

TAXONOMY AND ITS RELEVANCE

T C Narendran

Taxonomy is the science of classifying organisms. At no time there has been a greater need for taxonomists than now when the crisis facing biodiversity is escalating. Decision 11/8 of the second meeting of the Conference of Parties to the Convention on Biological Diversity (CBD) identified the lack of sufficient taxonomists as a significant impediment for implementing the decisions of the convention at national as well as international levels. Over the past half a billion years the world lost perhaps one species per million species each year including everything from mammals to plants and today the annual rate of extinction is estimated to be 1000 to 10000 times faster (Wilson,2003). This is really a matter of grave concern for all those who think that our biodiversity is precious and should be protected. It is also known now that centinelan extinctions take place on many regions of the world today and not merely a thing of the past which happened in that cloud forest of the Western Ecuador in 1978-1980. Besides we are quite ignorant of the real magnitude of the world's biodiversity. The audit of biodiversity today is far short of a reality. Though opinions on the biodiversity of the world differ from 5-100 million(Wilson,2003) species, a 'best guess' or mid way on the road, places it at 14 million living species today (Cherian,2004). Among these fewer than 2 million species of organisms are scientifically identified and named. At the current pace of taxonomic research, it may

T C Narendran, Systematic Entomology Laboratory, Department of Zoology,
University of Calicut, Kerala-673635, India.

require 5000 taxonomists to complete merely the taxonomic listing of 5 million species in 25-30 years if one taxonomist can deal with 1000 species.

Our efforts to conserve our biodiversity will be much more easier if we know the basic units that are species and their relationships. Taxonomy provides discovery and identification of these basic units and their relationships (Narendran, 2006,2008).

Taxonomy is the basis for all meaningful studies on biodiversity, pest management, medicine, bioprospecting, fisheries, quarantine, defense etc. Before initiating any kind of studies, it is absolutely essential to know the correct name of the organism on which the studies are initiated. This is important because the correct scientific name of the organism is a functional label, using which various pieces of information concerning that organism, including all the past work done on it, can be retrieved and stored ensuing ease of reference and stored ensuring easy reference (Narendran 2000). Taxonomy plays an important role in pest management programmes. When natural enemies are being sought or transferred from one region to another in biological control projects, the correct identification of both the pest and the natural enemy species is of great importance (Narendran2003). History and experience have already shown that absence of taxonomic expertise have resulted in the failure of several pest management programmes resulting in tremendous loss of agricultural products as well as huge amount of money. There are several instances in the history of pest management to show that failures resulted because taxonomists were not consulted in the identification of the pest or its natural enemies before starting the pest management programmes especially biological control programmes against insect pests. Without the help of taxonomists biological control workers may commit several mistakes (Schauff & LaSalle, 1998; Narendran 2001,2003,2006). They may inadvertently import a species of natural enemy that may be already present in the country of introduction. They may spend several days studying the biology of a species that may have already been done under an unpublished or published synonym of the species. The biological control workers may spend a lot of money and effort in shipping, curation, breeding etc of wrong species of natural enemies such as hyperparasites or natural enemies that do not attack target host species etc. Preservation of taxonomic collections has very great importance since they may prove to be of immense value in biological control projects.

Quarantine agencies often seek help of taxonomists to determine whether an imported plant or animal is harmful or not and based on the advise of taxonomists, prevent the entry of harmful organisms. In these days of germ warfare, it is necessary to seek help of taxonomists for the identification of organisms introduced to a country by enemies. Besides these, taxonomist's help can be made use of in many other fields such as medicine, fisheries, academic studies and many other useful fields. In spite of all these important aspects, taxonomy is still not adequately developed in the underdeveloped and developing countries like India. Taxonomy involves hard field oriented work. It needs careful observation, analytical mind and a little above average of intelligence to analyse and in weighting of a taxon to determine it at species or infraspecific level. In some cases several days or even months may be necessary to arrive at a proper conclusion in determining the identity of a taxon. In several other instances wide ranging discussions and consultations with experts working on the group or related fields are necessary for taking a decision in the identification process. Yet there are many workers of other fields of specialization who consider taxonomy is an out dated subject and not worthy of doing. These critics have myopic vision that has lost sight of the whole wonderful world of unexplored fauna and flora which await discovery by taxonomists. In order to understand taxonomy it is absolutely essential to have an impartial non-biased mind with a curiosity to find the undiscovered fauna and flora and with strong will to undertake hard work. It is ironic to note that often the very same people who criticize taxonomy approaches taxonomists for prompt and urgent identification of the specimens they want to work with.

