

Freshwater Resources Conservation: An Action-Oriented Overview



Biodiversity in rivers and wetlands is very seriously at risk as evident from the fact that 63% of freshwater fish species in South Africa, 42% of those in Europe and 27% of those in North America have become extinct, threatened or endangered. However, in terms of protection initiatives, rivers and wetlands have been critically neglected. The limited interest in protecting the biodiversity of these systems is reflected on the Internet, which has 78,200 pages on "biodiversity conservation" but only 12 on "river biodiversity conservation".

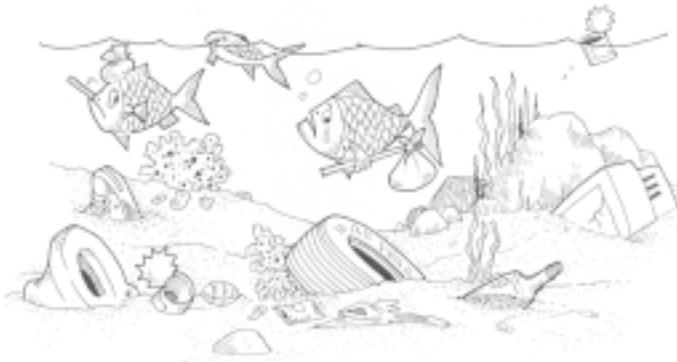
Addressing biodiversity from the perspective of practitioners is a challenge to scientists, as this broad concept has resulted in many international resolutions and vague recommendations more than pragmatic guidelines. In terms of action, two basic questions need to be considered: i) what practices should be avoided in order to prevent biodiversity degradation; and ii) what should be done to favor conservation?

What Should NOT be Done

The major negative activities to be avoided to prevent aquatic biodiversity degradation are habitat fragmentation or degradation, pollution, overexploitation and bad fishing practices, and the introduction of alien species.

Habitat Fragmentation or Degradation

The diversity of aquatic species results from the existence of a wide range of habitats for animals and plants. Destruction or homogenization of natural habitats -- for instance by extensive agricultural development in floodplains, channelling of rivers or the dredging or reclamation of wetlands -- results in a loss of living space and food for species. In many cases, the animals and plants cannot survive in the modified habitats because they have evolved to use particular resources that are no longer available.



Pollution

Regardless of the obvious effects of heavy pollutions, there is a danger of low-level pollution (for example, organic matter released by pig farms, "relatively clean" effluent from a factory) going unnoticed even though it affects sensitive and rare species, simply because it does not pose a problem for more robust species of commercial interest.

Overexploitation and Mismanagement

Overpopulation and mismanagement are regularly mentioned but difficult to deal with, the driving factors being growing population density, poverty and increased demand for protein. Symptoms of overexploitation in fisheries are:

- big fishes -either species or individuals- become rare;
- the abundance of long-distance migrants is reduced; and
- small species of short life-span and low value become dominant.

Introduction of Alien Species

Introduction of alien species in the natural environment (on purpose, or accidentally from aquaculture farms) is also a major danger to local biodiversity, as these species tend to be invasive and lead to the extinction of native ones. In Lake Victoria (East Africa), several dozen native species disappeared following introduction of the carnivorous Nile perch.



Pragmatic actions should be considered at two levels: that of the practitioner (working on natural resources and/or with human communities), and that of organizations or government agencies that can initiate projects beyond the reach of a local community. We review below possible actions at these two levels, with a focus on species, environment or people.

What Should be Done

Species-Oriented Action

Identification of Indicator Species

Some particularly sensitive species may be indicators of habitat degradation, but are not necessarily known as such by fish biologists as they are often rare.

Identification of these species, on the basis of local knowledge, constitutes very helpful information that can be incorporated into environmental assessment and monitoring.



Protection of Critical Life Stages

Some species are particularly sensitive at certain times of their life. Initiating protection measures focusing on these critical stages will help species conservation. Thus, juvenile fishes can be protected by the maintenance of shallow, herbaceous habitats along main streams, and breeders of large species will benefit from protection of their refuges during the dry season such as in the deep pools in tropical streams.

Optimization of Socially Valued Species

Certain species are regarded as flagships or symbols in some cultures, such as salmon in Northern Europe, pirarucu in South America or mahseer in the Himalayan region. Promoting conservation based on these species will maximize impact and the chances of success.

Monitoring

Local communities can very efficiently contribute to resource monitoring and therefore to a warning system if standardized harvesting procedures (fishing and monitoring) are applied over several years. This does not require major resources, as demonstrated by the extremely valuable monitoring during seven years of the catches of ten fisherman in Khone Island (Mekong River, Lao PDR).

Prioritization of Species

Implementation of conservation measures require categorization and prioritization of endangered species, and aquaculture as well as the ornamental fish trade requires identification of new candidate species.

