PRELIMINARY REVIEW OF WATER QUALITY RESEARCH IN GREECE

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The present study focuses in Greek surface waters, i.e. rivers, lakes, reservoirs, estuaries, gulfs etc. attempting a review of their environmental status.

Till now, information on surface water quality in Greece was not gathered at any National Service Department. Moreover, a statistical elaboration of data on water quality on one hand and the related institutions and researchers on the other, was totally missing. A project aiming to collect and elaborate the existing data in Greece, within the framework of the implementation of the Council Directive 222/06 regarding the monitoring and improvement of the ecological quality of the surface waters among the Member States of the European Union, has been recently started and partially financed by the Greek Biotope Wetland Centre (EKBY). The aim of this study was to partially cover the gaps mentioned above and to help the preparation of the country for the implementation of the Council Directive.

The results seem to be encouraging. A total of 128 scientists dealing with water quality has been recorded, most of them being chemists (32,8%) and biologists (29,6%) (Fig. 1).
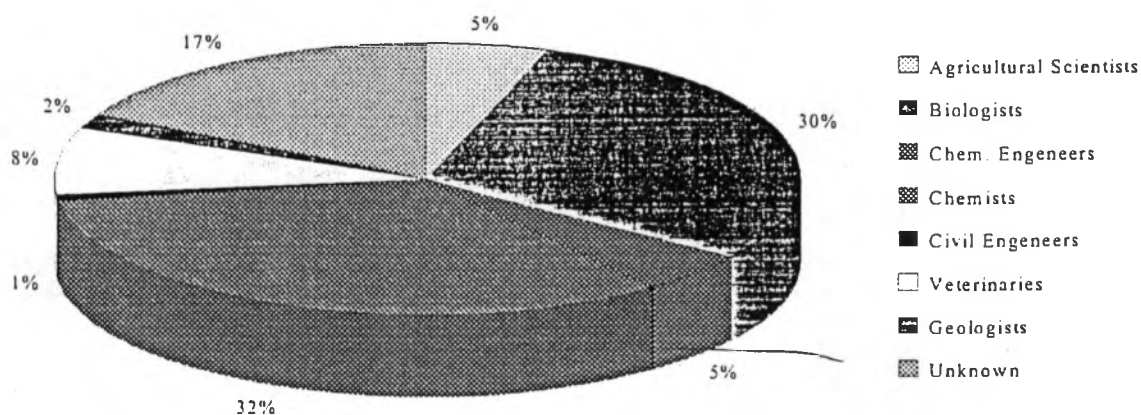

Fig. 1. Percentage contribution of Greek scientists on water quality research in Greece.

The majority of them is occupied in the University of Thessaloniki (38,1%) and the University of Athens (20,3%).

Tabl. 1. Institutes hosting water researchers

Institute	No of scientists	(%)	Institute	No of scientists	(%)
Demokritos	9	7,6	University of Ioannina	7	5,9
EKBY	2	1,6	University of Patras	3	2,5
Nat. Agricultural Centre	2	1,6	University of Pireas	3	2,5
NCMR	13	11	University of Thessaloniki	45	38,1
Polytechnical School of Athens	5	4,2	University of Thrace	1	0,8
University of Aegeon	4	3,3	Others	10	8,4
University of Athens	24	20,3			

Since 1980, the research on water quality of the Greek surface waters reveals a remarkable increase with regard to the trophic level of inland waters, pollution of metals, organic and inorganic substances. The articles before 1980 are limited in number whereas within the last five years a big amount of work concerning water quality was published (75% of the published papers on rivers, 62% on coasts and gulfs and 51% on lakes and reservoirs). From a total of 119 scientific papers, reports, studies and dissertations gathered, 57,1% are based on chemical analyses, 17,6% on analyses of biological material and 26,8% are mixed. 104 of them concern the quality of water itself whereas only 30 are also dealing with characteristics of the sediment.

Tabl. 2. Number of references and types of research concerning water and sediment.

Type of reference		Type of research			Concerning	
	No	chemical	biological	mixed	water	sediment
Scientific papers	91	57	19	15	80	25
Dissertations	7	1	2	4	7	1
Reports	14	8	0	8	10	4
Studies	7	2	0	5	7	0
Total	119	68	21	32	104	30

Scientific studies (reports, research papers etc) on 24 of the total of 56 lakes encountered in Greece (approximately 43%) and on 16 rivers, of a total number of 91

(approximately 17.5%), were gathered. In figure 2 can be seen the number of sites in Greece where water quality was studied, related to published papers.
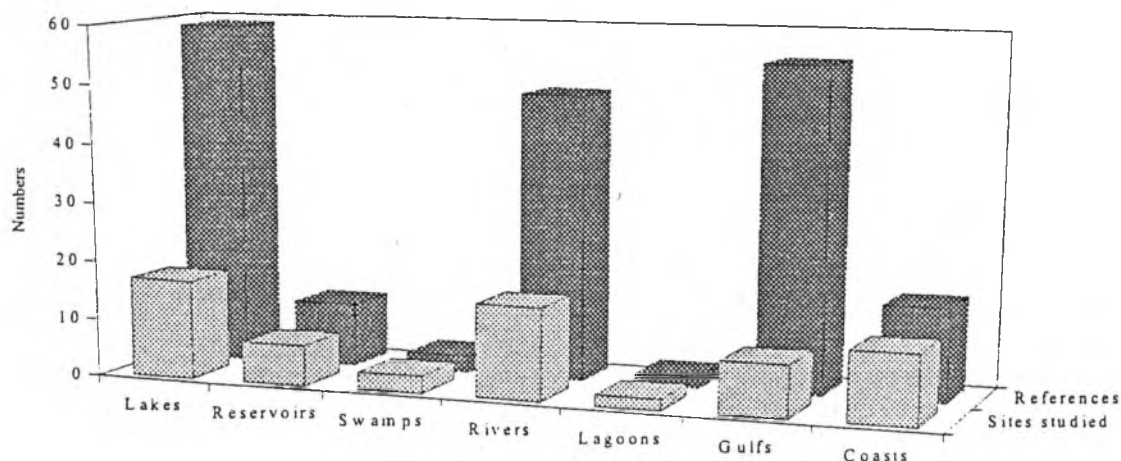

Fig. 2. Number of sites in Greece were water quality was studied related to published papers.

