2010 - International Year of Biodiversity

Science and non-science of biodiversity and conservation

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A Chinese proverb states that to name things is the beginning of the wisdom. And one such string of wisdom was started in 1968 when Raymond F. Dasmann coined the term Biological Diversity. Thomas Lovejoy advertised and pushed it further during the 1980s and in 1985, W Rosen `condensed' this wisdom to Bio-diversity. This year (2010), the world is celebrating this bit of wisdom called Bio-diversity.

But Celebrating What?

That we do not yet understand what biodiversity is? Hence are we to celebrate the unknown?

That we do not yet know how to assess biodiversity? Hence are we to celebrate this diffused entity?

That we are striving in vain to conserve it even as we are not clear about how to go about conserving it? Hence are we to celebrate the illusion that we are doing justice to the posterity?

Obviously all of it and much more!! Indeed. Because an honest introspection is enough to realize that biodiversity, as a subject of study and research, has hardly evolved as a body of knowledge accumulated through an unbiased and objective process of science. We are not sure if the spirit with which 2010 was declared as the year of biodiversity is indeed to draw attention to these very basic doubts, but we nevertheless wish to utilize this opportunity to press further on these stark questions.

Biodiversity As A Subject Of Study And Research

That the two terms Biodiversity and Conservation are almost always associated (and perceived to be so even when we do not use them together), suggests an implicit message that study of biodiversity (BD) is undertaken with an explicit and sacred purpose of conserving it. Thus, though not always implied, almost all of our investments in biodiversity studies are promoted with an expectation that the end results of the exploration shall be rewarding for conservation. While there is no denial of the importance of conservation, unfortunately, owing to this emphasis, the luxury of studying the subject of BD for the sake of the pure beauty that might lie in it, is hardly encouraged. The truth about the nature is unveiled by searching for the beauty of the processes underlying it (Chandrashekar, 1990). But such underlying beauty may not be easily captured if our approach is biased with the anthropocentric purpose of managing nature.

Indeed the emphasis and need to study biodiversity is rooted mostly in the guilty feeling that we and our actions are mostly responsible for its damage. The guilt is only enhanced due to the fact that we are victimizing our present generations for all the cumulative burden of growth and developmental activities of the entire human civilizations till now. Bearing the sin of this heavy guilt, the students of biodiversity are manipulated to believe that their imminent duty and responsibility to preserve the biodiversity is the reason why they should study and understand it. To this extent most of the research in BD is also driven typically by the purpose oriented questions that are shaped by the urgency and need for conserving BD. Irrespective of the history, however, while it may not be ethically right for the present generations to fob off the responsibility of preserving BD, it is also sad that they are missing the luxury of studying the subject of BD purely as a body of knowledge free of any application biases.

The guilt aspect is further aggravated by a series of unjustified claims made by the flag-holders of BD during the 80s and 90s. They effectively ▶▶

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employed this guilt factor to ensure that subject of BD is `heard' by the world in the highest decibels possible. For example, consider the claims on the rates at which forests and populations are dwindling, on the erosion of habitats and, on the rates of extinction of species (Wilson, 1992) - scary claims that are now widely ridiculed as they are hardly supported by data. In fact, given the rates of extinctions claimed and projected during early 80s, there should have been hundreds of species of plants that should have become extinct in the last three decades. But we can hardly produce an unquestionable list of one dozen species of plants extinct in the recent past. In fact if anything, more and more `extinct' species are being `rediscovered' raising questions about the objectivity of these claims and hence of the entire subject of BD per se.

Science Of Biodiversity

The science of BD has not yet taken its birth and hence it does not have a science of its own. It is still being conceived from the unplanned promiscuous marriage among several other subjects such as Ecology, Evolution, Systematics, Information Technology, Forestry etc.. Principles developed in these subjects, where BD was NOT a focal subject of study, are being borrowed freely for managing and conserving BD. For instance the spatial patterns in the global distribution of BD, such as latitudinal gradient, or richness of phyla in the oceanic compared to terrestrial system etc., emerged from studies in evolution and systematics. The consequence of forest fragmentation on BD emerged as a consequence of the ecological theory of Island Bio-Geography. Similarly using species as a basic unit of study in BD - perhaps a poor practice, is a legacy borrowed from systematics.

