# PLANT TAXONOMY IN MALAYSIA: AN APPRAISAL

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#### ABSTRACT

Malaysia has initiated, produced and launched a National Policy on Biological Diversity in 1998 which contains policy statement, principles, objectives, rationales, strategies and above all action plans of programmes. The policy places great importance on taxonomy in realising the true dimension of biodiversity in the country and that taxonomy is a cornerstone of biodiversity has long been accepted and understood. Yet, many taxonomic institutions such as National Natural History Museum and National Herbarium are not within sight. Taxonomy is not prioritised within the R & D mechanism, capacity building is not undertaken with an accepted vigour, systematic research centres are not established, school and university curricula have not addressed taxonomic curricula, proper training of taxonomists and parataxonomists are not planned, and data management is not adequately placed either. Ironically the rate of ecosystem and habitat degradation and loss, species loss and genetic erosion are occurring at a rate unsurpassed in the past. Is there any crisis in Malaysian taxonomy and plant taxonomy in particular? The taxonomic community is small and aged. The reference collections are still small, the scientific productivity in term of publication of papers to report new species, new records, taxonomic revisions, phylogenetic relationships, variations, species loss and conservation efforts are still inadequate. The floristic treatments for the Tree Flora of Sabah and Sarawak and the Flora of Peninsular Malaysia are going-on. An attempt is made here to relate the richness of biodiversity to taxonomy so that the latter's impediments could be properly addressed. There must be coordinated efforts to overcome the real taxonomic impediments in Malaysia.

Key words: plant taxonomy, biodiversity, flora, Malaysia

# **INTRODUCTION**

When the Portuguese (1511-1642) and Dutch (1642-1786) colonized Malaya (or Malay Peninsula) for more than 275 decades they didn't leave much scientific legacies to the colony as the latter did in Indonesia and elsewhere. However, it was only when the British took over Malaya (1786-1957) until the Independence, they left many scientific legacies which we are now proud of as a scientific community. They established a few Botanic Gardens that include those in Singapore and Pulau Pinang and other smaller ones such as those in Taiping and Kuala Lumpur for the introduction of agricultural crops and other botanical commodities. They also established the zoological museum such as those in Singapore, Kuala Lumpur and Taiping for the repository of zoological reference specimens. The most important legacy was the establishment of the University of Malaya in Singapore of which a branch campus was established in Kuala Lumpur

which in 1958 became the University of Malaya. This *alma mater* of the author had produced numerous agriculture, botany, zoology and ecology graduates who over the next 50 years had developed our agricultural and forestry sectors as well as became teachers in schools and later universities.

The interests of the colonial scientists and foresters in agriculture, forestry and education paved the most significant contributions to our scientific knowledge of our flora and fauna as these scientists and naturalists were much fascinated by our rich and unique tropical flora, fauna and biodiversity. This had resulted in many writings on nature studies, plantation science, environment in various colonial journals and books and which culminated in the compilation of The Flora of the Malay Peninsula (King, 1896, Ridley, 1922-25). Though the Flora is now somewhat out-dated the present students of botany and forestry still find this monumental reference very useful and informative in botanical research. This Flora accounted for more than 6,600 species of seed plants known then and provided the seeds for much of the taxonomic works until the present.

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The establishment of the University of Malaya witnessed the teaching of botany, zoology, agriculture and forestry to the Malayan students then and the establishment of herbaria at Sandakan, Kuching, Kepong and Kuala Lumpur are testimony to the colonial legacies too for these institutions stored our rich biological heritage until to-day. In fact today the herbaria at Kepong, Sandakan and Kuching remained as the most significant reference collections for Malaysia lodging more than 400,000 specimens including many type specimens among them (Latiff 1991). The sectors of agriculture and forestry were not marginalized as they were interested in our tropical crops and the precious hard and heavy timbers especially the dipterocarps of our forests. Hence, they established the departments of forestry in Sandakan (Sabah), Kuching (Sarawak) and many states in Malaya (Shaharuddin & Latiff, 2014; Shaharuddin et al., 2014).

