Rajiv Gandhi Chair Special Publication - 2008

GLIMPSES OF AQUATIC BIODIVERSITY

Editors

Prof. (Dr.) P. Natarajan
Rajiv Gandhi Chair Professor, CUSAT, Cochin - 682 022

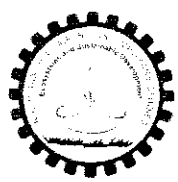
Prof. (Dr.) K.V. Jayachandran
College of Fisheries, Kerala Agricultural University
Cochin 682 506, Kerala, India

Prof. (Dr.) S. Kannaiyan
Former Chairman - National Biodiversity Authority
Chennai-600 041

Dr. Babu Ambat
Executive Director, Centre for Environment and Development
Trivandrum-695 013

Arun Augustine
Research fellow, Rajiv Gandhi Chair, CUSAT, Cochin-682 022

Published by



RAJIV GANDHI CHAIR IN CONTEMPORARY STUDIES
SCHOOL OF ENVIRONMENTAL STUDIES
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
Kochi - 22

Glimpses of Aquatic Biodiversity - Rajiv Gandhi Chair Spl. Pub., 7 : 244 - 251 (2008).

VALUING MARINE BIODIVERSITY

Rekha J. Nair & Somy Kuriakose
Central Marine Fisheries Research Institute, Kochi -18, Kerala
rekhacmfri@rediffmail.com

Biodiversity is valuable, as recognised by the Convention of Biological Diversity...

... yet partly because much of the value is implicit rather than explicit, biodiversity continues to be lost at unprecedented rates.

Why Focus on Biodiversity?

Earth is a closed system and therefore, all of its life is interdependent, relying upon each other as resources. The more biologically diverse the Earth is, the better the chance all species will have for survival. Humans abuse much of the Earth's resources in order to achieve economic success. However, this success comes at the expense of humanity's future. The resources on Earth have the potential to sustain life indefinitely, if used with caution. However, when exploited, the resources can be lost forever. The concern for the world's loss of biodiversity was embodied in the debate on Convention on Biological Diversity in 1992 at Rio de Janeiro. The 1992 Convention on Biological Diversity demonstrates how biodiversity has emerged as a rallying goal for environmental conservation and protection. **Biological diversity** means *"the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems"*. Biodiversity is however a multi-dimensional concept and therefore can be classified at four levels as follows:

- **Genetic diversity**: the variation in the information represented by the genes of individual plants and animals.
- **Species diversity**: the variety within and between species, subspecies, populations.
- **Ecosystem diversity**: the variety of communities of plants and animals within particular habitats at scales ranging from individual habitats to landscapes and bioregions.
- **Functional diversity**: the range of functions generated by ecosystems, including ecosystem life support functions, such as regulating water and carbon cycles and photosynthesis.

Each type of diversity is inter–related, however, they are to be considered separately too.

Why is Biodiversity Valuable?

We do not know the true number of species on earth, even to the nearest order of magnitude. Wilson (1988) estimates that the absolute number of species falls between 5 and 30 million, although some scientists have put forward even higher estimates, up to 50 million. At present approximately 1.4 million living species of all kinds of organisms have been described. The best catalogued groups include vertebrates and flowering plants, with other groups relatively under-researched, such as lichens, bacteria, fungi and roundworms. The apparently lower biodiversity in the oceans (250,000 named marine species compared to the 1.7 million known terrestrial species) may be justified as an artifact of inadequate explorations, especially of the deep seas and taxonomic studies. This is further illustrated by those groups of animals that are relatively well studied such as marine fish, which have higher species diversity when compared to freshwater fishes. Likewise, some ecosystems and habitats are better researched than others, for example coral reefs and deep ocean floor are being researched upon more only very recently. This lack of knowledge has considerable implications for the economics of biodiversity conservation, particularly in defining priorities for cost-effective conservation interventions.

Biodiversity is essential for meeting human needs. Diversity within the natural environment is important. It provides variety that people enjoy, both in species and landscape. Species variety plays a dual role of ensuring and signaling the vitality of the natural environment. Protecting biodiversity protects the health of the natural environment and this enables it to provide goods and services which people depend upon. Valuation of biodiversity therefore becomes necessary to illustrate the importance of biodiversity. The importance of economic valuation is recognized in the CBD's Conference of the Parties (COP) Decision IV/10 acknowledges that ***"economic valuation of biodiversity and biological resources is an important tool for well-targeted and calibrated economic incentive measures"***, and encourages the Parties to ***"take into account economic, social, cultural, and ethical valuation in the development of relevant incentive measures"***.