Consequently, several of the protocols to document, map, and conserve `biodiversity' are based on the experience of the parent subjects which have always assumed that the elementary units of study are taxonomic in nature while in fact the elementary units for BD could be different. In fact several of the strategies derived for conservation and management of BD are not a result of any direct experimentation rather they are lessons derived from the experience in other subjects but borrowed with the assumption that they can be directly applied for BD conservation . In other words, for most of its contents, BD still borrows heavily from its parental subjects- ecology, evolution, systematics and other such subjects but it needs to be weaned away immediately from its parental subjects such that it develops as an independent subject.

Mis-measuring biodiversity

Despite three decades of work and globalization of the subject of BD, we still do not have unequivocal tools and techniques to quantify BD (Ganeshaiah et al., 1997; Ganeshaiah and Uma Shaanker, 2000). Perhaps this difficulty may be resolved once we are able to arrive at a universally accepted definition of BD. But it also appears that defining and expressing BD is possible only when we develop a technique to measure and quantify it.

But both of them, defining and measuring BD, are tied down by historical legacy of using species, genera, or such Taxonomic Units (TUs) as basis for understanding diversity. In other words, the task of measuring BD still lingers around the process of counting and quantifying taxonomic units such as species and genera while in fact, biodiversity should go beyond counting these TUs. BD encompasses layers of biological elements both below and above the species; and in fact beyond species- such as biological interactions, functional relations, the genetic labyrinths etc., Unfortunately, owing to our difficulty to develop a technique that can integrate all these layers, we have compromised and resorted to measuring only the species richness. But what is needed is a new paradigm to assess BD- a paradigm that goes beyond mere bar codes and finger prints and liberates the science of BD from historical legacies. Perhaps we need to arrange for a strange and as yet unexplored promiscuous marriage among diverse subjects such as biotechnology, information technology, computation biology and BD, that could integrate all levels and elements of BD and offer an entirely novel tool for assessing biodiversity.

Non-science Of Conservation

Perhaps owing to the fact that there is no universalization of the elements and themes some of the concepts of BD and their application have become more parochial- a feature uncharacteristic of the objectivity of science. For

instance there is no universal consensus on conservation principles; no unequivocal method to identify Protected Areas; there is no consensus at all on defining and mapping Ecologically Sensitive Areas for conservation (Madhav Gadgil et al, personal communication; and also in (www.westerghatsindia.org); and there have been debates on the right list of RET species (Garendfors, 2001, Possingham et al., 2002 Aravind et al., 2005) - not unexpectedly as we have diverse views on what needs to be conserved.

In this context, we wish to illustrate a specific example. It was sometime during the mid 90s; we were discussing with a group of well established experts from a western country on a McArthur project that was developed on the hypothesis that adding value in situ to the non-timber forest products harvested by the forest dwellers would enhance their net income which in turn would also reduce the total harvest from the forests leading to an effective conservation. While the reality of the world we are living in amply demonstrated a simple rule of human nature, that our demands expand in proportion to the income at hand, this project was being setup under the assumption that, the native dwellers are different in their nature!! Obviously there were differences of opinion on this. Some of us argued that with increased income, the forest dwellers might empower themselves to harvest more- perhaps by procuring motored transport system, or employing outside labour for harvesting etc., and thus the project may in fact be a dangerous experiment; the others however believed that the demands and `desires' of the native dwellers are always `limited', `nonexpanding' and hence they would resort to reduce the levels of harvesting leading to forest conservation. There was no anthropological data to support either of the arguments but eventually those who opposed the proposal were cowed down on the grounds that their argument is not human!! The project went on to be executed just as perhaps hundreds of similar projects world over that believed that value addition is a good model to combine the livelihood with conservation !!!. But what is not realized in the whole process is that the extra-ordinary view, that the native dwellers are a better lot in conservation of their resources, could at times be an internally inconsistent argument. This is because the concept of conservation with value addition assumes that they have already been non-sustainable in their harvesting regimes and hence, the assumption that they are noble in their conservation attitude is perhaps questionable.

