A DATABASE FOR FRESHWATER ECOLOGICAL STATUS IN GREECE

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An environmental database has been created, recording water bodies on a national level and assembling relevant data collected by various public services and institutions in charge of water resources management and research in Greece. Water bodies were classified into categories according to European Union Directive 2000/60/EC. In total 674 water bodies have been registered: 379 rivers, 88 lakes, 121 transitional water bodies (mostly river estuaries, deltas and lagoons) and 105 artificial or heavily modified water bodies (mostly artificial reservoirs). Data consists of physico-chemical parameters, geomorphological descriptions, inventories of fauna and flora species, environmental pressures, vulnerability evaluation and other information useful for the assessment of current and former ecological status. Data gathering has proven to be a challenging task, due to the large number and the generally small size of the surface freshwater bodies as well as the numerous competent services and institutions and the multiple and sometimes conflicting responsibilities that therefore result. The latter is also partly the cause of lack of continuity of data, gaps or sometimes questionable reliability. Performing a global data overview, we note that (a) ecological status can be characterized as good for the majority of the sites, especially for small mountain streams, and (b) the general trend in most cases is degradation of current conditions, related either to anthropogenic pressures or to human activity combined with natural factors.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Rivers (%)</th>
<th>Lakes (%)</th>
<th>Transitional (%)</th>
<th>Art./Mod. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>47</td>
<td>23</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Good</td>
<td>118</td>
<td>57.5</td>
<td>52</td>
<td>30</td>
</tr>
<tr>
<td>Moderate/poor</td>
<td>39</td>
<td>19</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>Bad</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>TOTAL</td>
<td>205 / 379</td>
<td>71 / 88</td>
<td>91 / 121</td>
<td>43 / 105</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trend</th>
<th>Rivers (%)</th>
<th>Lakes (%)</th>
<th>Transitional (%)</th>
<th>Art./Mod. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement/Restoration</td>
<td>8</td>
<td>4</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>Stability/Conservation</td>
<td>88</td>
<td>46</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Slow degradation</td>
<td>78</td>
<td>40</td>
<td>35</td>
<td>17</td>
</tr>
<tr>
<td>Fast degradation</td>
<td>19</td>
<td>10</td>
<td>27</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>193 / 379</td>
<td>67 / 88</td>
<td>85 / 121</td>
<td>42 / 105</td>
</tr>
</tbody>
</table>

Before planning a suitable policy aiming to reverse the current situation, it is necessary to establish environmental quality criteria, with respect to each category of water bodies. These criteria should provide general guidelines aiming to define “good surface water status” and must combine precision with flexibility and adaptability. They can be classified in three categories:

A. Water uses oriented criteria, which aim to provide a satisfactory environment for all “users” of the water resource. The word “user” has here a broader meaning, standing for living organisms – which “use” the aquatic environment – as well as human activities. These criteria are the following:

- Populations of all native species should achieve a safe level.
Reference conditions should guarantee the balanced functioning of the ecosystem and the ability to overcome possible short-term disturbances (accidents etc). All quantity, quality and environmental criteria set by legislation and water management agencies (water users) for existing or future water uses (water supply, irrigation, aquaculture, recreation or other) should be fulfilled.

An additional criterion applies to the particular case of transitional waters:

- The intrinsic character of transitional waters must always be preserved. In other words, the balance between freshwater flows and coastal water influence must remain within natural limits.

B. Economic feasibility oriented criteria which can be formulated as follows: The goal of the strategic management and restoration policy will be to achieve the highest possible grade of ecological status in each water body, provided that the cost for the implementation of measures required to achieve that status: (1) is not disproportionally high with regard to the benefits gained – alias improvement of environmental status, (2) does not compromise the economic performance of activities related to the water resource and (3) does not exhaust economic resources that could have been allocated elsewhere (other water bodies) to obtain better environmental results.

C. Naturalness oriented criteria, which do not take into account financial costs but aim at re-establishing the natural conditions of the water body, a zero-pollution level among other properties. This of course may be impossible, since certain water bodies have been subjected to anthropogenic influence for so long that one can only speculate about their pristine natural conditions. In other cases, the measures to be undertaken may be extremely expensive, so it may be in our best interest to accept a certain level of ecological degradation and allocate the economic resources in better performing environmental projects. For artificial water bodies, for which by definition we have no data concerning reference conditions, this criterion aims to achieve the best possible surface water quality status (i.e. good surface water quality potential) as this can be determined by neighbouring and/or similar water bodies.

The three groups of criteria should be combined and gradually implemented, in accordance with the particular characteristics of each river basin district and of each water body.

**Literature**

A DATABASE FOR FRESHWATER ECOLOGICAL STATUS IN GREECE

A. Tornos, K. Zervos, K. Doulas, A. Andreadou

ABSTRACT

The objective of this study was to develop a database for the ecological status of freshwater ecosystems in Greece. The database was developed using an integrated approach that combined data from various sources, including national and international databases, local surveys, and expert knowledge. The database includes information on the physicochemical and biological characteristics of Greek freshwater ecosystems, as well as data on their habitat, species composition, and ecological processes. The database is intended to be used for ecological monitoring, conservation planning, and management of freshwater ecosystems in Greece.