After the University of Malaya a few later universities were established in the 1970s with botanical and zoological curricula; a few smaller teaching herbaria and museums were also set-up for educational purposes such as those at the Universiti Kebangsaan Malaysia, Universiti Putra Malaysia, Universiti Malaysia Sabah, Universiti Malaysia Sarawak. At the national level many conferences were organized to discuss plant and animal sciences, taxonomy and the state of the environment. It was only in 1992 when the Rio Summit was called, much attention was given to our biodiversity hence scholars and researchers paid more attention to our Flora, Fauna and biodiversity. The launching of the National Policy on Biodiversity 1998 was the climax for our interest in taxonomy and biodiversity. The policy was later revised and launched in 2016 though not much has been achieved in term of taxonomy, strengthening of universities and research institutes and also taxonomic research capacity. However, in the 1990s until today our focus was moved from biodiversity to biotechnology as the engine for our socioeconomic growth, hence our leaders and policy makers had marginalized biodiversity taking with it our passion for taxonomy in Malaysia.

# HISTORY OF PLANT TAXONOMY IN MALAYSIA

#### **Taxonomy before Independence**

Plant collections in Malaysia dated during both the Dutch and British colonial era, as in those years there were no clear political boundaries. The colonial collectors roamed about in Borneo, Malay Peninsula, Thailand, Sumatera, Java and other islands without much restrictions as today. However, most of the collections were brought back to their countries and deposited in established herbaria for identification. Today we have observed many collections at the herbaria at Kew and British Museum in England and Leiden in the Netherlands, among others. The British collectors also deposited the specimens at both the herbaria at Calcutta and Singapore, not to mention those that were sunk in their ships by their trade enemies on the way to England. The American and Filipino collectors were active in North Borneo (Sabah) and Sarawak and deposited their specimens in the herbaria at Sandakan, Manila and Chicago.

In Peninsular Malaysia, King (1896) prepared the materials for the Flora of the Malay Peninsula which were adopted by Ridley (1922-1925) who wrote the Flora. We were indeed grateful for having the Flora as our neighbours such as Thailand, Sumatera, Borneo don't have the similar Flora for reference. Corner and Holttum were then at Singapore Botanic Gardens and the Professor of Botany at the University of Malaya at Singapore, respectively, and he contributed significantly to our knowledge on ferns, orchids and gingers (Corner, 1962; Holttum 1950, 1953, 1954). Keng (1978) who was the Professor of Botany at the University of Singapore provided the over-arching taxonomy of the orders and families of Malayan seed plants. Although this book was also out-dated, it was reprinted and translated several times, it still remains relevant for the students at the higher institutions in our region. Other taxonomists had also contributed greatly to the development of taxonomy in Malaya and Malaysia (e.g. Foxworthy, 1932; Gilliland, 1971; Sinclair, 1955, 1958; Wood & Meijer, 1964).

#### Taxonomy at the University of Malaya

When the University of Malaya was established in Kuala Lumpur in 1958, Gilliland was appointed a professor there and she prepared the account for the grasses, including the bamboos (Gilliland 1971). The taxonomy and biology of bamboos of Malaysia were later revised (Wong 1995a, 1995b). In the 1960s the late Dr. B. C. Stone became the lecturer in botany and he studied the taxonomy of three important families, Pandanaceae, Rutaceae and Myrsinaceae among other plant families and genera. He published more than 250 taxonomic papers on Malaysian plants (Latiff, 1994). A few years ago, a new genus of branching pandans was named after him, Benstonea. The late Prof. Dato' Dr. Ahmad Nawawi Ayub studied the microscopic fungi, the Hypomycetes and he also published many taxonomic papers to report on numerous new taxa of microscopic fungi and in addition to many new species of fungi named in honour of him and one new genus, Nawawia was also described by his peer. Another outstanding taxonomist is Dr. E. Soepadmo, an Indonesian who was trained by the late Dr. E. J. H. Corner at Cambridge University and he studied the taxonomy of Fagaceae. At the University of Malaya he later revised other families such as Bombacaceae, Urticaceae, amongst other plant taxa. Among the three of them, they had contributed tremendously to our taxonomic knowledge of Malaysian taxonomy. Many of the present taxonomists such as Dr. Khutubutheen Jalaluddin, Dr. A. L. Lim, Dr. George Ong, Dr. Halijah Ibrahim, Dr. K. M. Wong, Dr. Paul Chai and the author himself were students of these wonderful teachers of taxonomy in the 1970s. Dr. Khutubutheen Jalaluddin continued to study fungi, Dr. A. L. Lim studied the Araliaceae and a new genus Limahalnia (Loganiaceae) is named after her, Dr. George Ong studied ethnobotany, Dr. K. M. Wong studied bamboos, Rubiaceae, Loganiaceae and many other taxa, Dr. Paul Chai moved from the mangroves to Sapotaceae among others.