Yet, biodiversity continues to be lost at an alarming rate. While the conservation actions taken so far are positive, most of the effort was directed toward terrestrial ecosystems. The importance of conserving marine biodiversity has only been recently realized; consequently less action has been taken. This is especially of urgent concern as marine biodiversity is being plundered and the loss is going unaccounted. Although there are many different factors contributing to the decrease in marine biodiversity the most important change needed is increased public awareness. With greater public support, government and corporations could be pressured into doing more to protect marine biodiversity. Public awareness can be accomplished through educating people about the value of marine biodiversity, how seriously it is threatened, what is currently being done, and finally what still needs to be done.

Importance of Valuation of Biodiversity

Decision-making involves weighing costs and benefits of the ecosystem and it is difficult to include biodiversity in this because its value is not quantified or understood. Many of the goods and services provided by biodiversity and ecosystems are crucial, but not always quantifiable in monetary terms. Many of these goods and services are also not traded in the market place and so do not have an obvious price or commercial value. The danger is that if these unpriced values are not included in the decision-making process, the final decision may favour outcomes which do have a commercial value. Hence decision makers may not be fully aware of the consequences for not having adequate biodiversity conservation.

Valuation becomes necessary therefore to illustrate the importance of biodiversity. Valuing biodiversity may seem an odd thing to do. It is also a very difficult thing to do. However, valuing biodiversity requires an understanding of the range of benefits it provides. The need to pursue cost-effective investment interventions in biodiversity conservation has added considerable urgency to biodiversity valuation. As there are competing uses of the natural environment, for farming, development or as a natural space, society needs to be able to choose which is best. The benefits from farming or development can be seen from the value of their products in the market place. But the products from the natural environment often do not appear directly in any market. It is worth highlighting, that, even though such natural products may not appear in markets, they are nonetheless just like any other good. For example, just as a person may purchase a cup of tea for the satisfaction it gives him, another may choose to take a walk in the beach for the pleasure it provides. Though a cup of tea may cost, taking a walk may not 'cost' anything; it can appear free or worthless. Unless these products are valued to reflect the benefit they bring to people, preserving a natural space or environment could be mistaken for an inferior option. With the advances in fishing practices over the world, for example, trawling the depths rakes up millions of organisms which do not get the space and time to resettle before the next trawl. Corals, sponges, benthic invertebrates are all raked up and disturbed from the deep bottom turning their homes into their own graves. No effort is taken to cost the damage or value the damage caused by these damages done to the ecosystem in monetary terms.

Products and Services Provided by the Ecosystem Include:

- ✓ food (fisheries, aquaculture) for man.
- ✓ natural treatment system for human waste
- ✓ sink for pollutants from air and land
- ✓ physical and chemical buffering system for global climate change
- ✓ an educational amenity
- ✓ ingredients for biotechnology (bioactive chemicals, substances for food and medicine)
- ✓ oil, gas, gravel, sand and other mineral resources
- ✓ transport.
- ✓ cooling water for power-generation plants and industry
- ✓ leisure and recreational facilities (e.g. water sports, sport fishing, wildlife observation, and tourism).
- ✓ resilience and resistance.

Current environmental management tends to focus on market linked goods and services, such as tourism and fisheries. It is this narrow approach which has contributed to the over exploitation and degradation of marine biodiversity. Only by understanding all the goods and services provided by marine biodiversity is it possible to appreciate the true value of this resource. This understanding is the key to developing sustainable management plans to maximise the benefits received from marine biodiversity.

How to Value Biodiversity?

The economic valuation of biodiversity can be a powerful management tool, and a convincing argument for conservation especially when used alongside social, scientific and spiritual studies of

biodiversity. Economic valuation offers a way to compare the diverse benefits and costs associated with ecosystems, by attempting to measure them and expressing them in a common denominator- typically a monetary unit.

The **Total Economic Value (TEV)** framework can be used to value the natural environment. It breaks down why people value the environment by looking at whether the benefits they gain are **'Use value'** and **'Non-Use'**.

Use value: A use value is much as it sounds- a value arising from an actual use made of a given resource. They are of three types - **Direct, Indirect and Option**. People value the environment because they use it, both directly and indirectly. Visiting the countryside, walking in the beaches are examples of directly using the environment. But natural processes in the environment also provide services to people. These include climate regulation through absorbing CO_2 from the atmosphere, and water quality through natural filtration. Although these are 'used' by people, it is indirect as most people are not aware that they are benefiting in this way.