There are various subdivisions in Taxonomy and among these the most commonly used one is the Classical Taxonomy which is the conventional taxonomy based mainly on external morphology which is often supported and supplemented by ethological and ecological data. Some taxonomists base their classification on greater number of characters from many sets of data in order to produce an entirely phenetic classification and this is known as Numerical Taxonomy. It is based on phenetic similarities and maximum number of characters (morphological, behavioral, karyological, etc) and each character is given equal weight. Molecular taxonomy is relatively a recent research branch of taxonomy, invaded often by prejudiced workers of molecular biology. It includes DNA barcoding, analyses of isosymes, molecular cytogenetics and a number of other related techniques. Recently many biologists

have turned their interests to DNA bar-coding technique for taxonomic identification. DNA bar coding is a taxonomic method which uses a short genetic marker in the mitochondrial DNA (mtDNA) of an organism so as to identify that organism as belonging to a particular species. Though molecular taxonomy has its usefulness, it has several demerits too. For identifying two unknown organisms, species or subspecies it would be difficult to use this method. The main problem is the distribution of variability within and between species. Long periods of independence allow variability within groups pose a serious stumbling block in molecular taxonomy (Narendran, 2006). DNA bar coding does not provide reliable information above species level. It is also now known that recently diverged species might not be distinguishable on the basis of DNA bar coding (CO1 sequences). One of the main differences between molecular taxonomy and classical taxonomy is that the former uses a technique such as DNA bar coding which is nothing but an over simplification of the science of taxonomy. Classical taxonomy on the other hand has a holistic approach, treating each organism as a whole and it is not described in vacuum but in comparison with other organisms, objects and substances (Grimaldi and Engel, 2007). A living organism expresses its identity in the way it organizes its various parts and how it relates to the environment. In molecular technique (DNA bar coding) an organism is nothing but a DNA sequence. In order to understand a living organism, it is absolutely essential to have a holistic approach establishing a relationship with it and such relationships are possible only by looking or sensing an organism as a whole and not by bar codes (Katz,2005). This is not to state that molecular taxonomy is not useful and classical taxonomy is better. Genomic bar coding is definitely useful as a supplementary tool to classical taxonomy (especially in differentiating sibling species) and not to replace it completely. The problem, as Grimaldi and Engel (2007) point out is that high tech descriptions (such as molecular taxonomy) are seen by some as more scientific and this view is not acceptable to many scientists who believe that all branches of science is important especially when classical taxonomy is still making startling discoveries(for instance discovery of a new insect order recently viz. Matophasmatoidea) even now. As Ogura(1964) pointed out classical taxonomy will continue to reign supreme many more years to come.

The article 7(a) of the convention of of Biological Diversity states that the countries which signed the biodiversity document, have to undertake an inventory of biological diversity in order to provide fun-

damental information on the distribution and abundance of biodiversity. Such data are necessary for the long-term sustainable management, use and conservation of biodiverse area. The fourth meeting on CBD held at Darwin (Australia) in 1998 stated that the various countries which participated in the meeting, affirmed the existence of a taxonomic impediment for the proper management and conservation of world's biodiversity. Removal of these impediments is very essential not only for discovering and understanding the world's biodiversity but also for global efforts to conserve our biodiversity. The main impediments include shortage of man power in taxonomic work, lack of adequate funding for taxonomic research, lack of training in taxonomy from higher secondary school level, lack of library facilities for taxonomic studies and lack of adequate taxonomic centers not only for identification but also for giving adequate training in taxonomy besides many other impediments. There are many requirements for removing these taxonomic impediments and some of the major ones are: 1) Taxonomy (all aspects from Classical to molecular) should be included as a compulsory subject in the curriculum and syllabi from higher secondary school level to postgraduate levels.; 2) enough funds should be given to taxonomists or to non-governmental and governmental organizations and institutes for meeting the cost of publishing papers and monographs in taxonomy. ;3) creating enough employment opportunities for taxonomists etc are some of the major requirements to be met with by the respective countries which signed the biodiversity document. It is high time we set our priorities straight for the development of all aspects of taxonomy without being prejudiced or biased to any any aspect of taxonomy. More and more students should take up taxonomy as their carrier. "Taxonomy... is no less attractive, challengingly difficult, statisfying and productive than most sophisticated, spectacularly dramatic biological experiments currently in fashion- here is an unknown and a new world, literally at our door step, for discovery, exploration and conquest " (Mani, 1989).

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