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Explosion of Environmental Issues?

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EXPLOSION OF ENVIRONMENTAL ISSUES ?

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From few to many, from local to global.

The World's science community is presently witnessing an avalanche of new environmental issues, entirely different from the ones it became familiar with and was educated for over the past decades. The issues that we were facing some 20 years ago seem fairly simple and manageable today. Sanitary conditions in urban centres have been dramatically improved by construction of sewerage systems and treatment plants; the eutrophication process in the Great Lakes, particularly Lake Erie and Ontario, has been reversed and this event, so far the greatest lake rehabilitation success in history, has passed unnoticed.It does not mean that eutrophication is no more a problem: it is still a predominant concern in most of the countries of the World, particularly those with a high density of population (China, India, Russia and Eastern Europe). Nevertheless, the strategies for combatting this degenerative process are generally known (tertiary sewage treatment with phosphorus removal, ban on P- containing laundry detergents, improved agricultural practices), and it is just a matter of technology and resources available to stop or reverse the process. The same applies to acidification: installation of scrubbers in SO2 producing industries and compliance with emmission targets, as well as phase-out of coal to alternative energy sources, are the commonly known solutions; unfortunately, not always practiced.

Since the beginning of the '70s, and particularly during the 80s, the number of new environmental issues has been growing at an alarming rate. At first, it was the wide-spread contamination of lake and river sediments and the biota by mercury, reaching dangerous levels in North America and Scandinavian countries, as well as the wide- spread pollution by other heavy metals (lead, copper, zinc, cadmium etc.), originating from industrial discharges and

emmissions, and frequently carried over long distances via airborne transport (a good example of this is the contamination of the Canadian Arctic from industrial sources in Russia).

Detection in the early '70s of extremely low concentrations of organic toxic contaminants from the family of chlorinated benzene compounds (PCBs, dioxins, furans, DDT derivatives, together with hundreds of pesticides used in agriculture and thousands of new compounds manufactured annually by industry),which was made possible only through highly sensitive and sophisticated analytical techniques, has brought along new unexpected "surprises": deformed fish-eating birds laying eggs with the shell too thin to hatch the off-springs, tail-less turtles, feminized fish populations with degenerating male reproductive organs, fish contaminated in excess of the health limits and unsuitable for human consumption, etc.(IJC 1994.) The latest stories from Europe and China on the impact of some chlorinated compounds, that are able to mimic the female hormone estrogen, on the human reproductive system, are even more alarming . We are paying a high price for unwise introduction of foreign substances into our lives.

As the number of new environmental issues was increasing, so was their geographic extent , reaching regional and often continental proportions. The Chernobyl disaster of 1986 was a serious reminder that environmental problems and accidents are no longer a local matter and refuse to recognize international boundaries. It is now obvious that increasing frequencies of oil and other chemical spill episodes are here to stay, the same way as trafic accidents are prone to happen on busy expressways. Invasion of zebra mussels into the Great Lakes system has been a swift and highly successful operation (from the mussels' point of view), ruining commercial fisheries, depriving the fish of their food source, the plankton, and making the recent success story of phosphorus controls in Lake Erie questionable.

Now, almost at the turn of the century, come further new surprises: potential danger of global warming through accumulation of CO_2 in the atmosphere and the resulting green house effect and expected water shortages; diminishing protective ozone layer of the Earth with increasing UVB radiation threatening the life on this planet; population explosion in the Third World which is already poor in food supply; uncontrolled sprawling of big cities in both developing and developed countries; crises in solid waste disposal, and, finally, the potential genetic impact of foreign and unknown substances on humans and their reproductive capability (low sperm count in male populations of industrialized countries, learning disorders of children raised in contaminated areas, etc.;IJC 1994).

The diagram in Fig. 1 presents a summary of major environmental issues which we have been facing over the past century, together with the observed response from the science community and regulatory agencies. Not only the number of issues has been growing dramatically, but their geographic extent into the whole-continent and global scale is clearly evident. Some of these issue have been with us prior to their identification by scientists (acid rain, toxics); most of them, like deformities, the ozone hole or greenhouse effect, are genuinely new. The graphic pattern of the inrease of of new issues suggests an exponential trend, alarmingly similar to the exponential growth of the global human population (Barica 1993). Is this a coincindence or a causal relationship? Rather, is this trend related to the recent, also exponential developments in technology and ever increasing complexity of our life?

Science response to the environmental issues.

From the very beginning, the emerging environmental issues were the driving force in science development, particularly in the aquatic research area. During the 20s to 40s it was the sanitary enginneers, drawing on science disciplines like hydrology and hydraulics, with some help from chemists and microbiologists, who developed a scientific base for construction of first sewage treatment plants, ensuring substantial reduction of organic carbon and overall improvement of dissolved oxygen conditions in receiving water bodies (primary and secondary sewage treatment process).