1. Introduction

2. Methods

3. Results

4. Discussion

5. Conclusion

6. Acknowledgments

7. References
Towards the definitions (conceptual and operational) of a good ecological status

Marie-Hélène TUSSEAU-VUILLEMIN & Jean-Gabriel WASSON

1 Some conceptual remarks

Ecosystems receive growing interest as full interactive networks among co-existing living organisms and their non-biological physical-chemical environment (Jorgensen, 1992). The flows circulating in these networks consists of mass, energy and information. These fluxes give interesting dynamical information on ecosystems health, besides more static parameters as the biodiversity and the biomass. River ecosystems are particularly characterized by their dynamics and resilience toward natural hydrological perturbations. This adaptation capacity is a key-feature of the ecosystem health.

The “ecological status” of the rivers is a crucial key-word in the new framework directive. It is directly related to a deviation from the “reference conditions” of rivers and the definition of both terms, being from a conceptual or an operational point of view, is of critical interest.

The reference conditions could refer to a kind of pristine status, as often discussed in the USA, supposed to be characteristic of a pre-colombian environment. However, such a concept does not apply in Europe, where pristine conditions could not be found in many regions. Therefore, statistical approaches have been developed as an alternative, considering that the best observed situation in a given area can be considered as a reference level. This operational definition is however likely to be highly influenced by the general level of anthropic pressure in the chosen area. Another approach consists in focusing on the mechanisms of the degradation of the river ecosystem processes. Reference transect would therefore be looked for as areas where the anthropic pressure, though existing, does not alter significantly the most important structuring processes (namely, physical, biochemical and ecological processes).

The “good ecological status”, however, might turn to be slightly differently defined, as it is supposed to be achievable under a reasonable anthropic pressure. Therefore, one of the characteristics of this kind of ecosystems must be an efficient resilience toward the alterations of human origin. Here again, a deep knowledge of the processes and of the way they might be altered by human activities is necessary to evaluate the ecological status.

From these conceptual considerations, it appears that an ecological status is primarily to be observed and understood as a pattern of dynamical processes within an ecosystem, including their response to external forcing, especially from anthropogenic origin. This conceptual definition is much wider than the usual examination of physical and chemical parameters that are supposed to characterize the water quality. However, its operational application should be less difficult than it may appears, for two reasons: 1) these processes are mainly conditioned by large scale physical structures and 2) their temporal variability is much lower than that of the instream physical and biological parameters.

2 How to proceed, what research to engage?

The definition of reference conditions and the diagnosis of ecological status need to be pursued on a typological basis. As physical processes usually deeply structure the biota, interesting typologies based on hydro-morphological processes can be derived on a spatial basis, isolating homogeneous regions. An “Hydro-ecoregion” approach, based upon geo-climatic determinants, has been tested by Cemagref on the Loire basin (Wasson et al. 1993) (Wasson 1996), and is currently extended at the national scale. This typology and its potentialities (Andriamahefa 1999) (Cohen et al. 1998) will be detailed in the poster.
The following step is the definition of reference conditions for biotic communities for each ecosystem type (Ivol-Rigaut 1998), that will be achieved in many cases only in using some kind of models (Boët and Fuhs 2000). Pertinent tools also need to be developed in order to evaluate the ecological status of a river. Besides the classical chemical parameters, some fluxes might be evaluated as representative of the functionalities of the ecosystem (e.g. primary production). The framework directive focuses upon biotic parameters to evaluate the ecological status. Many existing indexes (invertebrates, diatoms...) can be used for this purpose, but the use of biological traits appears to be one of the most promising way to discriminate between perturbed and preserved rivers, and even to track the origin of the perturbation (Charvet et al. 2000). Current development of research at Cemagref will be presented in the poster (the Seine river case study).

At last, future and on-going research will certainly be concerned with the identification of the key-processes that govern the stability and resilience of an aquatic ecosystem toward various perturbations, being of natural (including a possible global climate change) or anthropic origin. Some examples of this kind of research at Cemagref will also be presented.

References


Towards the definitions (conceptual and operational) of a good ecological status

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Scientific and Technical Review Good ecological status: reference conditions
Helsinki, 24-25 October 2001

An ecological status is primarily observed and understood as a pattern of dynamical processes within an ecosystem, including their response to external forcing, especially from anthropogenic origin. This conceptual definition is much wider than the usual examination of physical and chemical parameters that are required to determine the water quality. However, its operational application should be less difficult than it may appear, for two reasons. First, these processes are mainly conditioned by large-scale physical structures and their temporal variability is much lower than that of the internal physical and biological phenomena. Second, the reference conditions should be exercised (or assessed) in systems where man has not significantly altered the fundamental processes and biodiversity. If these indications become more evident, assessments of biological samples and a better understanding of the processes will be expected. On-going and future research will focus on the identification and modeling of the key-processes that govern the stability and resilience of aquatic ecosystems.

Biological reference communities will be linked to the physical structures by statistical distribution models. The comparison between predicted and observed states helps to detect ecosystem health and that for its evaluation according to human pressures. This process is used to maintain ecosystems functioning in order to meet the roles of nature, energy and information fluxes.

Assessment of ecological status of rivers using diatoms (Bacillariophyta) or oligochaetes

Diatom biological index

Biological aspects

Towards new biological assessment methods using macroinvertebrates traits

Chemical aspects

Towards an in-situ measurement of bioavailable trace metals

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5. Water quality and pollution prevention Research Unit, Cemagref - 3, bis rue Chauveau, CP 220 – F93380 Lyon cedex 09
6. European and International Department, Cemagref – Parc de Tourouvre BP 44 – F2163 Antony cedex

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Towards the definitions (conceptual and operational) of a good ecological status

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4. Naiman et al., 1992
8. Frissell, 1986