Direct & Indirect Use Benefits

Mangroves are a good example of the natural environment providing both direct and indirect use benefits to society. By hosting a variety of birds and animals, mangroves attract large numbers of visitors. These are people who are directly 'enjoying' the natural environment. However, mangroves also provide other services of benefit to society, including nursery ground for fishes and flood control. Without these, society would have to pay higher costs to build flood defences. These are considered indirect benefits because people do not 'consume' these services directly, rather they impact on services needed by people.

Option values (OV) is a value approximating an individual's willingness to pay to safeguard an asset for the option of using it at a future date. In other words, it is the value people place on simply knowing that certain species or natural bodies exist anywhere in the world, even though they may never see or experience them.

Non-Use: There is a value in maintaining the natural environment separate to the benefits from using it directly or indirectly. Part of this is a bequest value that current generations may place on the ability to pass on pristine natural spaces to future generations.

Non-use values (NUV) are slightly more problematic in definition and estimation, but are usually divided between a **bequest value (BV)** and an **existence** or **'passive' use value** (XV) (Arrow *et al.,* 1993). The former measures the benefit accruing to any individual from the knowledge that others might benefit from a resource in future. The latter are unrelated to current use or option values, deriving simply from the existence of any particular asset. An individual's concern to protect, say, the blue whale although he or she has never seen one and is never likely to, could be an example of **existence value**

Non-Use Benefits

Charitable donations to wildlife organisations which endeavour to protect endangered species across the world are an example of non-use benefits, and amount to hundreds of millions of pounds worldwide each year. Individuals are willing to give up some of their income in order that species which they may never see or enjoy in any 'direct' sense may survive. Individuals receive satisfaction from knowing that the species survives, and are willing to pay to ensure that it does.

Thus in total we have:

$$TEV = UV + NUV = (DUV + IUV + OV) + (XV + BV)$$

Total Economic value = Use value + Non Use value

= (Direct use value+ Indirect Use value + Option Value) +

(Existence value + Bequest value)