The eutrophication era resulted in integration of several scientific disciplines, particularly hydrobiology, chemistry and physics into one, known as limnology. Number of research institutes and university departments were established during this period of time around the world. I call this period the "First Integration" of aquatic disciplines into a common conglomeration, with the focus on quality of freshwater resources. Limnology, however, soon became incapable of solving upcoming problems of heavy metals and organic toxic contaminants; a new specialized discipline, ecotoxicology, had to come up as a partner to adress the new issue jointly.

The concept of ecosystem approach in the early 80s (Vallentyne and Hamilton 1987) expanded our traditional focus from the water to the whole basin including human population. Later, the

philosophy of sustainable development (UN 1987), has brought economy as a partner rather than adversary into the environmental endeavour. These two new views, combined with the large-scale environmental disasters occuring around the same period (the Chernobyl and Exxon Valdez accidents), together with the first evidence of the ozone layer distortion and global warming, gave a rise to the "Second Integration" of scientific disciplines into the overall Environmental Sciences , with several new university departments or institutes created, to date primarily in North America. This time, the "menu" of disciplines invited to cooperate was much larger than in the first integration which was basically limited to natural sciences: it included non- traditional disciplines such as economics, social and political science, law, medicine, etc. The new issues are simply too complex to be adressed solely by natural scientists or engineers , as it used to be in the past. They require a cross- and multidisciplinary approach, with an active participation of the educated public, citizen groups and the media. Perhaps the Remedial Action Plans for the Areas of Concern in the Great Lakes Basin are a promising experiment along this line. Only a close interaction of different compartments of society, particularly scientists, legislators and the general public, can provide solutions and help us survive the difficult times ahead. This notion, however, does not suggest any relaxation in training and research in the highly specialized science disciplines. The integration assumes high quality individuals with world class expertise in their own field; but with an ability to see the issue in its full extent.(To see the whole forest, but not to ignore the individual trees).

Response of regulatory agencies.

Response of regulatory agencies to major environmental issues, as they evolved, was slower than the advancement in science. This can be expected, as regulatory agencies need a solid scientific base to introduce protective or corrective action. The ban of phosphate-containing laundry detergents in the Great Lakes Basin, embodied in the 1972 Great Lakes Water Quality Agreement, took almost a decade of intensive research on causes of eutrophication. The same applies to setting SO2 emmission targets to combat acid rain. With the time, the action response has become faster and faster: the Montreal Convention of 1989 to phase-out CFCs met only a few years after the evidence of the ozone layer problems; the Rio Convention of 1992 was even faster in taking steps to protect biodiversity on this Planet. This indicates an improvement in the

speed of communicating the results of environmental research to the legislators. Again, the active help from the concerned public and the media is becoming imperative.

Whatever the speed of the regulatory response to new environmental issues may be- and it is likely going to be faster with improved communication between science and the public, the regulatory decisions and measures must be implemented strictly and unconditionally, without loopholes or exceptions, and with an effective system in place to police the compliance with the law. The "polluter pays" and a zero-discharge policy, together with personal liability to fines of plant managers where applicable, is an example from the Great Lakes Basin, proved to work and worthy to be followed in other countries. This is particularly recommended to new democracies of Central and Eastern Europe, who are struggling with the legacy of unsustainable development over the past four decades, with inherent catastrophic environmental conditions. They can learn from Canadian experience, particularly abatement of eutrophication in the Great Lakes and the successful involvement of the public in the Remedial Action Plans for the IJC Areas of Concern. They can also learn from our mistakes.

* Presented as an invited lecture for the 1994 Czech and Slovak Limnological Society's Conference in Stara Tura, Slovakia

Caption:

Figure 1. A historic overview of major environmental issues over the century, with an outline of science and regulatory responses. The extent of the impact modified after Somlyody 1994.