Our purpose of taking this example is not to argue that given the opportunities, there is no difference among the human communities in their conservation commitments; rather our purpose is to illustrate that our conservation efforts are more often motivated by emotions and untested assumptions than scientific principles critically tested and supported by datasets. In fact similar views have been raised by others (Suderland et al, 2004) who have also suggested that there is not enough science in conservation of BD (Uma Shaanker and Ganeshaiah, 2010).

Finally, with 2010 coming to an end, our intention here was two folded. One was that of a mere introspection during the year of Biodiversity because we believe that introspection is also an important process of celebration. Second was that of raising simple questions on our own profession because we believe that new questions shall take us to new avenues. Clearly we see that the subject of BD needs a lot of new avenues.■

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Kamaljit S. Bawa

At the outset, I should mention that I do agree with Dr. K.N. Ganeshaiah (KNG) and Dr. R. Uma Shaanker (RUS) that there is nothing much to celebrate in this International Year of Biodiversity (IYOB). It was the United Nations that designated 2010 as IYOB to celebrate life on Earth and to motivate the global community to safeguard this life. However 2010 is also the year when the Conference of Parties (COP), the governing body of the Convention of Biological Diversity (CBD), had an opportunity to review the biodiversity conservation targets it had set in 2002, targets that were endorsed by the World Summit on Sustainable Development, and incorporated by the United Nations General Assembly in the Millennium Development Goals (MDGs). The conclusion, not surprisingly, was that most of these targets related to curtailing biodiversity losses and promoting sustainable use of biodiversity have not been met. Clearly we do not have much to celebrate.

India's ability to meet new targets set by COP-10 in Nagoya, Japan in October, 2010 will very much depend upon the extent to which policy makers commit themselves to realizing these goals and to advancing biodiversity science. KNG and RUS however doubt the validity of biodiversity science, question the rate at which biodiversity is being lost, and are uncertain about some existing paradigms for conservation. I would like to address these issues by highlighting some priorities for us in biodiversity science, priorities that might allow us to meet the CBD targets, MDGs, and goals associated with India's Green Mission.

Science of Biodiversity

Biodiversity science is an applied science, but the fact that it is directed mostly towards problems associated with loss of biodiversity does not mean that the field does not offer the excitement and joy of doing pure science. In fact, in 2000, David Ehrenfeld, who is one of the cofounders of the modern discipline of conservation biology lamented that after more than a decade and a half since the emergence of conservation biology as a distinct area of study, very little work was being done in the field that actually helps in conservation: much of the research in the field has been basic rather than applied (Ehrenfeld, 2000). The tensions between basic - pursuing knowledge for knowledge sake - and applied - pursuing knowledge to solve societal problems - is not unique to biodiversity science. It is common to many other fields, and this tension will remain as long as we face pressing problems that we believe that our science can address.

Keeping in mind the biodiversity in India, work in applied areas such as assessment and monitoring of biodiversity in the face of global change, restoration, sustainable use of biodiversity, and development of effective conservation approaches cannot be addressed without basic advances in biodiversity science and allied disciplines in social sciences.

Consider, for example, the rates of change in biodiversity. KNG and RUS would make us believe that the rates of biodiversity loss predicted in 1980s and 1990s have not materialized, but I think the jury is out on these rates. Rates estimated by Ed Wilson (Wilson, 1992), whom KNG and RUS quote, are based on the theory of island biogeography, also mentioned by KNG and RUS, and developed by Ed Wilson and his associate Robert MacArthur (MacArthur and Wilson, 1967). The theory tells us that if a certain amount of natural habitat is lost, a certain

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proportion of species will become extinct. The theory does not tell us over what period these species will become extinct. The only certainty is that they will. Some, as for example, Rosenzweig (2003), believe that the rates of extinction will be much higher than those predicted by the theory of island biogeography. That fewer species have become extinct or the rates of loss are somewhat lower than widely assumed cannot be a cause for celebration. Rather it should prompt empirical research into rates of habitat and species loss.

