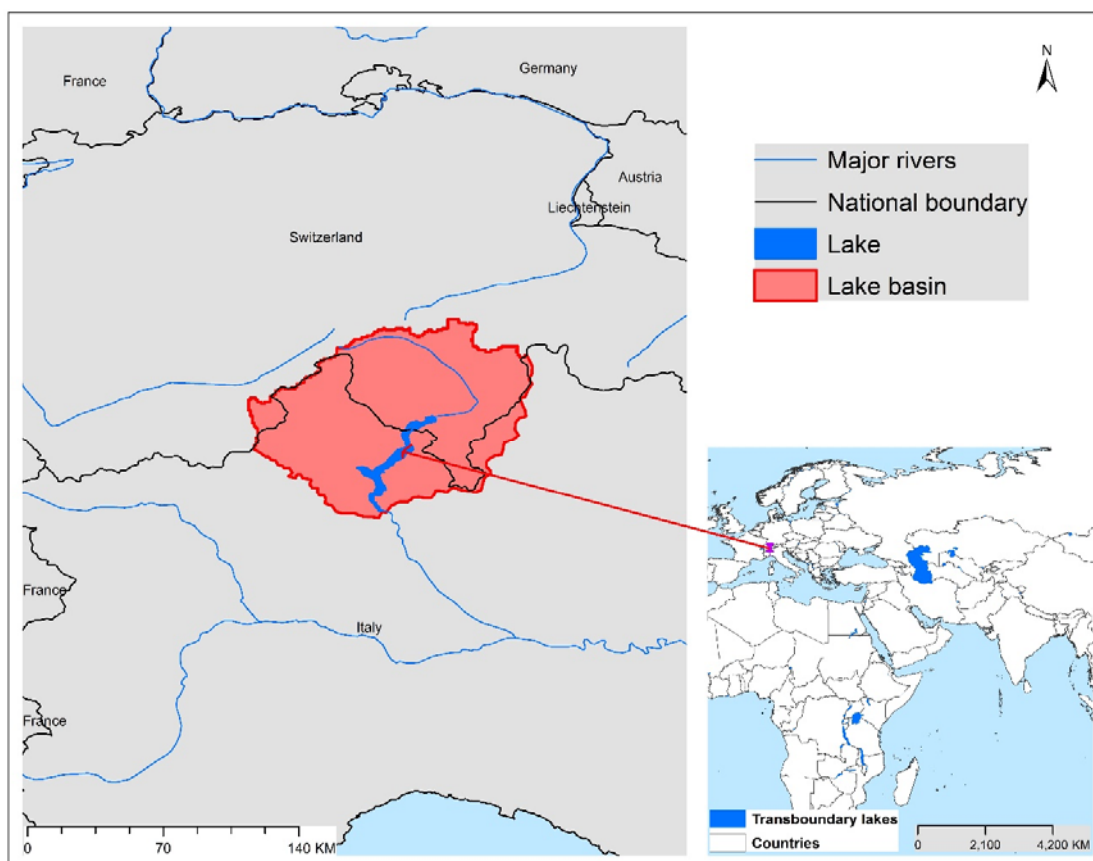
This is based on the results of Multiple Lake Threat Assessment and its Scenario Analysis. Refer to the Technical Report for details.



