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THE BIOLOGICAL DIVERSITY OF THYSANOPTERA IN INDIA — IS THERE A WAY FORWARD?

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This discussion is targeted at the problems of taxonomy in India, but the comments could apply equally well to the situation of thrips taxonomy in many countries. At first sight, the available data for India suggest that the Thysanoptera fauna is reasonably well known. Two recent checklists are available for the described members of this Order of insects (Tyagi and Kumar 2016; Rachana and Varatharajan 2017), and together these lists indicate that about 750 species of thrips in 260 genera are recorded from India. Indeed, as early as 1928 that great entomologist, T. V. Ramakrishna Ayyar, produced a 100-page summary of what was then known of the thrips of India. That publication indicated that 126 species of Thysanoptera were then known from India, having increased from a mere 14 species known in 1915 (Ramakrishna, 1928). More recently, two further workers have made enormous contributions to our knowledge of this fauna: T. N. Ananthakrishnan emphasised the faunal richness by describing over 300 new species in about 70 new genus-group names, and J. S. Bhatti has added greatly to our knowledge of the taxonomy of these insects particularly through highly original and detailed accounts of their external morphology. Moreover, in recent years innovative contributions by K. Tyagi and her colleagues have emphasised the significance of DNA studies in thrips taxonomy (Tyagi et al., 2020). But how does all this taxonomic data contribute to our knowledge of *biological diversity*? The answer to that question depends on how one interprets those two words.

To many people, including many taxonomists, biological diversity is measured in terms of taxon richness. Furthermore, taxonomy is commonly regarded as the process of naming and describing the entities that we call species or genera. But the published descriptions of many thrips species from India often involve little more than sufficient comments on colour and shape to validate a new name under the requirements of the Code of Zoological Nomenclature. This activity contributes to our knowledge of structural diversity within a particular genus or family, but it tells us little about the biological significance of that diversity. I suggest that the most important attribute of a species is how it perpetuates itself – that is, how it lives and breeds. From this point of view, the most important aspects of biological diversity are the differences in biology between species, yet for most described thrips species we remain ignorant of the host plant and habitat that are essential to their continued existence. Each species has presumably evolved from some population that developed slight differences in behaviour, diet or ecological preferences. It is these biological differences that lead to genetic isolation between populations, and subsequently facilitate the evolution of those structural differences that taxonomists recognise.

Limiting the objectives of taxonomy to a series of structural descriptions is traditional, and it reflects the way that the subject has developed, based on the recognition of differences. Curiously, some modern taxonomy also emphasises differences in molecular structure rather than differences in biology. But this commonly accepted dichotomy between 'taxonomists' and 'biologists' is destructive of our efforts to understand and protect biological diversity and ecological systems. When I first joined the staff of a museum, I was told that taxonomists work alone and publish only single authored papers. This contrasted with my previous experience as a research biologist in tropical agriculture, because that had involved collaboration with plant breeders, agronomists and physiologists. The taxonomist's approach is derived from the concept of the 'authorities' who provide a name for a species, and as a result this is often competitive rather than collaborative. Students quickly acquire the idea that there is some sort of prestige in having one's own name published in association with the name of a taxon. But this approach is focussed on self-satisfaction rather than on contributing to general knowledge within the scientific community, or on the well-being of society.

My major interest has been in the many species of thrips that exhibit remarkable differences in body structure – sometimes in association with body size, including extensive allometry, but often between sexes and winged and wingless morphs. Taxonomists commonly regarded as different species the different forms that can be found. This changed with more intensive field work involving larger samples that established the reality of intra-population structural variation. In discovering and describing such highly polymorphic species, I needed to consider why such structural variation is maintained within populations and how these species spend their lives. This necessitated collaboration with other biologists to understand what levels of competition, intra- and inter-specific, were driving the structural differences. The resultant associations with botanists, ecologists, geneticists, and even medical entomologists, as well as with other thrips taxonomists, has been highly productive - most noticeably in the crude measure of how many taxa were described. But in increasing our knowledge of thrips taxon diversity and structural variation, it has also increased our understanding of the biological diversity that can be found among Thysanoptera. These studies have commonly targeted particular groups of plants, with a view to examining the diversity and radiation of their associated thrips. This approach has thus been based on the biology of species,leading to an understanding of their systematic and taxonomic position. Curiously, such an approach reverses the one that is often stressed- that we must first describe species in order to study their biology. That more traditional approach considers taxonomists as the providers of the taxon building blocks and framework that can then be used by ecologists and evolutionary biologists.

Ideas in all sciences change with time, in response to new data and new methods of analysis. Thus, conclusions in taxonomy and systematics also change, stemming from newly acquired field observations,specimens and molecular data. The taxonomy of all groups of organisms is thus never static — it is constantly evolving in association with new interpretations, new techniques and new concepts. As a result, published information in taxonomy needs regular re-interpretation, to reflect revised taxonomic and evolutionary concepts. The subject is therefore rooted not in the available published descriptions, but in the specimens that were studied by each original author. Preserving those original specimens is an onerous task and has clear financial implications for depositories. But these specimens are essential for the future expansion of knowledge generated by subsequent workers. Such workers need information about, and access to, these original specimens. Some depository institutes produce web-based lists of the type-material that is preserved in their collections, thus facilitating the integration of the specimens into new studies by other taxonomists. However, in India such information is not available about the major collections of Thysanoptera. The original descriptions of the 300new species of thrips described by Ananthakrishnan often did not include character states that are required by more recent taxonomists. But it remains impossible to obtain any information about the whereabouts or accessibility of his type specimens. The identity and relationships of many of these species remains unknown. Theyaremerely names on paper,with no prospect of considering their significance to Indian biological diversity. Thus, work on the biological diversity of these insects in India is effectively frozen in time. Such problems may be related to the taxonomic disease of ‘mihi-itis’— the competitive and solitary way in which taxonomy has so often been practised. Unfortunately, many taxonomists are content with this situation, practising their relatively inexpensive discipline in private,whilst universities regard taxonomy as merely descriptive and of limited intellectual interest. This can lead to separate departments of molecular taxonomy that are independent of the collections, with the latter becoming the responsibility of non-specialist collections managers emphasising the protection rather than the use of archival material.

For a biologist, the Indian thrips fauna provides many fascinating problems that involve taxonomy. The remarkable differences in body form of males in many fungus-feeding species is probably related to male–male competition, but there have been remarkably few behavioural studies to confirm this, or to determine if structural differences are nutritionally determined or represent genetically distinct morphs. Similarly, the extraordinary crab-clawed species of *Veerabahuthrips* seem to be associated with bamboo species, but there is no explanation of their bizarre structure and relevance to how these thrips live and behave. Molecularly distinct sibling species are increasingly reported amongst common pestiferous thrips, but the sophisticated molecular work is not associated with critical studies on host specificity or virus vectoring ability by the different siblings, nor are there serious breeding studies to establish the effect of host plants and climate on the commonly observed structural and colour differences. Investigations such as this require collaboration between different groups of biologists. One recent example is the remarkable demonstration by K. Tyagi and her colleagues that gut bacteria may be important in gall induction by *Gynaikothrips* on *Ficus* trees (Tyagi et al., 2022). Such a collaborative approach to studying biological diversity requires considerable changes in thought processes, in defining research objectives, and in how funding is approached. Changes of this kind involve how taxonomists think of themselves and of the objectives of their work. Funding agencies and administrators will need to be more imaginative in how they deploy their available scientific and financial resources across disciplines, toward an objective of achieving a greater understanding of biological diversity.

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