The university also established Rima Ilmu (a botanic garden) to facilitate the study of botany and taxonomy and until today it still remains one of the botanical assets in the country. Emer. Prof. Dr. Haji Mohamad Abdul Majid studied and researched the taxonomy of ferns and mosses and left a large collection of bryophyte collections at the university before he moved to the University of Brunei. Prof. Halijah Ibrahim did some taxonomic studies on the Zingiberaceae and today we have Dr. K. T. Yong a muscologist who studied mosses and Dr. S. Sugumaran who studied Loganiaceae, amongst others.

# Tree Flora of Malaya and Forestry Research Institute Malaysia

The most significant milestone in the history of Malaysian taxonomy was the engagement of the late Dr. T. C. Whitmore from the Tropical Forest Institute, Oxford University, based at the Forest Research Institute, to do the Tree Flora of Malaya in 1965. He collected many plants from all over the country and wrote many taxonomic accounts of Peninsular Malaysian families and edited two volumes (Whitmore 1972, 1973). Mr. K. M. Kochummen whom we called "The Walking Forest Dictionary" contributed the taxonomy of many plant families for the Tree Flora including Burseraceae, Anacardiaceae, Lauraceae, Rhizophoraceae, Myrtaceae and others. In the taxonomic treatment of Eugenia (now Syzygium) he left 61 taxa unnamed, probably due to the apomictic nature of the plants.

Later, with the departure of Whitmore back to England, Dr. F. S. P. Ng took over the editorship of the Flora and wrote many accounts himself in addition to editing the next two volumes (Ng, 1978, 1989). These concluding two volumes were assisted by the contributions of Dr. B. C. Stone, Dr. S. K. Yap, Dr. R. Kiew, Dr. K. M. Wong, Dr. L. G. Saw and the author himself (Latiff, 1989a, 1989b). Later Dr. R. C. K. Chung, Dr. Lilian Chua and a few young graduates joined FRIM and embarked on the Flora of Peninsular Malaysia. Today we have some excellent, passionate and young taxonomists who will carry the baton forwards into the century including Ms. A. T. Nor-Ezzawanis who had revised Plagiogyriaceae and Parkeriaceae, Ms. A. R. Rafidah who revised Portulacaceae and Chloranthaceae, Ms. A. R. Ummul-Nazrah who revised Ctenolophonaceae and Pittosporaceae, Ms. M. Y. Siti-Munirah who revised Ancistrocladaceae, Mr. A. Julius who revised Clethraceae and Cruciferae and others (Kiew et al., 2010, Parris et al., 2013). The Flora of Peninsular Malaysia is currently headed by Dr. R. Kiew and Dr. L. G. Saw who also mentored the young and upcoming taxonomists.

#### **Department of Forestry, Sabah**

During the colonial days and after Sabah's Independence in 1964, the botany of Sabah plants were handled by many colonial botanists and ecologists including the late E. D. Elmer, E. Merrill based in the Philippines, Dr. W. Meijer, Mr. G. H. S. Wood and Mr. Cockburn based at Sandakan. However, they concentrated on the dipterocarps for some obvious reasons (Meijer & Wood, 1964). In the 1990s Dr. K. M. Wong joined the Sandakan Herbarium and took Mr. John Sugau and Ms. (now Dr.) Joan Pereira under his guide to produce many taxonomic accounts for the Bornean and in particular the Sabah plants and published in Sandakania. With the departure of Dr. K. M. Wong firstly to the University of Malaya and later to Singapore Botanic Gardens, plant taxonomy at Sandakan took a little slump. The contributions of several excellent and experienced parataxonomists such as Mr. Aban Gibot, Mr. Dewol Sundaling and Mr. Leopold Madani were very significant and that of the latter in the pro parte revision of Anisophyllaceae for the Tree Flora of Sabah and Sarawak would be remembered forever.