Examples of these are the work carried out by the Indian National Bureau of Fish Genetic Resources (NBFGR) on the biodiversity regions of Western Ghats and Northeast India, and the initiative of the Mekong River Commission involving Lao PDR, Cambodia, Thailand and Vietnam. The prioritization exercise, though subjective, was carried out in a well defined manner and made use of the expertise of research scientists from local institutions. As an extension of these exercises, institutions located in the regions concerned are refining breeding and



culture techniques for the species identified. Keeping the focus on prioritized species, the NBFGR program also includes inventory of habitat and fishes as well as genetic characterization and gene banking. Knowledge of local persons and ornamental fish traders, though not formally documented, has contributed to the prioritization exercise.

Inventory of Biodiversity

With realization of the value of biodiversity, local communities are interested in documenting what is available in their region. An example of a “people’s inventory,” including freshwater species, is one carried out in the state of Kerala, India. Such inventories are a good starting point for conservation efforts. However, they require taxonomic expertise that might not be available locally.

In these efforts, it would be advantageous to utilize national or global biodiversity databases publicly available such as *FishBase*, developed by the International Center for Living Aquatic Resources Management (ICLARM) -- The World Fish Center (www.fishbase.org). From *FishBase*, national or regional information on fish biodiversity can be obtained and initial taxonomic identification can also be carried out. *FishBase* also has a module, *FishWatcher*, where interested persons can contribute information. Modules designed for learning also contribute to raising awareness and training.

Environment-Oriented Action

Due to the limited role of gene banks and aquaria in conservation of fish and other aquatic species, freshwater biodiversity protection is habitat conservation. It has also been shown that riverine fish diversity is proportional to habitat heterogeneity. Therefore, efforts aimed at habitat



conservation (river integrity, absence of dams, no channeling, natural variability) and habitat diversity (shallow banks, riffles and pools, presence of wetlands, maintenance of access to floodplains, connections between habitats) are critically important to the maintenance of freshwater biodiversity.

Assessing the Status of a River ("Riverwatch")

Assessing a river's status can be a very useful exercise generating responsibility and a sense of ownership among participants. Such an undertaking was recently proposed for the Dniester River (Ukraine and Moldova), mostly by using canoes to collect information, in collaboration with many non-government organizations (NGOs) and local authorities along the river. General assessment should focus on animal and vegetal species diversity; on the location and extent of natural habitats; on alterations to natural flows (dams, embankments, derivations); on sources of organic pollution (urbanization, livestock density), contamination (industries, chlorination) and sediments (quarries, agricultural and construction erosion, logging, dredging); and on boating practices.

Identification of Sensitive Sites

Researchers and decision-makers do not have information about all sensitive or threatened sites. Pointing out such sites where (they are, why they are significant, why they are threatened, whether they should be monitored) and communicating with scientists and institutions with a view to targeted activities and the institution of long-term monitoring constitute an important contribution to biodiversity conservation. The Aquatic Rapid Assessment Program (AquaRAP, www.biodiversityscience.org) provides a framework for such an activity.

Use of Socially Valued Sites as Conservation Sites

Some natural waterbodies are highly regarded in local cultures (e.g. wetlands by temples in Sri Lanka, ponds in Buddhist monasteries, sacred pools in Africa). Promoting conservation centred on these sites is naturally appealing to people of these cultures. Such sites can also be very useful in

the conservation of genetic biodiversity: for example when the common carp stocks in the Himachel Preadesh state farm (India) became contaminated with the goldfish genome due to interbreeding, a source of uncontaminated natural carp broodstock was discovered in the Rewalsar Lake, where it had not been fished due to religious restrictions.



Creation of Reserves

Setting up a reserve is a tempting but challenging initiative. There is still controversy among scientists as to whether multiple small protected areas should be preferred to a few large ones, or whether the emphasis should be on species-rich or species-deficient zones, taking any of those protection initiatives is undoubtedly welcome. Moreover, water bodies within protected wildlife reserves can serve as freshwater aquatic reserves. The presence, within two