Limited data for India suggest that the rates of habitat loss are high. The most recent estimate, backed by several independent analyses, indicate the annual rate of decline in native forests between 1.5% and 2.7% (Pyurvaud et al., 2010). The readers can judge for themselves if this is an acceptable rate of loss. As far as species losses are concerned, we hear about the tiger numbers every day. True, we need to update lists of Rare, Endangered and Threatened (RET) Species. This will require nurturing of population ecology, a sub-discipline of biodiversity science, vital for a range of biodiversity problems confronting us, but poorly developed in our country. Removal of species from RET lists based on population level studies will provide insights to resilience of natural systems in the face of continuous and intense change.

Measuring changes in biodiversity and developing management responses to such changes will require use of concepts and tools from several sub-disciplines of natural and social sciences. Fortunately, biodiversity science encompasses a range of sub-disciplines; the synthetic nature of the field is its strength, not weakness. The history of evolution, one discipline that unifies biology, tells us that major advances in evolutionary theory coincided with incorporation of ideas and approaches from such related disciplines as genetics, ecology, systematics, behavior and biogeography leading to the development of the synthetic theory of evolution, almost a hundred years after Darwin published his Origin of Species. Biodiversity science represents synthesis of many more disciplines to resolve complex problems. This calls for celebration, not despair.


Picture: Sandesh Kadur

Cataloguing life is another priority for our country (Bawa, 2010 a, b), notwithstanding the difficulties KNG and RUS cite in defining, assessing and measuring biodiversity. I agree that integration of molecular biology, information technology, and computation biology has the potential to provide us new tools and new measures for assessing biodiversity. However, until such tools are available we can make considerable progress with what we have.

Non-science or an inclusive science and changing conservation paradigms?

Conserving biodiversity in India, as elsewhere, remains a challenge. There are few regions in the world where the interactions between native biodiversity and local communities are as intense as in India. Thus the development of conservation approaches that involve local communities, and their knowledge systems is of vital importance to conservation science in India. KNG and RUS cite an example from the Western Ghats that sought to engage local communities in conservation action, and suggest that conservation efforts are often based on emotions rather than scientific principles. They have misunderstood the conceptual basis of the project that I directed with support from the World Wildlife Fund (not MacArthur Foundation, nor was it guided by "Western experts").

The proponents of the project were not naïve enough to believe that increase in local income of indigenous communities will keep the extraction levels of non-timber forest products low- - we were working in a protected area where there are mechanisms for monitoring harvest levels by the state and community organizations, perhaps by harvesters themselves too, and there are regulations by the state for conservation of biodiversity. Furthermore, ecological monitoring by the scientists as well as participatory monitoring by communities were integral elements of the program (see Bawa et al., 2007, Setty et al., 2008). More important, the incentive based approach is one of the tools in a larger multi-dimensional approach to community based conservation. There is growing literature in the field of development and conservation with strong underpinnings in natural and social sciences (see Lele et al., 2010 and references therein, also Tallis et al., 2008). Conceptual issues and methodological tools described in this literature are very relevant to biodiversity conservation in India.

Community based conservation is complex, and science, certainly not natural science, has all the

answers. We need a more inclusive science or approach that integrates various knowledge systems, and that develops new paradigms for generating usable knowledge. Clearly those that assign primacy to applied over basic knowledge will have a more important role to play in this endeavor.

Conclusion

In conclusion, the science of biodiversity is alive and well, and its best days are ahead of us. Debates about basic and applied needs or the synthetic nature of biodiversity science should not distract us from the important role this science can play in addressing our pressing challenges, some of which have been outlined here. The synthetic nature of biodiversity science makes it a stronger, not a weaker science, and its integration with social sciences offers new and exciting intellectual challenges, and possibilities of unprecedented progress in making conceptual and practical advances, and in meeting societal goals.

One of the most pleasant experiences in my professional career has been my association with KNG and RUS. We have collaborated in the field of biodiversity science for more than two and a half decades. Although we have worked together and continue to do so, we also have often disagreed on priorities as well as critical issues in biodiversity science. Such disagreements have helped us reflect on core issues, and certainly for me to learn more about our discipline. These two brief articles represent another occasion for us to disagree, and hopefully for reflection and introspection. ■

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