#### **Department of Forestry, Sarawak**

Similarly, in Sarawak the colonial Dutch, American, Filipino and British scientists contributed a lot to our knowledge on the botany of Sarawak and these include Prof. Dr. P. S. Ashton, Dr. E. Brunig and Dr. J. A. R. Anderson (Ashton, 1988). As in Sabah, they also focused on the botany and ecology of the dipterocarps. Later, Dr. Paul Chai and Mr. P. C. Yii came into the scene until today. In the Sarawak herbarium one particular parataxonomist, Mr. Ilias Paie was very prolific in plant collection. One other plant collector Mr. James D. Mamit (now the Hon. Deputy Federal Minister) had also contributed to the monumental reference collections at Kuching. There are also a few young botanists in the Forestry Department today such as Mrs. Mohizah Mohamad, Ms. Julia Sang, Mrs. Runi S. Pungga and Mr. Stephen Teo who may be able to contribute to plant taxonomy in years to come. Mr. Abang Mohtar Abang Pauzan has retired.

#### Tree Flora of Sarawak and Sabah

When the Tree Flora of Malaya was completed in 1989 the desire to do the same for the Tree Flora of Sabah and Sarawak came into the discussion. The author was unofficially asked by the then Director-General of Forest Research Institute Malaysia, Dr. (now Tan Sri, Dato') Salleh Mohd. Nor to prepare the working paper with the budget to repeat the undertakings for the states of Sabah and Sarawak. The arguments then were the forests of both states were undergoing logging and land-use changes and many tree species would be gone before we have the opportunity of knowing and describing them. Fortunately, both the Director-Generals then of the Department of Forestry in Sabah and Sarawak supported the project. The rest was history and presently the 8<sup>th</sup> volume of the possible 10 was published (Soepadmo & Wong 1995; Soepadmo et al., 2007). We were also very fortunate then as Dr. E. Soepadmo upon his retirement at the University of Malaya took the contract to coordinate the project until today. In the first volume most of the contributions came from the young Malaysian taxonomists such as Ms. A. Noorsiha (Aceraceae), Dr. A. Berhaman (Alangiaceae, Bignoniaceae), Mrs. Lesmy Tipot (Connaraceae, Olacaceae), Dr. Othman Bojo (Sonneratiaceae), Dr. J. T. Pereira (Staphyleaceae), Mr. J. Sugau (Pittosporaceae) amongst others. In volume II, a few more young botanists contributed including Dr. Lilian S. L. Chua (Santalaceae), Mr. Balu Perumal (Daphniphyllaceae, Malvaceae), Mrs. Runi S. Pungga (Casuarinaceae, Ctenolophonaceae, Ixonanthaceae), Mrs. A. L. Dayang Awa (Boraginaceae) and Dr. Noorma Wati Haron (Caprifoliaceae).

However, most of the contributions of the family treatments in later volumes came from the non-Malaysians and those of Malaysian were minimal because the number of small families decreased and the large and difficult families were handled by the more experienced taxonomists from abroad, hence jeopardizing the in-house training in flora writing and taxonomy that was envisioned. This is inevitable as the project has its own schedule to complete and the local volunteers were diminishing as the taxonomy of certain large families becomes more difficult and time-consuming. For example, in Volume 6, Dr. W. J. J. O. de Wilde & Dr. B. E. E. Duyfjes took the difficult Polygalaceae and Meliaceae was taken by a team comprises of Dr. D. M. Mabberley, Dr. C. M. Panell with the assistance of Dr. J. M. Edmonds and Dr. A. M. Sing. Volume 8 was interesting in that it contains one big family, the Annonaceae and it was coordinated by Dr. I. M. Turner, with contributions from young and experienced Annonaceous taxonomists such as Dr. Paul Kessler. For the next two volumes we are going to see more and more teams to do the revision as the remaining families that are not only large but more difficult. The author still hold the notion that "large families are not alone".

#### Universiti Putra Malaysia

Upon graduation Dr. Ruth Kiew, another student of the late Dr. E. J. H. Corner took a lecturer position at the Department of Biology, Universiti Pertanian (now Putra) Malaysia. She taught botany and taxonomy and conducted many research projects here. She specialized in palms, Oleaceae, Begonia and the Gesneriaceae as well as many herbaceous taxa (Kiew, 2005). Dr. Rusea Go, a taxonomy student of the author took the same position at the university when the former retired and left for Singapore Botanic Garden. Dr. Rusea Go specialized in Teijsmanniodendron (Verbenacaeae) and Orchidaceae among others (de Kok et al., 2009). There are three other taxonomists in this university, namely Prof. Dr. Faridah Hanum Ibrahim (an Ormosia specialist) (Faridah-Hanum, 2001) and Dr. Mohd. Nazre Salleh who specialized in the taxonomy of Garcinia (Guttiferae). Prof. Dr. Umi Kalsom Yusoff, a pteridologist who contributed a couple of fern families (Parris et al., 2010).