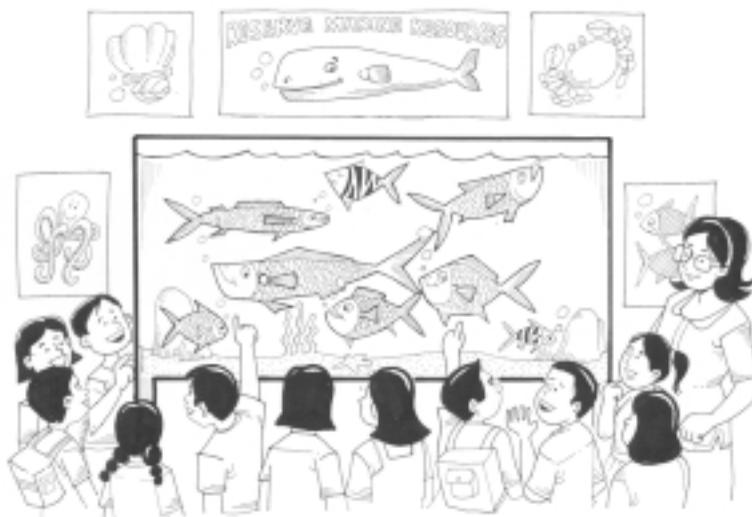
A reserve can also be a zone temporarily protected during periods of the year critical to aquatic species. At least, efforts should be made so that streams are not explicitly excluded from terrestrial protected areas, as it is the case in Yunnan (China). In all cases, initiatives centred around reserves should be undertaken in close collaboration with local communities, and expected gains - particularly in terms of enhanced catches - should not be emphasized.



wildlife reserves monitored by NBFGR in the state of Uttar Pradesh (India), of a large number of threatened species with maximum sizes exceeding those reported in the literature indicates the potential for using wildlife reserves as aquatic sanctuaries.

Establishments of Aquariums

Aquaria are excellent means to raise awareness of the diversity and beauty of aquatic resources in the population. Even modest local aquaria exhibiting local species can play a helpful role if the peculiarities or uniqueness of displayed species are outlined to the public. Furthermore, well-managed aquaria such as the Vancouver Aquarium Marine Science Center (Canada) have breeding programs for rare species that contribute to their conservation. In existing aquaria, the promotion of conservation and the display of educational posters can be encouraged.



Genebanks

Gene banks can hold live animals or cryopreserved gametes. Gene banks can be considered as a last line of defense against species extinction. The Dexter farm for endangered species (USA) is a successful example of a live gene bank that has contributed to delisting of threatened species by captive breeding and restocking in species-specific recovery programs. Such gene banks can contribute to recovery and utilization of genetic diversity and its use in genetic enhancement (e.g., salmon in Norway and common carp in Hungary) and conservation programs (e.g., by NBFGR, India and World Fisheries Trust, Canada).

People-Oriented Action

The following actions focus on the social aspects of conserving aquatic biodiversity. They can consist of community-based initiatives, but also encompass advocacy of local perspectives and communication (awareness-building).

Working with Local Communities

- **Co-management of aquatic resources:**

Co-management is a complex topic that has generated much literature (see for instance www.co-management.org). Operational co-management regimes generally include socially defined groups, clear territorial limits, an ability to limit the access of outsiders and to make and enforce rules among community members, and collaborative mechanisms for monitoring and regulation.



Local participation in conservation projects should not be limited to day-to-day activities, but should also include consistent involvement in strategic issues.

There are four areas in which local people can participate in projects:

1. information gathering;
2. decision-making;
3. initiating action; and
4. evaluation.

If the lessons learnt from successful projects are to benefit other sites or regions, it is important to clearly define what local people are participating in, who is participating, and how they become participants. It has been found that experience gained in rural development would act to significantly “fertilize” biodiversity conservation, which implies contributors from this field in project design and implementation. Last, securing people’s involvement and local participation at a significant scale is a lengthy process, and experience having shown that at least a decade is necessary.

- **Economic incentives.** In order to be attractive, measures designed to promote sustainable use or protection of biodiversity must provide economic incentives to local communities. Such incentives can be derived from the use of previously neglected aquatic resources, but also from assistance to local communities as compensation for their conservation efforts. Hence in a national park in Madagascar, assistance in repairing irrigation canals and establishing tree nurseries was provided in return for efforts towards the conservation



of natural environments. Economic incentives can be more straightforward, when for instance the income from a tourist lodge by a river is partly paid into a community trust fund (South Africa).

- **Ecotourism** is an activity that has generated much literature; however its role has been often over-emphasized as tourists are often satisfied with what they see within quite a small area, in which case it becomes profitable at a small scale and operators have little incentive to protect the large areas that are necessary for actual species conservation.

- **Social initiatives.**

Protection of biodiversity does not consist of ecological action alone. Research has revealed that loss of biodiversity is linked also to



population growth, poverty and social or political disintegration, so any positive action in these fields will also act in favor of biodiversity conservation. For this reason, projects that target poverty eradication, changes in social structure or even family planning can claim a role in biodiversity conservation. Specific projects focusing on the development of alternative sources of livelihood for artisanal fishermen are also extremely helpful. They may well be effective in areas having no direct connection with fisheries resources, such as tourism, small business enterprises and household cottage industries. Successful integrated conservation projects, as for instance in Guinea Bissau, have along with fish processing and enhancements, also encompassed other social initiatives like the creation of associations, micro-credit, literacy programs, and even judicial support.

