Hydrobiologia (2005) 542:23–26
H. Segers & K. Martens (eds), Aquatic Biodiversity II
DOI 10.1007/s10750-005-0891-0

Comment on De Meester and Declerck, 2005 (target review)

Conservation of freshwater biodiversity: does the real world meet scientific dreams?

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The paper from De Meester & Declerck (2005) raises current and future challenges faced by biodiversity research in freshwater habitats. The most relevant question they ask is 'is science on biodiversity necessary?'. This question may open a debate about what kind of information is necessary for stakeholders. Meanwhile if we are talking about setting research priorities, we should more clearly identify the goals we want to reach. This debate is often hidden in scientific forums. We would like here to challenge some of the ideas developed by De Meester & Declerck (2005), partly as a devil's advocate, partly because we believe that scientists are not well prepared conceptually to face the real world which is not based on theories, but on facts.

The accumulation of scientific information is not a solution in itself to our environmental problems such as the erosion of biodiversity (Novacek & Cleland, 2001). As stated in the paper, it is not a good idea to wait for more information to implement proper management. Clearly, we do need strong political decisions to reduce the ecological footprint of people, and such decisions are usually unpopular. Moreover, the recognition that the planet is embraced by human-dominated ecosystems undercuts any assumption that we can restore the biota back to some state recognized as ideally pristine or 'uncontaminated' by human activities (Novacek & Cleland, 2001).

The discussion about policy-driven research vs. academic science is less pertinent to us. For long, limnologists (academic science) did not consider fish populations as part of the ecosystem because fish were studied by fisheries biologists (policy driven?). As a result, most research carried in the IBP focused on plankton, not on fish. On the other hand, the role of, e.g., fish (and other animal species) in nutrient cycling was equally ignored by chemists, who focus on chemical analysis, or the role of sediment, etc. This attitude was not very productive and the recognition of the top–down view (Northcote, 1988) strongly modified our perception of the ecosystem's functioning. Another example of policy-driven research has been the Onchocerciasis control programme in West African rivers (Lévêque et al., 2003). Most of our existing knowledge on freshwater biodiversity in West Africa has been obtained by an aquatic monitoring programme implemented in 1974 to evaluate the impact on the aquatic fauna of the insecticides used to control blackflies.

A first conclusion may be drawn: there is no clear boundary between academic and applied research, the latter one being often a source of new ideas for academic research and, let's be realistic, a major source of funding.

However, our major concern is that the paper enumerates a long list of topics to be covered by academic research that are certainly relevant for ecologists, but not for the purpose of biodiversity conservation. We would suggest, instead, to concentrate on the time scale, that is the past, present and future of freshwater biological diversity, taking the example of the European area. A priority not stated by De Meester & Declerck (2005) is to set up truly relevant study areas based on past history. Actually, it is important for conservation purposes to know what is the legacy and how it could explain the present-day distribution of biodiversity (geographic range, endemic species, hot spots, etc.).

First, it should be stressed that the history of freshwater biodiversity in temperate systems is somewhat different from that in tropical regions. In northern temperate areas, an ice age occurred every 100 000 years since at least 2 million years. Such major events caused extinction and repeated changes in the ranges of taxa that survived (Hewitt, 2004). During glaciations all the freshwater systems disappeared, or were strongly modified, due to climate change. The Danube in Europe and the Mississippi River in North America are assumed to be the refuge zones during these periods (Oberdorff et al., 1996). Recolonization took place progressively when ecological conditions recovered sufficiently to allow life in freshwater systems. Such a recolonization was a matter of chance for many species, which took advantage of opportunities presented by connections between watersheds to migrate. The present biological diversity of freshwater systems in Europe is the legacy of successive glaciation–deglaciation cycles. The last glaciation occurred some 20 000 years ago so that the lakes and river systems are relatively very 'young' and quite impoverished in comparison with tropical systems, which are characterized by their much longer life span (Lévêque, 2003). It is therefore not surprising to find few endemic species in Northern Europe.

However, we can also assume that the freshwater fauna in most European countries include species that have been introduced by humans, either directly or indirectly through physical connections established between river systems. The channels built during the XIXth and XXth centuries directly breached the natural barriers between adjacent watersheds. Even recently (1992), a new canal was opened between the Main-Danube Basin and Rhine River, allowing migration of species. In the absence of written information, we ignore what was the role of humans during historical times, except for the case of carp, which has been introduced everywhere for fish culture. If carp travelled all over Europe (and Asia?), probably other fish and aquatic species also did.