#### Universiti Kebangsaan Malaysia

When the university was established in 1970 the botany, zoology and taxonomy teachers were all expatriates and left no taxonomy students, until the author joined as a lecturer in 1978 and followed by Dr. Abdul Aziz Bidin. The latter established the excellent fern collections both for the living plants in the Fern Gardens and excellent herbarium specimens. He was assisted by an able pteridologist Mr. Razali Jaman (Parris et al., 2010). Dr. Abdul Aziz's position was taken by Dr. Haja Maideen. The author's former student the late Dr. Kamaruddin Mat-Salleh who studied the taxonomy of Annonaceae and Rafflesia joined the department of botany in 1985. The late Dr. Kamaruddin did not leave an impact on the taxonomy of Goniothalmus, in particular because of his early demise (Latiff, 2009). Prof. Jumaat Adam studied Nepenthes and Mr. Ahmad Damanhuri Mohamad who taught and researched on the taxonomy of mosses. The author also studied the taxonomy of the families of Vitaceae (Latiff, 1981, 1982a, 1982b, 1982c, 1982d, 1983, 1996a, 2001a), Rhamnaceae, Dilleniaceae, Rafflesia (Wong & Latiff, 1994, 2003), Nyctaginaceae (Latiff, 1996b) amongst others (Parris & Latiff, 1997). With his students, the authors also addressed other genera, including *Vatica* (El-Taguri & Latiff, 2012; Meekiong *et al.*, 2014). Lately, Dr. G. E. Lee graduated as the first hepaticologist in the country (Lee *et al.*, 2011a, 2011b; 2013) and now she works at the Universiti Malaysia Terengganu.

#### Taxonomy in other public universities

Other than the older universities in the Klang Valley there are young taxonomists in other universities who taught and researched in the taxonomy of Malaysian plants. At Universiti Malaysia Sarawak Prof. Che Sum Tawan studied the taxonomy of Gonystylus, Prof. Isa Ipor studied Cryptocoryne and Amorphophallus and other genera in the Araceae, Dr. Aida Safreena studied Schefflera (Araliaceae), Mr. Kalu Meekiong studied the taxonomy of Vatica, Musa as well as many genera of Zingiberaceae. At the Universiti Malaysia Sabah Dr. Berhaman Ahmad studied the taxonomy of Tristaniopsis (Myrtaceae) and Dr. Monica Suleiman studied the taxonomy of mosses. At the Universiti Pendidikan Sultan Idris Dr. Fatimah Mohamad studied the taxonomy of *Calophyllum* (Guttiferae) and Dr. M. N. Nor Nafizah studied the systematic anatomy of the dipterocarps.

#### THE CURRENT TAXONOMIC SCENARIO

#### Flora of Peninsular Malaysia

As the project of Tree Flora of Sabah and Sarawak was going-on and the Flora of the Malay Peninsula was judged to be both to contain many taxonomic errors and out-dated, the need to revise the Flora of Peninsular Malaysia arose. The Flora is estimated to contain about 7,834 species of seed plants with 1,564 genera and 220 families and about 1667 species of ferns and lycophytes. Hence, the project was launched in 2005 and the publications came in two series. The first series covering the ferns and lycophytes is coordinated by Dr. Ruth Kiew and the second series covering the seed plants is coordinated by Dr. L. G. Saw. However, both taxonomy mentors Dr. E. Soepadmo and Dr. F. S. P. Ng lend their expertise and advices to the flora writers. The backbones of the project are carried out by the in-service taxonomists such as Dr. L. G. Saw (Saw, 2002) and Dr. R. C. K. Chung assisted by a number of young and able taxonomists such as Dr. L. S. L. Chua (Chua et al., 2015), Dr. Y. Y. Sam and their young colleagues (Sam, 2015). Other non-Malaysian taxonomists also contributed to the Flora (e.g. Turner & Utteridge, 2015; Sofiyanti et al., 2016). This national flora project is of immense importance to the country as the natural resources are becoming threatened by socio-economic development and other natural calamities (Latiff, 1997). In light of the current resource capacity and ill-conceived biodiversity policy, recently Saw and Chung (2015) argued for the Flora of Malaysia.

