Aim of the presentation

- The contribute given by Richard A. Vollenweider to the understanding and quantification of eutrophication processes is well known and widely accepted. He is properly considered as a pioneer in predictive ecology (e.g. Peters 1986, 1991).

- We discuss the early stage of his career (1950-1968), focusing on his research topics which contributed to the first relevant synthesis he did with the OECD report on eutrophication (1968).

- Special attention is given to his 9 (out of 16) years of activity at the Institute of Hydrobiology in Pallanza, well documented, besides several papers, with archive documents and images.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>1952-53</td>
<td>Research assistant at the EAWAG (Kastanienbaum, CH)</td>
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<tr>
<td>1954-55</td>
<td>Postdoctoral fellowship at the Istituto Italiano di Idrobiologia, Pallanza</td>
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<tr>
<td>1955-57</td>
<td>Research assistant at the Limnology Institute of the University of Uppsala (primary production of Lake Erken, Steeman-Nielsen 14C technique)</td>
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<tr>
<td>1959-66</td>
<td>Research fellow at the Istituto Italiano di Idrobiologia.</td>
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<tr>
<td>1967-68</td>
<td>OECD appointment as a consultant for a literature review on the causes, effects and remedies of freshwater eutrophication.</td>
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<tr>
<td>1968</td>
<td>Head of the Fisheries Research Board of Canada Detachment at the Canada Centre for Inland Waters, Burlington, ON.</td>
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The Istituto Italiano Idrobiologia (about 1960)
River Po watershed

Mediterranean sea

Insular lakes

Insubrian lakes

Maggiore

Como

Lugano

Garda

Iseo

Orta

Pallanza

TORINO

MILANO

VENEZIA

River Po
Vollenweider’s research at the Istituto Italiano di Idrobiologia

**Physical characteristics of lakes as related to phytoplankton production**

River Toce turbid plume behavior in the Pallanza Basin of Lake Maggiore

The radiation climate of Lake Maggiore and its significance for phytoplankton photosynthesis.

The water mixing pattern of Lake Maggiore and other deep southern alpine lakes.
Vollenweider’s research at the Istituto Italiano di Idrobiologia

Water chemistry

Improvements of some analytical techniques

The hydrochemistry of 20 Insubrian lakes as related to the geology of the watersheds, human impacts, lake maximum depth

The case history of Lake Orta, polluted by copper-ammonia industrial effluent (ammonium oxidation as a source of acidity, toxic effect of copper, etc.)

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Vollenweider’s research at the Istituto Italiano di Idrobiologia

Biological aspects

Introduction in Italy of the $^{14}$C technique for measuring primary production

*Oscillatoria rubescens* D.C. as an indicator of Lake Maggiore eutrophication

Nutrients limiting algal production (lake measurements and laboratory algal cultures)
Lake water tanks, used for experiments on nutrient limitation of primary production
Professional and social life in Pallanza

During his time in Pallanza Richard fully participated in the scientific and social life of the Institute, where the main Italian researchers in the field were active and which was often visited by limnologists from other countries.

Vollenweider actively collaborated with several researchers at the Institute, primarily with Vittorio Tonolli, Director, on the pollution of Lake Orta; Carlo Saraceni, and the guests Theano Becacos and A.V. Viesi, in measurements of primary production and laboratory algal cultures; Oscar Ravera, lake biology, first appearance of Oscillatoria rubescens in Lake Maggiore; Domenico Povoledo, water chemistry.

He appreciated all the aspects of Italian life and culture, he spoke fluently Italian, read books and newspaper in this language, he was an enthusiast of music and played masterly the violin.

In 1965 he married an Italian woman, known in Pallanza.
I.B.P. PF symposium, Pallanza, April 26-May 1, 1965
R.A. Vollenweider as a OECD consultant

Following an OECD expert meeting in Paris in February 1966 he is appointed to conduct a review of existing studies on eutrophication of freshwater.

He produced a synthesis report focusing on the causes, mechanisms and effects of eutrophication, pointing out quantitative relationships between causes and effects, taking into account morphometric and hydrological characteristics of lakes and respective watersheds.

The report is prepared in two and half years and submitted in September 1968 to a group of experts; a reprint in 1971 was widely diffused.

Oscar Ravera and R. A. Vollenweider travelling on the Baltic Sea (contacts with W. Rode at the limnological Institute in Uppsala)
R.A. Vollenweider as an OECD consultant

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Vollenweider’s OECD report 1968

The report highlights the role of phosphorus and nitrogen in determining eutrophication; remedial actions should address on P, as mostly deriving from point sources, more easily catchable for treatment.

P and N in lake concentrations must be related to the loads from the watershed.

Several other variables influence eutrophication, mostly lake morphometry and hydrology, optics of water, climate; Vollenweider used lake morphometry and water renewal time for its quantitative approach.

The identification of P as a key factor for eutrophication produced a strong reaction from industries treating products containing P, mainly industrial and domestic detergents, and fertilizers. The predictive approach proposed in the report played an important role in the debate for limitation.
In spite of the low number of cases and uncertainties associated to the data, this approach highlighted:

- P as the primary variable influencing eutrophication;
- the possibility to quantify the relationship between the external P load and the trophic state of the lake;
- a tool for the evaluation of P load reduction needed to reach a target trophic level.
From the OECD report, 1968

Plot obtained in an expert meeting in the framework of the OECD North American Project.

Further steps of the OECD study considering about 150 lakes, clustered in four groups:

Alpine project
Nordic project
Reservoir and shallow lakes project
North American Project

The lesson from R.A. Vollenweider

- Excellent knowledge of the main (climatic, physical, chemical, biological) processes which contribute to the target variable (primary production, algal biomass, Chl concentration…)

- Studies on lakes with different morphometric and watershed characteristics (climate, geology, human impacts, etc.)

- Identification of the links existing among the main processes and of the “key” factors controlling the target variable

- Tentative to quantify the links among the cause(s) and effect(s), using a statistical approach to face with the variability of the set of considered lakes

- Test the model on different pools of lakes to verify and improve its performance.

Thanks for your attention!
Acknowledgements

References

References