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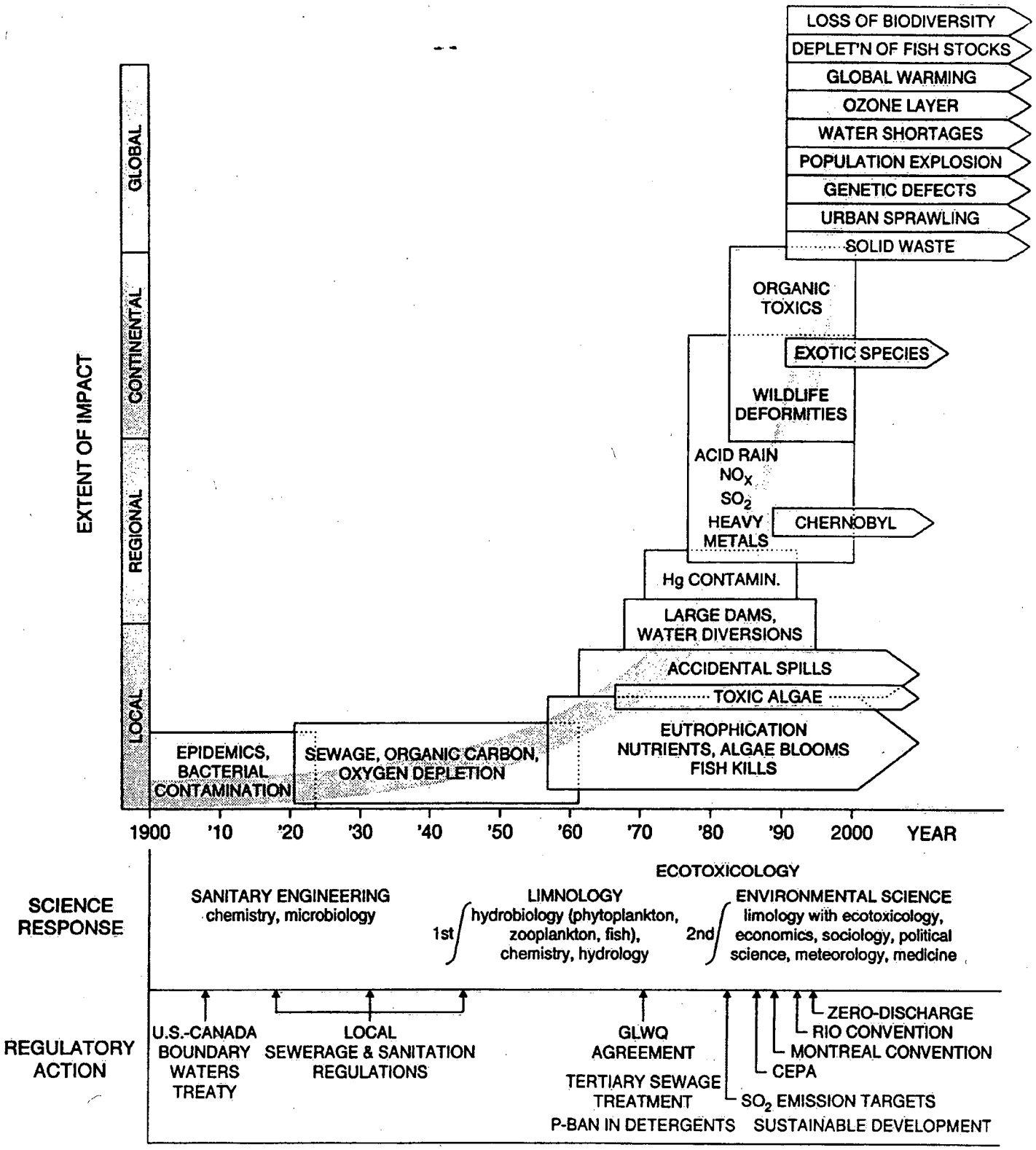
Abstract.
This is a brief overview of major environmental issues as they became evident to science community and general public in the developed countries over the twentieth century. It also gives an information on the response of environmental science to new emerging issues and integrating trends to adress them through multi- and cross-disciplinary approach. The major regulatory measures to minimize effects of these issues are briefly listed , emphasizing the need for better communication between the science community, general public, media and the legislators.


LOSS OF BIODIVERSITY
DEPLET'N OF FISH STOCKS
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SOLID WASTE
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EXOTIC SPECIES
WILDLIFE DEFORMITIES
ACID RAIN
NO_X
SO_2
HEAVY METALS
CHERNOBYL
Hg CONTAMIN.
LARGE DAMS, WATER DIVERSIONS
ACCIDENTAL SPILLS
TOXIC ALGAE
EUTROPHICATION NUTRIENTS, ALGAE BLOOMS FISH KILLS
EPIDEMICS, BACTERIAL CONTAMINATION
SEWAGE, ORGANIC CARBON, OXYGEN DEPLETION
EXTENT OF IMPACT
GLOBAL
CONTINENTAL
REGIONAL
LOCAL
1900
'10
'20
'30
'40
'50
'60
'70
'80
'90
2000
YEAR
SCIENCE RESPONSE
SANITARY ENGINEERING chemistry, microbiology
ECOTOXICOLOGY
1st
LIMNOLOGY hydrobiology (phytoplankton, zooplankton, fish), chemistry, hydrology
2nd
ENVIRONMENTAL SCIENCE limology with ecotoxicology, economics, sociology, political science, meteorology, medicine
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