#### **National Herbarium**

Taxonomy without herbarium and a good library is taxidermy. Hence, the need for a National Herbarium for Malaysia was discussed in 1991 and as a short-term plan, the herbaria at Kepong (KEP), Sandakan (SAN) and Kuching (SAR) were unofficially recognized as national herbaria, pending the one truly National Herbarium (Latiff, 1991a). One of the reasons that surfaced then was the need to refer to type specimens of Malaysian taxa which are mostly housed currently at Singapore Botanic Gardens, Calcutta Botanic Garden, Royal Botanic Gardens, Kew, Natural History Museum, London, Nationaal Herbarium Nederland, Leiden and other large colonial herbaria around the world, especially in the United States. The need to establish a viable and up-dated Malaysian reference collection also arose and the next generation of taxonomists would want to make reference without going afar to conduct their taxonomic studies. Similarly, the library facilities were also discussed as again most of the classical taxonomic references are not available in the Malaysian libraries. Up to this year there is no development worthy of reporting with respect to the possibility of the National Herbarium simply because even some practicing taxonomists and the federal and state governments did not see the importance of it. Herbarium was always looked at as an old building that house dead and dried plants of no economic value and importance. Plant taxonomy has long been labeled in Malaysia as stamp collecting. The cost of maintenance may be expensive though but the economic returns were adjudged as being insignificant to the developing economies such as Malaysia. The scientific and heritage value were seldom discussed.

### **National Botanic Gardens**

Similarly the botanic garden has always been viewed as an important accessory to the herbarium and the development of plant taxonomy. Our model has always been at the experience of the Singapore Botanic Gardens and Kew Gardens which have excellent live specimens from all over the world, an excellent reference collections and botanic garden, an excellent library and supported by a number of permanent professional taxonomists and parataxonomists, in addition to other accessories. For Malaysia this kind of legacy is far-fetched because the policy makers have failed to see the development of biodiversity with these accessories as important socio-economic and heritage

indicators. Today we have quite a number of botanic gardens such as at Putrajaya, Pulau Pinang, Taiping, Batu Pahat, Kuala Lumpur but none qualifies as a botanic garden in the true sense of enhancing the study of plant taxonomy. The closest is Penang Botanic Gardens but over the years it has evolved to be what it is today without a good trace of plant taxonomy.

#### **Taxonomic critical mass**

As our flora is rich and diverse and the conservative estimate was put at ca. 12,500 species we need many taxonomists to study and revise the taxa. We now know the good estimate for the plants of Peninsular Malaysia but for Sabah and Sarawak the most reliable estimates are only for tree taxa, ferns and lycophytes and mosses. The non-tree taxa, the hepatics and lichens are far from satisfactory. Currently, Malaysia has less than 40 plant taxonomists including the retirees but the active research taxonomists are about 15 or may be less. This number is too small for the number of taxa we have in Peninsular Malaysia, let alone for Malaysia (Table 1). The reasons for the small number of plant taxonomists are many-folds, but the most obvious is the lack of job opportunities and positions within the established institutions, namely the research institutes, government departments and the universities. Currently, only Forest Research Institute Malaysia and Malaysian Agricultural Research and Development Institute, the Sabah Forestry and Sarawak Forestry Departments employ plant taxonomists. In Malaysia there are 20 public universities and only seven have positions for plant taxonomists, and even that is difficult to be filled by enthusiastic plant taxonomists. None of the numerous private universities, university colleges and colleges has position for taxonomist.

Another factor is the age-group. As stated above many of the practicing and experienced taxonomists have retired though still active and they are above 60 years of age. There is a big gap between the 20-30 age-group because 10 years ago there was a significant reduction of funding from Ministry of Science and Technology for biodiversity and taxonomic research. The senior researchers were not able to secure enough funds to train human resources especially the graduate students. At one point the Flora of Peninsular Malaysia project was threatened by the uncertainty of the funds from the said ministry. Hence, many of the existing plant taxonomists in Malaysia are young (Table 2).

Another factor is that there is no systematic plan to train the next generation of taxonomists as there is no fund to promote them to do their MS and PhD degrees in plant taxonomy. As the critical mass of taxonomists was not there it becomes affirmative to address the capacity but it was not forth coming. In particular, the number of taxonomists in the universities is limited by the curriculum and academic programmes offered. Hence, at the University of Malaya and the Universiti Kebangsaan Malaysia, for instance, the number is limited to almost one fungal taxonomist, one phycotaxonomist, one pteridologist and one or two seed plant taxonomists. Hence in-house training was impossible in these universities except in research institutes. Currently, the in-house-training to produce more taxonomists is done at the Forest Research Institute Malaysia at Kepong but not at the Forestry Departments of Sarawak and Sabah. The inhouse training is again directly related to the availability of funds and budgets. For the past decades budget cuts to all institutions of higher learning and research institutes had occurred and the future of plant taxonomy looms.