Lake Maggiore

Geographic Information

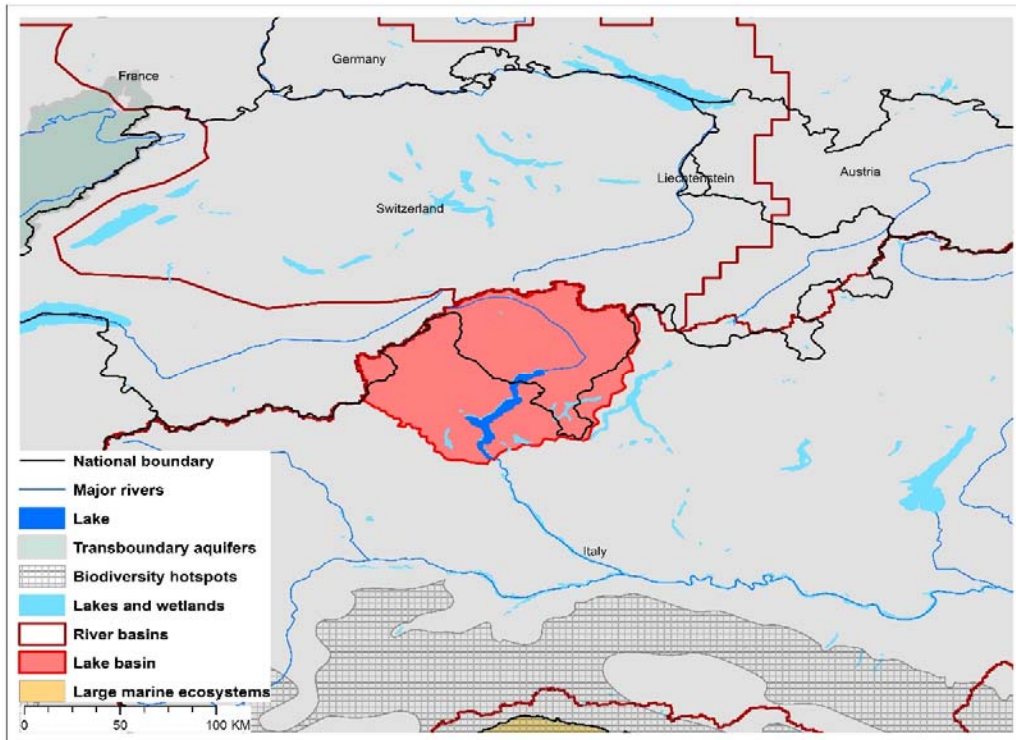
Lake Maggiore is a large, deep lake located on the southern side of the Alps, the largest lake in southern Switzerland. It also is the longest and second largest lake in Italy, being the most westerly of the three great southern prealpine lakes (Maggiore, Como, Garda). Although located in a mountainous region, it is very deep, with its bottom being below sea level throughout most of the lake. Its sinuous shape makes it difficult to see the entire lake at a single glance from any point around the lake. The upper end of the lake has completely alpine characteristics, the middle regions exhibits gentler hills, and the lower end exhibits a more plain-like character. Because water releases heat energy more slowly than the overlying atmosphere, the lake helps maintain a higher temperature in the surrounding region.



