MEETING REPORT

Key issues in the conservation of marine biodiversity*

The tsunami of 26 December 2004 was perhaps the most prevailing event that awakened countries in the Bay of Bengal region on the need to understand marine ecosystems in a more holistic sense. Although the tsunami extensively damaged human lives and property, it created ecological opportunities; and the possibility to find means by which human confidence and livelihoods could be rebuilt without interfering with the ecological integrity of the marine ecosystem – an ecosystem that is to be considered as a larger composite unit spread across the Bay of Bengal and Arabian Sea, cutting across political boundaries and encompassing many natural and man-made habitats than previously recognized.

Fifteen months after the disaster, a process of retrospection and review is underway. Initial results reveal that relief and rehabilitation efforts, despite their best intentions, were characterized by a lack of coordination amongst implementing agencies, a discounted attitude towards scientific and technological inputs, the non-recognition of the cultural plurality and ecological diversity that typify coastal habitats, and most importantly, a thorough disregard to find sustainable, long-term solutions. In this regard, a national symposium was organized recently. The sessions were structured to seek directions to two basic questions: how much do we know of marine ecosystems and what needs to be done in the coming years?

J. R. B. Alfred, Director, Zoological Survey of India, highlighted the magnitude of marine living resources and said that 80 different marine habitats could be enumerated for India, of which the shallow coastal waters (not exceeding a depth of 200 m) are the most productive. Experts like T. N. Ananthakrishnan, stressed upon the need to reassess the biodiversity of seas around India, especially in well-known sites like the Gulf of Mannar. S. Kannaiyan, Chairman of the National Biodiversity Authority emphasized on the need to focus on marine inventory and integration of our understanding of marine systems with sustainable use of resources.

Presentations were made on topics: marine biodiversity and its significance, ecological valuation of marine biodiversity and economic valuation of marine biodiversity. R. J. Ranjit Daniels, Director, Care Earth summarized the key issues of the symposium as follows:

Species diversity and taxonomic capacity: 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.

Also, recent taxonomic research on lower organisms (invertebrates) has brought to light the higher number of species in each group and the many unidentified ones that are being collected from the marine ecosystem. For example, among the 156 species of sea fans collected from the coast of Tamil Nadu, only 60 have been previously identified. Among the 50 species of brachyuran crabs collected in Karwar (Karnataka), 37 are new to the locality and at least one is new to India. Of the nearly 40 species of benthic polychaetes of Tamil Nadu that were recently collected, one-third is new to India. There are 294 species of reef-building corals known from India till date with the possibility of adding another 400 species.

Another attribute of marine biological diversity that renders it poorer than terrestrial biological diversity is the lower levels of endemism. The example of Andaman and Nicobar Islands illustrates this. Among the 5344 marine animals that are known from the islands till date, only 297 (5.5%) are endemic. Among marine organisms in general, molluscs have the highest levels of endemism (14%).

Alternate views on the apparently poor species richness in the seas drew attention to the fact that there is greater diversity at the higher taxonomic categories, especially the phyla. Among the 33 animal phyla known to science, 32 occur in the sea and 15 are exclusive to the marine ecosystem. The greater diversity of animal phyla (most of which are represented by smaller number of species) may suggest that marine faunal diversity is a 'relic'; and that oceans have experienced greater episodes of mass extinctions in the prehistoric past. Also, the great variety of life forms in the life-history stages of marine animals suggests that ecological diversity of the oceans may be comparable to that on land or even higher. Therefore, systems of categorizing the life forms as distinct 'ecological species' and using them in ecological valuation may prove to be a better choice in the evaluation of marine biodiversity. Further, variations in size within taxa that are seen amongst marine organisms are not surpassed by terrestrial species.

Ecological communities, valuation and conservation: The presentations revealed that there has been a continuous decline in the range and abundance of species in different marine habitats. Examples of this trend include the decline in migratory birds to an extent of 70% along the southeast coast of India over a period of 30 years, decline in fishery yields especially of tuna and sharks, destruction of coral reefs and seaweed habitats, decrease in range of holothurians, lobsters and sea perches, etc.

One of the most critical factors responsible for the decline of species is the unregulated use of fishing gear that selectively eliminates a particular sex of target/non-target animals, leading to skewed sex ratios. This is especially pertinent to sharks, tunas and sea turtles. All loss of biodiversity at the levels of species, communities or habitats can be attributed to the lack of the following three aspects: awareness, institutional coordination and effective implementation of existing laws.