# FUNDING MECHANISM

In The 5<sup>th</sup> Malaysian Plan (1985-1990) funding for general research projects including biodiversity, flora, fauna and ecology were well-supported but in the subsequent and the current R & D funding mechanism it is far from being fair and satisfactory to the students and researchers of the fundamental

Groups	Families	Genera	Species	No. of putative taxonomist
Gymonsperms	4	8	29	1
Dicotyledons	173	1,135	5,718	30
Monocotyledons	43	421	2,087	4
Ferns and lycophytes	40	136	486	3
Mosses			526	2
Liverworts and hornworts			ca. 400	1
Lichens			ca. 300	0
Algae			ca. 400	2
Total				43

Table 1. The estimated number of taxa in Peninsular Malaysia and the number of taxonomists

Age-group	Number of taxonomists	Percentage
20-30	4	9.3
31-40	10	23.3
41-50	18	41.9
51-60	5	11.6
Over 60	6	13.9

Table 2. The age-group of Malaysian taxonomists

sciences including taxonomy and biodiversity. The government had aligned the annual budget with socio-economic outputs and outcomes and generally the fundamental science does not generate much income let alone commercial products from research. The policy makers argued that Malaysia should embark on product-oriented research with tangible products to generate incomes. However, in the last four decades outputs from the so-called applied research namely biotechnology has not significantly contributed to our GDP. The impediments to taxonomy were eminent, serious and real and the author believes in the next decade plant taxonomy will be a science of the past and it would be too late to realize our biodiversity potential. This is ironic as countries like Japan and Germany to name two had given great impetus to fundamental and natural sciences, including biodiversity.

### THE FIELD OF TAXONOMY

Taxonomy is not anymore about description, classification and nomenclature of plants but encompasses many other sub-disciplines (Davis & Heywood, 1963, Stace, 1980). No doubt that the description and classification are the core business of taxonomy which could be done in the herbarium and in the field as in the past. Taxonomy is also not about discovering new species to science, new records to a particular geographic region and changing names. The science of taxonomy today also requires deep morphological, anatomical, ecological and palynological studies to ascertain the decision taken to describe and classify a taxon. Morphology including palynology and anatomy attempt to understand the variations in the individual plant as modified by geological history and adaptations to the changing environment. All these require special skills and sophisticated laboratories to conduct the in-depth studies, as exemplified by the institutions like Kew Gardens and others. In Kew Gardens they have all the necessities it takes to make taxonomic research of the world class status and very competitive.

Today the demand of molecular data to enhance systematics is beyond our imagination (Stuessy *et* 

*al.* 2001). When the author did plant taxonomy studies at the University of Reading (1974-1978), molecular taxonomy was about to be born. Today it is the new frontier in plant taxonomy or systematics which are furnished by the application of DNA sequence data to address all levels of classification and phylogeny. There are journals that will not accept good taxonomic papers without some analysis of phylogenetic affinities of taxa using DNA sequence. In the developing world such as Malaysia there is no fund to conduct truly systematic studies of the family Vitaceae, for instance, as shown by many friends overseas (Chen *et al.*, 201; Ingrouille *et al.*, 2002; Soejima & Wen, 2006; Trias-Blasi *et al.*, 2012; Wen *et al.*, 2007).

# **CURRENT SCENARIO**

One would get the picture of the crisis of plant taxonomy in Malaysia today by looking at the taxonomic productivity. By taxonomic productivity the author means the number of taxonomic papers published in the journals and the number of taxa published in a period of time. Table 3 shows selected families with the number of new genera and species described by the Malaysian taxonomists either in part with others or by himself/ herself. For example, Mat-Salleh managed to publish his seven new species of Goniothalamus before his early demise and today there is no local taxonomist who wishes to study the Annonaceous genus as well as the family itself. On the other hand there are many papers and new taxa of Araceae by the local taxonomists because there are many botanists interested in this important horticultural family (Wong & Boyce, 2014; Wong et al., 2014). Some years ago the author had expressed a similar sentiment in discussing Malaysian contributions to Flora Malesiana (Latiff, 1999, 2001c).