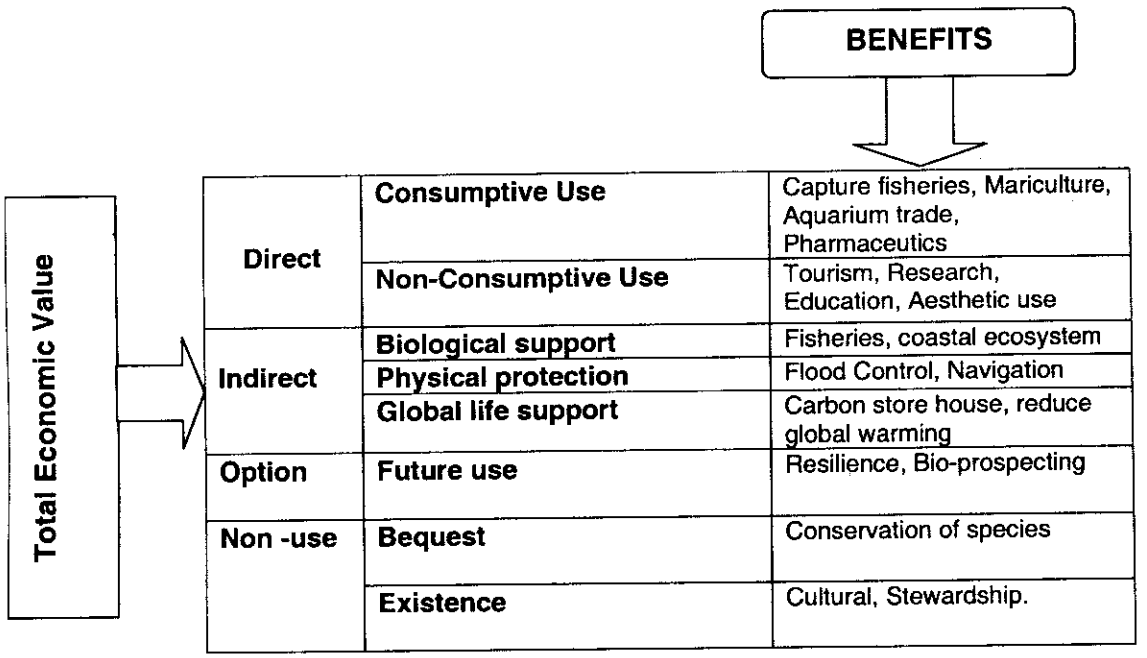
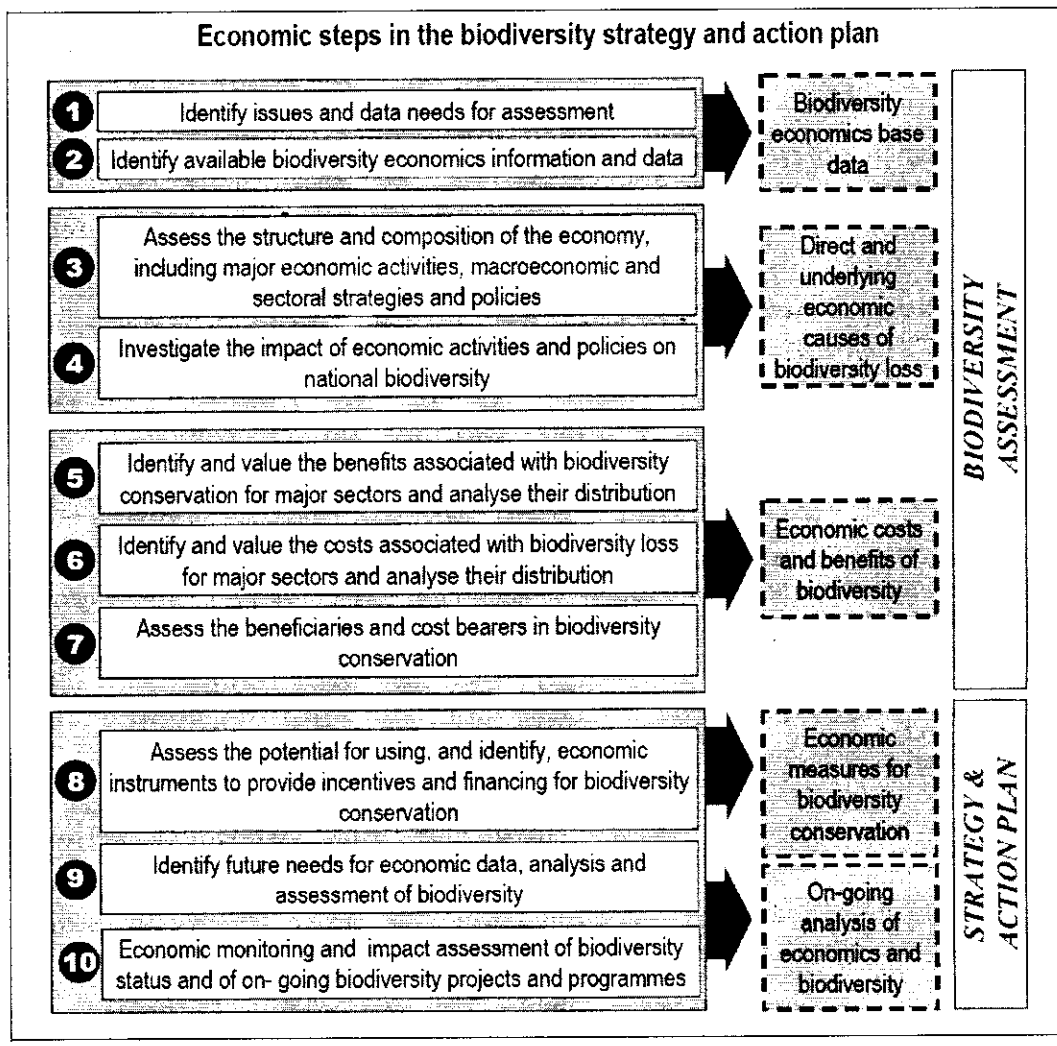


Fig. 1: *Valuing the Natural Environment*

Goods and services that are not traded in markets will remain unpriced. It is therefore necessary to assess the relative economic worth of these goods or services using non-market valuation techniques. The type of valuation technique chosen will depend on the type of non-market good or service to be valued, as well as the quantity and quality of data available. Where market prices exist for resources, these may have to be adjusted to provide social or shadow prices. Investment by public/ government bodies in conserving biodiversity may represent a surrogate value for aggregated individual willingness to pay and hence social value. These 'public prices' paid for resources can be used to approximate the value society places upon them, for example, the costs of designating an ecosystem as a nature reserve. The price or cost of other market goods and services is assumed to reflect the preferences for environmental resources. For example, individuals may spend considerable time traveling to a specific site for recreational purposes. Valuing the travel time (e.g. in terms of income that could have been earned instead) can give some indication as to the value individuals put upon the environmental resources they are using. This travel cost method is one revealed preference methodology; others include random utility models (used to estimate the value of different individual features of a site), hedonic pricing models (to estimate the effect of environmental characteristics on property values) and averting behaviours (using expenditure on avoiding behaviour as a proxy for damage costs).

