

## Taxonomy – the science and art of species

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Carolus Linnaeus called himself the ‘God’s Registrar’. If Linnaeus is God’s Registrar, Darwin is His Rector!

This is how I started when I was preparing a paper for presentation at the ‘Botanists of the Twenty First Century’ Conference organized by UNESCO in Paris in September 2014. The reason for the above is the mere appreciation of these two great scientists for their contribution to taxonomy.

For several years now, I am confronted with the questions – ‘Why is taxonomy a dying subject?’, ‘Why are taxonomists more endangered than species themselves?’. Several answers do come by, ranging from lack of interest by the young generation to learn and practice taxonomy to how boring teaching taxonomy has been to lack of employment opportunities.

The divide on debates on the role and importance of basic and applied sciences has come here to stay. While applied sciences and emerging areas of biology such as nanotechnology, bioinformatics, conservation psychology, structural engineering in ecology are all fast evolving, innovation in teaching and practicing basic sciences has been relatively slow and largely unresponsive.

Every scientist working in the field of natural sciences – basic and applied – recognizes that in the absence of identifying and naming species, there is no way forward and investments in applied biology will be questioned. Incorrect and delayed identification will have a toll both on the speed and cost of future research not just in biology but in a range of subjects.

Recently, I was reading a review article by Padiál *et al.* titled, ‘the integrative future of taxonomy’, where they conclude that ‘taxonomy needs to be pluralistic to improve species discovery and description, and to develop novel protocols to produce the much-needed inventory of life in a reasonable time’.

Since the time of publication of *Linnaeus Species Plantarum* in 1753, taxonomists have been describing and naming thousands of species every year, currently around 15,000–20,000 among animals only. Such progress is possible because of use and integration of new tools and techniques in taxonomic research such as virtual access to museum

collections, high-throughput DNA sequencing, computer tomography, geographical information systems, and multiple functions of the internet. Also, taxonomic information is increasingly digitized and made available through several global initiatives, such as Species2000, The Encyclopedia of Life (EOL), The Plant List, the International Plant Name Index (IPNI), The Global Biodiversity Information Facility (GBIF), or ZooBank. The future has been envisioned to be an interactive ‘cybertaxonomy’ with dynamic online description and publication of new species, and where updated taxonomic information would be accessible for almost everybody from everywhere. However, care should be taken to ensure such descriptions do not contribute to confusion.

Recent discourses under the discipline, evolutionary biology, now agree that species are separately evolving lineages of populations or meta-populations, with disagreements remaining about where along the divergence continuum separate lineages should be recognized as distinct species. The direct consequence of this trend is that after more than 250 years of predominance of comparative morphology in species documentation and discovery, new methods and data – mainly molecular – are conquering a great piece of the realm of taxonomy.

This is now calling for a new paradigm in the future of taxonomy and related research that need to focus on being ‘integrative’. During the past couple of decades, there has been significant reduction of taxonomic impediments: conflicts about species concepts are being replaced by a consensus on the view of species as lineages.

However, the speed with which we are able to identify and catalogue new species is rather slow. According to estimates, we need, at the current speed of species descriptions, another 400 years to complete the inventory of eukaryotes alone. But the challenge here is the speed with which species are disappearing.

### Research in systematics and taxonomy

The terms systematics and taxonomy are many times interchangeably used by

many, including by biologists. While systematics/phylogenetics can be considered as the ‘hard’ science, taxonomy can be considered as the art of interpreting that science.

During the UNESCO Conference, the participants articulated that there is a need to make teaching and research in both systematic and taxonomy more up-to-date, use wide array of available modern techniques and create a sense of inquisitiveness in the minds of our youngsters. To formally teach taxonomy as a subject aimed to identify species at tertiary level of education has to be replaced with teaching taxonomy at secondary and if possible primary levels of education need to be experimented with.

The Declaration from the UNESCO Conference calls for diversification of interests and expertise needed for practicing taxonomy and systematics in today’s world.

### Science and art

Let us now turn to the question – if we consider systematic/phylogenetics as the ‘hard’ science and taxonomy as the art of interpreting that science, then how do we perpetuate this Art form? Perpetuating the art form needs a shift in our approach to teach and practice taxonomy. But what could this new approach be?

Making taxonomy a combined study and science that brings on board non-experts and non-biologists to support identification of species as a hobby, passion and love for nature with support coming from trained scientists. In other words, we need to re-invent taxonomy as a ‘citizen science’.

I am sure this argument might not go well with traditional taxonomists who prefer long-term, absolute training in identification. While there is merit in this, both time and availability of expertise is working against us to secure the future of species.

Work undertaken by entobotanists, anthropologists, social scientists working with communities, have demonstrated that local communities have long perfected the ‘art’ of identification and classification of species and assemblages.

This descriptor has long been accepted and enormous sets of activities continue to happen to train and orient these communities on formal skills of systematic using programmes such as ‘bare-foot taxonomists training’, ‘parataxonomy training’ and the like.

But we need to pause and ask the question on how we can undertake a bit of this ‘art’ and skill of local communities to benefit a larger number of non-experts, children and youth to become our ‘interpreters’.

Analysis prepared by the Royal Society for the Protection of Birds (RSPB) in the UK is a perfect example of how a wide range and number of ornithologists or ‘birders’ are trained and oriented where the members and large number of volunteers are more ‘interpreters’ than systematic botanists and zoologists.

### **Taxonomy and conservation psychology**

Psychologist Kurt Lewin (1890–1947) and his student Roger Barker (1903–1990) work on environmental psychology come handy for re-invigorating our integrative approach to systematics and taxonomy. They were one of the first few psychologists who identified the need for studying people in the context of the environment.

Conservation psychology is a relatively new field of research with about a decade of formal experience in teaching and research. Moore and Cosco in 1990s

studied the effect of parks and play areas as behaviour settings.

The ability of people to undertake simple and easy tasks that result in recognizing and appreciating something around them is a big magnet for future of systematic and taxonomy. In India, there has been almost no attention and focus provided on this emerging science – conservation psychology – unlike in countries like the United States where several universities offer this subject as an inter and cross-disciplinary course.

Recent studies in the Nordic countries have shown that teaching a basic course in conservation psychology as a part of foundation course in biological sciences coupled with focus on other advanced components of biosystematics have begun to yield results in encouraging non-scientists to support conservation action.

### **The four-point agenda for taxonomy in India**

First, we need to expand the base of those interested in taxonomy as a hobby and passion rather than merely focus on academic teaching and research in our schools, colleges and universities.

Second, there is a need to develop specific course content focusing on ‘integrative taxonomy’ that needs to be taught first before training in systematics.

Third, we need to recognize the need to make the science and identification and cataloguing more fun for our students and children.

Fourth, current impediments in the name of restrictions regarding implementing the Biological Diversity Act have already taken a toll on taxonomic research. The Act was not intended to restrict research but to promote use of country’s biological diversity and resources. Urgent steps are needed to remove the impediments in the interest of science in India.

### **Conclusions**

The science and art of taxonomy need to be appreciated by both experts and non-experts. Once understanding and studying nature and its diversity becomes a part of ‘citizen’ movement, the future of biology is secure and people practicing the science and art forms will feel appreciated and recognized.

What is urgently needed is a refresher for all our teachers and scientists on the basics of conservation psychology so that we understand what the society perceives and absorbs rather than merely turning on data and information out in publications that has limited takers to practice the science. Let us not ignore the importance of work of God’s Registrar and Rector!

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