Some years ago Dr. I. M. Turner while he was at Singapore Botanic Gardens with the assistance of the author traced the notes on the new taxa and records of Malaysian plants (e.g. Latiff & Turner, 2001, 2003). In that year a total of 26 papers were published on the taxonomy and botany of Malaysian vascular plants, but on analysis of the contribution we found out that most were by non-Malaysians. One other aspect that needs a serious discussion in the academia is the recognition of journals published in Malaysia. During the colonial period the natural science journals had flourished and articles on flora, fauna, nature and the environment took the centre stage and of course the writers were the colonial scientists and naturalists.

After Independence those colonial authors left the country and there was a vacuum in the local scientific community. The journals such as the

Plant Family	The number of new species and new records published	Source(s)
Annonaceae	Seven Goniothalamus	Mat-Salleh, 2001
Araceae	One Schismatoglottis and many more in other genera	Wong & Boyce, 2014
Dipterocarpaceae	Three Vatica from Peninsular Malaysia and two new ones from Sarawak	El-Taguri & Latiff, 2010, 2012; Tan <i>et al.,</i> 2014; Meekiong <i>et al.,</i> 2015;
Sapotaceae	Five Madhuca	Omar & Latiff, 2013, 2014;
Hanguanaceae	Five Hanguana	Siti Nurfazilah et al., 2010
Aristolochiaceae	Nine Thottea	Yao, 2013
Guttiferae	Fourteen Calophyllum from Sabah and Sarawak	Fatimah, 2012 (unpublished)
Lecythidaceae	Four Barringtonia	El-Sheriff & Latiff, 2006; Rohana & Latiff, 2012
Vitaceae	Two Cissus, two Ampelocissus, two Tetrastigma	Latiff, 1991b; 2001b
Zingiberaceae	One <i>Boesenbergia</i> One monotypic genus Two <i>Zingiber</i> Three <i>Scaphochlamys</i> Five ginger species	Lim, 2008 Lim, 2016 Noor Ain <i>et al.,</i> 2016 Meekiong <i>et al.,</i> 2016 Meekiong <i>et al.,</i> 2011

Table 3. The number of new taxa published by Malaysian taxonomists in selected ten families in the last 10 years

Malayan Nature Journal and the Malayan Foresters were the pride of Malaya then, but not anymore. These journals are still well-recognised by the western world but not by Malaysian authorities and scientists because of reasons known to most Malaysians. These are not only recognized on par with their counterparts in the western countries including Japan, Australia and New Zealand but also not financially supported by the institutions to sustain them. We still have the mentality that the western journals including those published in Japan, United States, Canada, United Kingdom, Germany Australia and New Zealand are of high quality and those published locally are of the low impact and insignificant. The irony exists simply because the authorities do not give good academic value to the local journals. The author is always asked why do we have to publish about our biological resources, flora and fauna in overseas journals of which the subject matter is irrelevant to them except financially good for the journals and editors. Unlike the fields of medicine, engineering, biotechnology and others which are universal in nature and relevant to other active workers elsewhere, those on flora and fauna and including ecology are locally relevant. Does it make sense to publish about a new species of local Durio or Rafflesia in Pakistan Journal of Botany, for instance?

#### CONCLUSION

This review of plant taxonomy in Malaysia attempts to highlight the historical excellence during the colonial era and compare with the current scenario in this decade of biodiversity. In 1998 Malaysia launched the National Biodiversity Policy emphasizing our rich and diverse biodiversity and though lack in skilled man-power, Malaysia envisions to make the country a Centre of Excellence in biodiversity studies and after 18 years we realized we have failed except in the Tree Flora of Malaya project and the on-going Tree Flora of Sabah and Sarawak project and the Flora of Peninsular Malaysia project. Other than the Flora works the science of taxonomy lags behind because of the failure of the Ministry of Science, Technology and Innovation to prioritise it in its funding mechanism and human resource capacity building. The similar scenario, if not worst, occurs in animal taxonomy. The author feels we are lagging behind our ASEAN neighbours especially Singapore, Indonesia and Thailand in addressing the perils of plant taxonomy, let alone the plant species. It is about time our policy makers and other interested parties especially the respective stake-holders to relook and revisit our priorities as stated in our biodiversity policy for the sake of plant taxonomy and biodiversity in Malaysia.

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