Stated preferences is a technique which use survey methods to elicit the individuals' preferences and willingness to pay (WTP) for the non-market good in question. The advantage of such methodologies is that they can be used to estimate non-use as well as use value, which may be a significant part of the Total Economic Value for many biodiversity resources. Two types of stated preference techniques are contingent valuation (used to value the natural resource as a whole) and choice modelling (which focuses on the individual attributes of the resource in question).



(Ref: Economics And The Convention On Biological Diversity by Lucy Emerton IUCN Economics and Biodiversity Programme, IUCN).

When the Market Fail

Decision about biodiversity management are complicated by the fact that various types of market failure are associated with natural resources and the environment. Market faulures occurs when markets do not reflect the full social costs or benificts of good. Factors that cause market failures related to biodiversity protection include:

(I) Many ecosystems provide services that are public goods; they may be enjoyed by any number of people without affecting other people's enjoyment.

(II) Many ecosystem services are affecting by extrnalities (the side effects of human actions; for example, if a stream is polluted by runoff from agricultural land, the people downstram experiences a negative externality.

(III) Property rights related to ecosytem and their services are often not clearly defined.

Issues in Valuing Biodiversity?

Key issues are -

1) **The understanding of biodiversity**: There is limited understanding of the concept and worth of biodiversity amongst non-specialists, as well as the problem of incomplete information which could lead to biodiversity being undervalued by individuals. For this, people should be educated about the concept of biodiversity.

2) **Scientific understanding of ecosystems**: Even amongst the specialist community, there is much uncertainty about the range and scale of the species within ecosystems, as well as the functions and services provided.

3) **Marginal valuation**: In terms of policy decision-making what is required is the marginal value of biodiversity goods and services i.e. the value yielded by an additional unit of the good or service. This is because policy-making is focused on making trade-offs between use of resources.

4) **Scale:** The geographical scale (or accounting stance) of a study is determined by the extent of the population affected by the impact under investigation. An accounting stance has to be adopted in specifying the scale, where the gains in accuracy are balanced against the costs of spreading the scale wider.

5) Aggregation and double counting:

6) Allocation over time:

7) Irreversible change: Irreversible impacts, for instance the extinction of species or exhaustion of minerals, are not accounted for in the standard procedures for economic evaluation.

8) Data limitations: It is inevitable that some of the data required for an economic evaluation will not be readily available. Budgetary constraints often limit extensive collection of original data.

Biological Valuation Maps (BVMs) are maps showing the intrinsic biodiversity value of sub zones within a study area, would provide a useful 'intelligence system' for managers and decision makers. Such maps would need to make best use of available data sets, compiling and summarizing relevant biological and ecological information for a study area, and allocating an overall biological value to different sub zones. BVM can serve as a baseline map showing the distribution of complex biological and ecological information.

Rather than a general strategy for protecting areas that have some ecological significance, biological valuation maps are excellent tools for calling attention to areas which have particularly high ecological or biological significance and to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in such areas.

Marine Biodiversity Conservation

There is worldwide recognition of the benefits of management for sustainable use and conservation of the sea. Solid and meaningful biological and ecological information is urgently needed to inform and underpin sustainable management approaches. A significant benefit from biodiversity conservation is the impact on local economies of organizations that work to restore and maintain a high quality natural environment. These organizations provide employment and boost local GDP. Also, a high quality natural environment encourages the 'visitor economy', where day-trippers and tourists visit areas to enjoy free unpolluted air and scenery, generating custom for local enterprises. While this economic activity lies outside the TEV framework, it serves to illustrate some of the tangible benefits to local communities from preserving a high quality environment. Valuation is crucial to biodiversity conservation because ***unless it makes demonstrable economic and financial sense for people to conserve biodiversity, it is unlikely that individuals, households, industries, companiesor governments will take action to do so. People will continue to degrade and deplete biodiversity in the course of their activities because they feel that it is more profitable and economically desirable to do so.*** It is only when the cost-benefit ration is known, the true economic losses can be studied. It is only by valuation and preparation of the biological valuation maps that the diversity deep down in the oceans can be preserved for posterity.

References

Bennett, J. 2003. The economic value of biodiversity: a scoping paper. Paper presented to the national workshop *The Economic Value of Biodiversity*, 22-23 October 2003.

Nunes, PALD & van den Bergh, JCJM. 2001. Economic valuation of biodiversity: sense or nonsense? *Ecological Economics,* 39: 203-222.

Wilson, E.O.1988. The Current State of Biological Diversity. In: Wilson, E O (ed.), *Biodiversity* National Academy Press, Washington: 3–20.