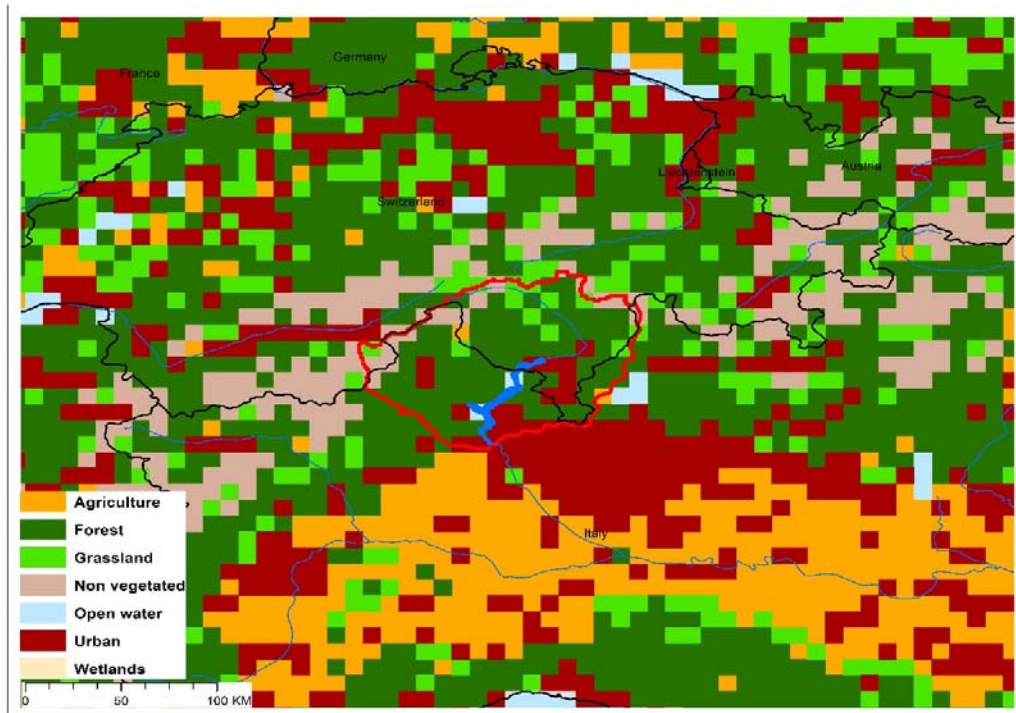
TWAP Regional Designation	Northern, Western & Southern Europe	Lake Basin Population (2010)	894,071
River Basin	Po	Lake Basin Population Density (2010; # km⁻²)	80.5
Riparian Countries	Italy, Switzerland	Average Basin Precipitation (mm yr⁻¹)	1,406
Basin Area (km²)	211.4	Shoreline Length (km)	156.9
Lake Area (km²)	7,012	Human Development Index (HDI)	0.89
Lake Area:Lake Basin Ratio	0.030	International Treaties/Agreements Identifying Lake	No



Lake Maggiore Basin Characteristics



(a) Lake Maggiore basin and associated transboundary water systems



(b) Lake Maggiore basin land use

Lake Maggiore Threat Ranking

A serious lack of global-scale uniform data on the TWAP transboundary in-lake conditions required their potential threat risks be estimated on the basis of the characteristics of their drainage basins, rather than in-lake conditions. Using basin characteristics to rank transboundary lake threats precludes consideration of the unique features that can buffer their in-lake responses to basin-derived disturbances, including an integrating nature for all inputs, long water retention times, and complex, non-linear response dynamics.

The lake threat ranks were calculated with a spreadsheet-based interactive scenario analysis program, incorporating data and information about the nature and magnitude of their basin-derived stresses, and their possible impacts on the sustainability of their ecosystem services. These descriptive data for Lake Maggiore and the other transboundary lakes included lake and basin areas, population numbers and densities, areal extent of basin stressors on the lake, data grid size, and other components considered important from the perspective of the user of the data results. The scenario analysis program also provides a means to define the appropriate context and preconditions for interpreting the ranking results.

The Lake Maggiore threat ranks are expressed in terms of the Adjusted Human Water Security (Adj-HWS) threats, Reverse Biodiversity (RvBD) threats, and the Human Development Index (HDI) score, as well as combinations of these indices. However, it is emphasized that, being based on specific characteristics and assumptions regarding Lake Maggiore and its basin characteristics, the calculated threat scores represent only one possible set of lake threat rankings. Defining the appropriate context and preconditions for interpreting the lake rankings remains an important responsibility of those using the threat ranking results, including lake managers and decision-makers.

Table 1. Lake Maggiore Relative Threat Ranks, Based on Adjusted Human Water Security (Adj-HWS) and Reverse Biodiversity Threats, and Human Development Index (HDI) Score

(Estimated risks: red – highest; orange – moderately high; yellow – medium; green – moderately low; blue – low)

Adjusted Human Water Security (Adj-HWS) Threat Score	Relative Adj-HWS Threat Rank	Reverse Biodiversity (RvBD) Threat Score	Relative RvBD Threat Rank	Human Development Index (HDI) Score	Relative HDI Rank
0.33	52	0.49	42	0.89	48

It is emphasized that the Lake Maggiore rankings above are discussed here within the context of the management and decision-making process, rather than as strict numerical ranks. Based on its geographic, population and socioeconomic assumptions used in the scenario analysis program, the calculated Adj-HWS score for Lake Maggiore indicates a low threat rank compared to other priority transboundary lakes.