Local Perspectives and Knowledge

Local points of view, values or experiences have often been overlooked by administrations in the decision-making process. This can result simply from a lack of information at upper levels, and it is partly up to local communities to overcome this problem by better advocacy of their own perspectives.

- **Economic valuation:** Economic valuation has been consistently outlined as one of the most efficient contributors to biodiversity conservation. This strategy is being actively implemented by large conservation NGOs such as World Conservation Union (IUCN) and World Wildlife Fund (WWF); however field practitioners can also significantly contribute by valuing the use of natural resource in their zone. This would consist of identifying the natural resources and ecological services generated by the environment, and putting a financial value on them.
- **Using local knowledge and information:** Local knowledge and information can also play an important role in biodiversity conservation. This can consist of the collection of ecological knowledge, as is being done along the whole Mekong River whose fish diversity is huge and whose fishing communities are very experienced. It can also involve the

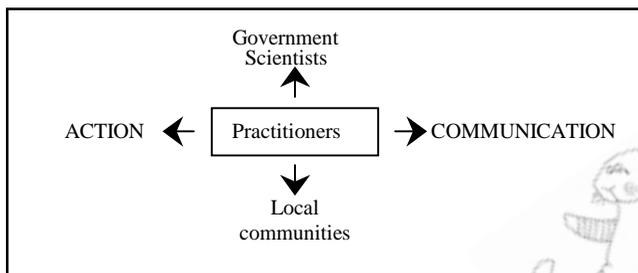
For instance, the value of traditional low-level exploitation of the Rufiji delta's natural resources in Tanzania was recently calculated to be US\$ 6.7 million a year (i.e., \$192/ha, vs. \$63/ha for cultivated lands)— a significant argument when talking to national decision-makers. Valuation can also consist of outlining the importance of resources usually overlooked in the livelihood and food security of local people, such as frogs, snails and lotus in Asia. Subsistence fisheries are also often overlooked, although self-consumption can be very considerable — for instance 134kg of fish per household and per year in Alaska. In all cases it is essential that the information gathered at the local level be conveyed to scientists and national decision-makers.



translation of relevant documents in the national language into English in situations where a case might be better argued on the international stage and might attract the attention of foreign donors. Compilation of information found in “grey” literature is also extremely helpful, as scientists tend to focus on flagship sites and to neglect new areas that may have been covered by local studies of limited diffusion. Such information is also valuable for the identification of indicator species.

Communication

Information is critically important in biodiversity conservation, as the scale of the degradation process necessarily requires the involvement of multiple stakeholders. Schematically, practitioners should consider themselves at a crossroad between national and local actors, and between action and communication. For efficient action, simultaneous initiatives are needed along those four directions.



- **Diffusion of results** should be an intrinsic element of initiatives in favor of biodiversity conservation. This would benefit coordination, synergy and the sharing of lessons learnt. The impact of such communication about a given project will be maximized if it clearly states which is the approach favored (biological, involvement of communities, awareness building,

etc), what is the environment considered (small stream, river, lake, wetland, coastal zone, etc; dimensions), what is the problem addressed (river discharge, pollution, damming, access to floodplains, etc), what is the target (x hectares of wetland rehabilitated, stabilised abundance of a declining species, removal of y% of an unsustainable fishery, etc); and what is the temporal scale addressed (a season, a year, a decade...). It is also noteworthy that objective "success stories" are particularly scarce despite their considerable potential value as a means of convincing decision-makers.

- **Collaboration with scientists** adds enormous value to field experiments, as scientists lend credibility, have time to report about initiatives, have access to means of diffusion and may have the ear of decision-makers.
- **Writing books and articles** on natural aquatic resources is an element of awareness building. Using the local language is an important factor in the impact that such material can have. Some donors have a policy of funding awareness-building initiatives. These can consist in educative brochures or posters, topic-oriented schoolbooks, news releases, but also in programs for broadcast (see for instance www.agfax.net) or even in karaoke songs that Asia is fond of, as developed by a project in Cambodia.

Conclusion

In the field of biodiversity conservation, scientists consider that translating the principles into effective on-the-ground-action is still a question that remains unanswered. There is also a demand for projects that would demonstrate



that significant improvements in biodiversity conservation can be attributable to, or connected with, improved local economic opportunities. There is therefore room for creativity among practitioners, keeping in mind that experimental projects should reflect the rural development experience, should ideally be funded in the long term, should decentralize decision-making to local levels, should be implemented by a mix of NGOs and government agencies, should encourage outside evaluation, and should involve collaboration with professional researchers to document, analyze and communicate their results -both successful and unsuccessful.

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