The most studied areas of Greece appear to be the Lakes and Rivers of North Greece (i.e. Lake Koronia, Lake Volvi, Lake Vegoritis, Lake Mikri Prespa, Lake Kastoria, Lake Doirani, Axios River, Aliakmon River, Loudias River, Strymon River). From the gulfs, the most studied areas appear to be the Thermaikos Gulf in North Greece and the Saronikos and Amvrakikos Gulfs in South Greece. Of these, Thermaikos and Saronikos Gulfs appear to be the most studied areas in Greece and simultaneously the most degraded embayments of the Greek coasts mainly due to a large number of industrial plants located around them and their large domestic population.

Saronikos Gulf, especially, receives the waste water of the city of Athens (population 4.000.000 inhabitants). Its water and sediment appears polluted by heavy metals (Fe, Zn, Pb, Cu) and by increased concentrations of organic matter. Higher concentrations of dissolved oxygen were measured at the outer part of the Gulf, lower at the inner and very low at the western part near Elefsis. The highest concentrations of heavy metals were measured in that part of Saronikos and a low biodiversity compared to the eastern part was observed. Generally, a qualitative and quantitative decrease of the macroalgal population towards the mouth of Athens sewage pipe and an increase of chlorophytes characterizes the Gulf.

Thermaikos Gulf receives a large volume of untreated waste water from the town of Thessaloniki (population 1.000.000 inhabitants) and is characterized mainly by increased

concentrations of heavy metals in the water and the sediment (Ni, Cr, Cd, Cu, Pb, Zn). However, pesticide and herbicide concentrations were not found to be high. The inner part of the Gulf is characterized by high nutrient concentrations and low dissolved oxygen, but the outer part the water mass is characterized as oligotrophic. A qualitative and quantitative decrease in the macroalgal population and a relative increase of chlorophytes that constitute eutrophication indicators were reported during the last 20 years.

Tabl. 3. Level of metal pollution of the studied coast areas and gulfs in Greece.

Not polluted	Slightly polluted	Polluted
Kavala	Evoikos (As, Co, Fe, Hg)	Saronikos (Ni, Pb, Cr, Fe, Zn)
Milos	Lesvos (Pb, Ni, Cr, Cu, Zn)	Thermaikos (Ni, Cr, Cd)
Pylos	Pagasitikos (Hg, Cu, Cd, Ni)	

Concerning the studied lakes and reservoirs, according to chlorophyll α, phytoplankton and nutrient measurements, 33% were characterized oligotrophic, 17% mesotrophic and 50% eutrophic whereas according to metal concentrations 2 out of 8 were characterized not polluted, 3 slightly polluted and 3 polluted (Tabl. 1, 2).

Tabl. 4. Classification of the studied lakes and reservoirs of Greece according to their trophic level (chl-a, phytoplankton, nutrients N, P).

Oligotrophic	Mesotrophic	Eutrophic
Amvrakia (phyt., nutr.)	Petron (nutr.)	Agras (nutr.)
Doirani (chl-a, nutr.)	Polyfitos (chl-a, nutr.)	Chimaditis (nutr.)
Kremaston (nutr.)	Vegoritis (chl-a, nutr.)	* Kastoria (chl-a, nutr.)
Megali Prespa (chl-a, nutr.)		Kerkini (phyt., nutr.)
Tavropos (phyt., nutr.)		* Koronia (chl-a, nutr.)
Trichonis (phyt., nutr.)		Mikri Prespa (phyt.)
		* Vistonis (phyt., nutr.)
		* Volvi (phyt.)
		Zazari (chl-a, nutr.)

* = Lakes with reported toxic blooms of cyanophytes (*Anabaena* sp., *Anabaenopsis* sp., *Microcystis* sp., *Oscillatoria* sp.).

Tabl. 2. Classification of the studied lakes and reservoirs of Greece according to metal concentrations (Fe, Mn, Cu, Pb, Zu, Hg, Ni, Cd, Cr).

Not polluted	Slightly polluted	Polluted
Doirani	Kastoria (Pb, Cu)	Koronia (Cu, Pb)
Pamvotis	Mikri Prespa (Cu, Mn, Ni, Pb)	Vistonis (Pb, Cd, Cr, Cu)
	Vegoritis (Fe, Mn, Cu, Pb)	Volvi (Hg, Zn)

Concerning the studied rivers in Greece, a general estimation of their pollution status can be seen in table 3.

Tabl. 3. Level of metal and organic pollution of the studied rivers in Greece (pest. = pesticides, det. = detergents).

Not polluted	Slightly polluted
Aliakmon	Acheron (Pb)
Almopeos	Axios (Fe, Mn, Zn, Pb, Cd)
Arachthos	Evros (Cr, Cu, Zn)
Kalamas	Loudias (Pb, Cd)
Louros	Strymon (Pb, Zn, Cd, pest., deter.)
Nestos	

This report consists one of the first attempts of the Greek Biotope Wetland Centre (EKBY) to asses the environmental state of Greek surface waters, since reliable high quality information about the water quality is essential for water management. Moreover, the structure of a data base file including the prepared works and the names of scientists dealing with the subject would definitively help the collaboration between them and between the various institutions, aiming to sustainable use and development.