The Reverse Biodiversity (RvBD) for Lake Maggiore, which is meant to describe its biodiversity sensitivity to basin-derived degradation, places the lake in a slightly higher threat rank, compared to the other

transboundary lakes. Management interventions directed to improving the biodiversity status must be viewed with caution, however, since we lack sufficient knowledge and experience to accurately predict the ultimate impacts of biodiversity manipulations and preservation efforts. Further, the RvBD scores indicate the relative sensitivity of a lake basin to human activities, and high threat scores *per se* do not necessarily justify management interventions. Such interventions may actually increase biodiversity degradation, noting that many developed countries have already fundamentally degraded their biodiversity because of economic development activities. Thus, activities undertaken to address the Adj-HWS threats may actually degrade the biodiversity status and resources, even if the health and socioeconomic conditions of the lake basin stakeholders are improved as a result of better conditions, thereby increasing stakeholder resource consumption.

The relative Human Development Index (HDI) places the Lake Maggiore basin in a low threat rank in regard to its health, educational and economic conditions.

Table 2. Lake Maggiore Threat Ranks, Based on Multiple Ranking Criteria
(Scores for Adj-HWS, RvBD and HDI ranks are presented in Table 1; the ranks may differ in some cases because of rounding of tied threat scores; Estimated risks: red – highest; orange – moderately high; yellow – medium; green – moderately low; blue – low)

Adj-HWS Rank	HDI Rank	RvBD Rank	Sum Adj-HWS + RvBD	Relative Threat Rank	Sum Adj-HWS + HDI	Relative Threat Rank	Sum Adj-HWS + RvBD + HDI	Overall Threat Rank
52	48	42	94	50	100	50	142	48

When multiple ranking criteria are considered together in the threat rank calculations, the Adj-HWS and HDI scores considered together place Lake Maggiore in the lower quarter of the threat ranks. The relative threat is similar when the Adj-HWS and RvBD threats are considered together. Considering all three ranking criteria together, Lake Maggiore exhibits a low threat ranking.

Further, a series of parametric sensitivity analyses of the ranking results also was performed to determine the effects of changing the importance of specific criteria on the relative transboundary lake rankings. This analysis involved increasing or decreasing the weights applied to the threat ranks derived from multiple ranking criteria to reassess the relative impacts of the weight combinations on the threat ranks. For example, in determining the sensitivity of the Adjusted Human Water Security (Adj-HWS) and Biodiversity (BD) ranking criteria, the threat rank associated with the first was assumed to be of complete (100%) importance (i.e., rank weight of 1.0), while the other was assumed to be of no (0%) importance (i.e., rank weight of 0.0). The relative importance of the two ranking criteria was then successively changed, with weight combinations of 0.9 and 0.1, 0.8 and 0.2, etc., until the first ranking criteria (Adj-HWS) was assumed to be of no importance (rank weight of 0.0) and the second (BD) was of complete importance (rank weight of 1.0). In the case of Lake Maggiore, the 0.5 and 0.5 weight combinations for three cases of parametric analysis for Lake Maggiore resulted in respective threat rankings of 8th, 9th and 4th, respectively, among the total of 9 European transboundary lakes in the TWAP study (see Technical Report, Section 4.3.3, pp44-48 and Appendix 6(1)).

In essence, therefore, identifying potential management intervention needs for Lake Maggiore must be considered on the basis of both educated judgement and accurate representations of its situation. A fundamental question to be addressed, therefore, is how can one decide that a given management

intervention will produce the greatest benefit(s) for the greatest number of people in the Lake Maggiore basin? Accurate answers to such questions for Lake Maggiore, and other transboundary lakes, will require a case-by-case assessment approach that considers the specific lake situation and context, the anticipated improvements from specific management interventions, and its interactions with water systems to which the lake is linked.