Although all the presentations emphasized the need to involve local communities, especially those who derive their

*A report on the National Symposium on Conservation and Valuation of Marine Biodiversity was held at Chennai during 26–29 December 2005, and organized by the Marine Biology Station of the Zoological Survey of India in collaboration with the National Biodiversity Authority and the Indian Society for Ecological Economics.

livelihoods through marine fishing in the conservation of marine ecosystems, it was also evident that alternatives need to be formulated to minimize the growing pressure on these ecosystems. Providing incentives for prudent extraction of biological resources, sea farming and sea ranching were some of the suggestions made by the speakers. The participants also expressed concern on the lack of infrastructure and incentives in India to pursue specialized research in marine biology. It was felt that India should revitalize its 200-year tradition of marine biodiversity inventorying. The symposium concluded with drafting of a road map for action based on the above conclusions.

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RESEARCH NEWS

Tailor-made stem cells

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Stem cells are the most primitive or unspecialized cells that have an extraordinary ability to grow rapidly and give rise to more specialized cells such as beating heart cells, skin cells displaying ciliary movements or pancreatic cells producing insulin. What is remarkable about them though, is that these rare categories of cells, which represent 'pure blank states' inside our body, have the capacity to divide and grow practically indefinitely over time. In nature, they reside in an early developing embryo or as discrete cells in adult organ systems, which undergo continuous replenishment. These systems include: the blood-forming system/bone marrow (hematopoietic system), pancreas, brain cells, muscle cells, skin and intestinal cells, etc. (Figure 1). Embryonic stem cells have the potential to become any cell or tissue of a human body like bone, skin or blood (referred to as 'pluripotency') and thus can replace any damaged tissue, a characteristic feature of these cells, described as 'plasticity'. In contrast, adult stem cells, which can be harvested from adults, are generally used to create specific cell types, like muscle tissue from muscle stem cells and so forth. They basically have the tendency to generate cell/tissue types from which they originate. However, their potential to demonstrate 'plasticity' has also been realized with recent experimentation and this allows researchers to use them for tissue repair in sites other than the organs from which they initially originate.

The embryonic stem cells (ESCs) are typically derived from a clump of cells known as 'inner cell mass' growing inside a very early developing embryo (3–5 days old, 100-celled, blastocyst stage). Studies in animal models and humans indicate that these cells could be potentially utilized with great versatility, to re-populate a damaged tissue, e.g. a heart after a stroke or damage, a spinal cord injury or brain damage, upon their successful isolation from the donor and engraftment into the host.

The human embryonic stem cells (hESCs) have the property of developing into any kind of cell/tissue in cultured conditions (*in vitro*) as well, which inspired researchers to employ them for cell-based therapies. However, the most challenging part is to grow these cells in a reliably directed fashion to become specific cell/tissue types. This is because these cells are often unstable, producing most unexpected results as they may divide prolifically to develop into cancerous growths. Therefore, they not only require strict and streamlined programming for their deliberate differentiation into specifically desired cell/tissue types, but also a well-coordinated signalling system comprising genetic factors and their microenvironment (called 'niche'). hESCs also cause immune rejection when transplanted into people. Cells used may be destroyed fast enough unless they are protected, which can perhaps be clinically accomplished by giving medication to suppress immune response in the host/patient undergoing treatment.

Despite the painstaking procedural protocols involved, potential of embryonic and adult stem cells has been realized in the field of biomedical research, and more precisely in regenerative or reparative medicine. Stem cells thus hold enormous promise for curing various human diseases like neurodegeneration, diabetes, cardiac disorders and infertility. These cells that basically represent 'blank' or 'quiescent' states in the body, also serve as elegant models for *in vitro* drug screening, understanding early embryonic development, cell–cell communication, differentiation, tissue remodelling and tissue engineering.

On the other hand, derivation of pure stem cells lines from adult and embryo, somatic cell nuclear transfer (SCNT) technology, cloning, lineage-specific differentiation and tissue regeneration have been some of the major advancements in this field, especially in the past one decade or so.

It was in February 2004, that a team of researchers at Seoul University, South Korea, led by Woo-Suk Hwang, reported their first exciting study[1] showing that cloning could be used to create human embryos that lived long enough in a laboratory culture plate to efficiently harvest stem cells from them. This major advance in stem-cell research immediately spurred a medical revolution, since it intended to help physicians produce cells and tissues 'tailored' and designed to perfectly match a patient's genetic identity[2], that could in turn be skillfully deployed to treat several human disorders.

Although reports and data are no more valid now, due to retraction, I am providing details of these so-called ground-breaking discoveries[1,2] here, to give a background of this study published in *Science* in 2004 and 2005. In their 2004 paper, the team reportedly collected 242 eggs from 16 volunteer women donors. The investigators then removed each egg's chromosomes. To replace this DNA (genetic material), they fused the egg with another cell (somatic in origin; somatic cells are cells other