So, the two main components of the present freshwater biodiversity in Europe are the remains of catastrophic climatic events that occurred repeatedly in the last 2 million of years, and the pool of species introduced by humans probably since a long time, but at an increasing rate during the last century. In other words, freshwater biodiversity in Europe has been shaped by chance and by human activities. The fish fauna of lake of Geneva, for instance, is a melting pot of species compared to the fish fauna of Lake Tanganyika which is the product of a long co-evolution over million of years between species and their environment (Lévêque, 2003).

A brief conclusion here is that Europe (and other temperate regions as well) does not offer the best opportunity to develop ecological theoretical models. In Lake Geneva, for instance, the biological diversity is not at all a fine product of evolution, just an assemblage (a melting pot) of species that did not evolve in sympatry and occur, by chance, in the same biota. What is the ecological meaning of such artificial assemblages and what can be learnt from their study? In other words, is it realistic to develop ecological theories (that are in some ways deterministic) based on the study of artificial species assemblages?

Another issue not highlighted by the authors relates to concepts and conservation goals. Today, most of the freshwater systems in Europe are heavily impacted by human activities: damming, canalisation, eutrophication, various types of pollutions as well as exploitation and species introduction. We are far from a mythic pristine system that likely never existed anyway. It would be misleading to claim to decision makers and citizens that we can restore the biodiversity of freshwaters. It should be stressed that there is no way to go back to any past situation that could be presented as a reference point. Of course we can reduce pollution, rehabilitate in some ways the 'natural' functioning of rivers, build new aquatic landscapes that are more pleasant to people than canalized ones. But the main changes cannot be reversed, just because many new living species exist and cannot be eradicated; and because we are also experiencing a period of climate change.

There is a critical need to clarify the current concepts used by ecologists and to identify what they can really propose as operational tools for managers. Quite a number of ecological concepts have been using terms such as ecological equilibrium, stability, steady state, climax, ecosystem integrity, etc. (Naselli-Flores et al., 2003). They are actually misleading for decision makers. The real world of biodiversity is in terms of change, variability, death and recovery.

The real world is therefore not the world of academic ecologists. Only increasing existing knowledge will not solve the questions raised by the loss of biodiversity. In crude terms, the issue should be: what does the society want? What kind of 'nature' do we want? What are our priorities? For example: we surely do not want the reappearance of malaria through protection of mosquitoes habitats; we probably want to increase the production of clean energy such as hydropower (that implies more damming) or to rebuild fine aquatic landscapes attractive for recreation of urban peoples and tourists?

Simply stated: what kind of realistic goals should scientists propose to decision-makers for managing biodiversity?

- Should they propose to manage ecosystems in order to restore 'good ecological condition' that expectedly prevailed in the past? As stated above, there is no way to go back because of species introductions, pollution (including eutrophication) and anthropisation of ecosystems.
- Should they propose to 'freeze' biodiversity at its present state? Why and what for conserving this state that is fairly artificial in temperate areas?
- Should they emphasize the conservation of economically important species, including sport fish? Would it be a more realistic approach considering that managing the ecosystems for the conservation of these species will also protect many other aquatic species? Actually the protection of sport fishing species is one of the major determinant for improving the quality of FW ecosystems in many European countries.
- Should they aim to 'feed the poor' without taking much care of the aquatic environment?
- Should they suggest to protect species of unique heritage value? Which would be these species in temperate zones? How would such an approach cope with global change (and particularly climate change)? Moreover it is not possible to protect such species without controlling the land and water use in the watershed. So the only way to manage freshwater biodiversity would be to develop an integrated ecosystem management (as stated by De Meester & Declerck, loc. cit.), including the control of land use (agriculture, urbanization, transport networks, etc.) in the watershed responsible for change in nutrient inputs, siltation, change in hydrology, etc. Let's be realistic: to what extent can we really control the land use and fluxes to water systems?

The debate is not exhausted. The loss of biodiversity cannot be attributed, on the whole, to ignorance (Orr, 2003). Considerable effort has been made to document the decline of biodiversity and the causes of decline, but it is difficult to say how much information reaches the public or any particular decision maker. Besides, we are ignorant of many reasons why diversity should be preserved.

If changes in freshwater systems are irreversible, what is the meaning of conservation and what strategy should we develop for research? What kind of biodiversity do we want? Here is the split between protectionists and interventionists in the controversial field of conservation. Either we believe that 'mother' nature did very well and that we have to protect the legacy, or we believe that the heritage is only a melting pot of species resulting from hazardous survival and human introductions.

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