ISEO: Improving the lake Status from Eutrophy towards Oligotrophy

University of Parma

Nutrient loads, factors affecting their availability and response of submerged vegetation

AIMS

WP1:

to evaluate the nutrient pollution potential of the different anthropic activities in the watershed

to quantify P (and also N and Si) loads to lake Iseo and evaluate how their magnitude and bioavailability are affected by hydrological conditions

to evaluate and improve the accuracy of P determination by the *in situ* auto analyzer

WP2:

to quantify P, (and also N and Si) concentrations in waters discharged by sewer overflows

to map the extension and composition of submerged macrophytes meadows and their ecological traits and how they change in relation to external pressures

to evaluate the functioning of the littoral areas and dominant primary producers as a buffer of the external nutrients loads

Nutrient pollution potential of the different anthropic activities in the watershed

estimate of net N and P loads to the watershed (NAPI, NANI)

NANI and NAPI are mass balances models that estimate the movement of N and P across the borders of the watershed



Net Anthropogenic Nitrogen Inputs to the watershed (NANI)



Howarth et al. 1996. Regional nitrogen budgets and riverine N & P fluxes for the drainages to the North Atlantic Ocean: natural and human influences. *Biogeochemistry* 35: 75-139.

Net Anthropogenic Phosphorous Inputs to the watershed (NAPI)



Hong B., et al., 2012. Evaluating regional variation of net anthropogenic nitrogen and phosphorus inputs (NANI/NAPI), major drivers, nutrient retention pattern and management implications in the multinational areas of Baltic Sea basin. Ecological Modelling 227: 117-135.

Data collection

Data	Data source
Agricoltural land divided by crops category - municipal level	6 th general agricoltural census 2010, ISTAT
Crops yeld - provincial level	ISTAT data 2010
Livestocks - municipal level	6 th general agricoltural census 2010, ISTAT
Population - municipal level	15 th general population census 2011, ISTAT; ARPA Lombardia data 2010
Distributed fertilizers - provincial level	ISTAT data 2010
N and P deposition	EMEP data



NANI and NAPI first calculated at the municipal scale

Municipality level data were transferred into excel spreadsheet and aggregated to watershed scale by weighting each municipality by the percentage of area included in the watershed.

Calculations performed by organizing the collected data into an electronic spreadsheet (Microsoft Office Excel software), each detail is readily upgradeable

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Preliminary results: watershed characteristics



urbanized areas are about the 3% of the watershed surface agricultural area is about 22% of the basin surface and mainly occupied by meadows and pastures total population amounts to 195000 units while the number of livestock amounts to 22132 livestock units

Total surface (km ²)	1794								
Agricultural area (km²)									
Pasture and meadows (km ²)	380								
Urbanized area (km²)	62								
Total population (n $^{\circ}$ ind)									
Total livestock (LSU)	22132								
Bovines (LSU)	14670								
Poultry (LSU)	3692								
Ovine (LSU)	1958								

Net anthropogenic P and N inputs to watershed



Net anthropogenic phosphorus input = 562 t P y⁻¹, (areal load of 314 kg P km⁻² y⁻¹)

average Po river watershed: 800 kg N km⁻² y⁻¹

Net anthropogenic nitrogen input = 6325 t N y⁻¹ (areal load of 3526 kg N km⁻² y⁻¹)

average Po river watershed: 8000 kg N km⁻² y⁻¹

Net anthropogenic P and N input to watersheds: a comparison



Composition of the net anthropogenic P and N inputs to watershed







Water quality and P, N and Si loads quantification: where





http://hydraulics.unibs.it/hydraulics/attivitascientifica/iseo-project/



Water quality and P, N and Si loads quantification: when



Water quality and P, N and Si loads quantification: what

triplicate water samples are collected from each sampling station and filtered to separate particulate and dissolved nutrients.

the filtered water is analyzed for determination of soluble reactive phosphorus (SRP), total dissolved phosphorous (TDP), nitrate (NO_3^{-}) , nitrite (NO_2^{-}) , ammonium (NH_4^{+}) , total dissolved nitrogen (TDN) and reactive silica (DRSi).

the material collected on the filter is analyzed for total suspended solids (**TSS**), particulate nitrogen (**PN**), particulate phosphorus (**PP**) and biogenic Si (**BSi**).

at selected dates a **sequential P extraction** will be performed on particulate material in order to evaluate the composition of the phosphorus pool





Composition of the total P load in rivers of the Po river watershed



Evidence that the P load carried during floods accounts for the major part of the annual P load and that it is mostly associated to refractory P forms

Composition of the particulate P pool in rivers of the Po river watershed



Some very preliminary results – total P concentrations



Some very preliminary results – total P and total N concentrations



Some very preliminary results – SRP concentrations



Some very preliminary results – SRP and ammonium concentrations



Some very preliminary results – nitrate concentrations



Some very preliminary results – nitrate and DRSi concentrations



Contribution to WP2

to evaluate the contribution of sewer overflows to nutrients load

Not started yet When – at flood flow at least 3 times (if any) Variables: conductivity, pH, TSS, SRP, TDP, TP, NOx, NH4⁺, TDN, TN, DSi, BSi,

to map the extention and composition of submerged macrophytes meadows and their ecological traits in relation to external pressures (in collaboration with IREA-CNR)

to evaluate the functioning of the littoral areas and dominant primary producers as a buffer of the external P loads extension and composition of submerged macrophytes meadows and their ecological traits

On 27 September 2016 we conducted a preliminary survey along the shore of lake

We collected SAV samples to quantify elemental composition (C, N, P), ¹³C and ¹⁵N fractionation

Collected samples are still under analysis





Planned activities for 2017

Field campaing in the second half of July to quantify the biomass of submerged aquatic vegetation, its distribution and composition (in collaboration with IREA CNR)



Planned activities for 2017

seasonal samplings and incubation of intact sediment cores and hard substrates under natural and increased P concentrations in order to evaluate:

- the effect of different primary producers on littoral benthic metabolism and nutrient fluxes
- their capacity to buffer against P loadings
- the consequences of changes in community structure on the functions modulated by the SAV communities







