

# North-South Collaboration in Writing Tropical Floras: The Flora of Thailand at a crossroads

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## Abstract

The Flora of Thailand project has revised about half the species in Thailand in 50 years, a relatively fast rate for a diverse, tropical flora. The reasons why this project has progressed faster than similar flora projects in other tropical areas include a strong component of international cooperation from the start of the project. Recent changes in the structure of the editorial board aim to speed up the revision of the remaining species. The speed at which a flora can be revised is closely linked to the number of expert botanists available. While modern technology has streamlined parts of the process of revision, nothing can substitute for detailed examination of thousands of herbarium specimens by trained botanists.

**Key Words:** conditions, international, rate, revision, risks

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The Flora of Thailand project aims to publish descriptions of all vascular plants native in Thailand, along with keys to their identification. Each plant family is revised by one or more specialists, who examine all relevant herbarium material, decide on the delimitation of taxa and ascertain the correct name for each one. Only when the *Flora of Thailand* is complete will the full baseline information exist that permits conservation of Thai plants for future generations. By now, half the flora has been revised and the end of the project is within sight but we can not simply continue to work as we have for this last half cen-

tury. The world is changing rapidly and those who work on the *Flora of Thailand* must react accordingly. Which way will be best for the future of Thailand's biodiversity and its people?

## History of Botanical Exploration in Thailand

By the 19<sup>th</sup> century, when most of the tropics had been colonised by European powers such as France, Great Britain, the Netherlands, Portugal, and Spain, the herbaria of these countries held huge collections of

tropical plants. Thailand was never colonised so it has taken a different path towards the scientific discovery and description of its native flora.

The earliest botanical collections made in Thailand were those of J.G. Koenig (1728–1785) who was born in Courland, now part of Latvia, and belonged to the Baltic-German ruling class. After some time as a pupil of Linnaeus in Sweden, he lived in Denmark before joining the Danish trade mission in Tharangambadi (in Danish Tranquebar), Tamil Nadu. From here, he was sent to explore southeast Asia and made collections in Thailand in the 1770s, particularly at Junk Ceylon, which is an old name for Phuket. Many of Koenig's collections have been lost but some are still to be found in the herbarium of the Natural History Museum of Denmark, Copenhagen (C), the herbarium of the Linnean Society of London (LINN), the Natural History Museum of London (BM), the Botanische Staatssammlung München (M), the World Museum Liverpool (LIV), and the herbarium of the Botanical Museum, Lund University (LD) (Seidenfaden 1995).

Few herbarium collections were made in Thailand in the 19<sup>th</sup> century. Most of those that we have were collected late in the century around the borders of Thailand by Clovis Thorel (1833–1911) and François Jules Harmand (1845–1921) near the River Mekong and by Charles Curtis (1853–1928) on the west coast of the Thai peninsula, from Phangnga southwards.

The second significant Danish initiative in Thai botany was the *Flora of Koh Chang* compiled by J. Schmidt (1901–1916). Koh Chang is an island administered as part of Trat Province in the Gulf of Thailand near the Cambodian border. Its area is small and its flora is not representative of the country as a whole, but the types of a number of taxa came out of this work and are also at C.

One of the most prolific collectors of Thai plants was A.F.G. Kerr (1877–1942), a medical doctor who arrived in Thailand in 1902 and stayed for 30 years until his retirement (Jacobs 1962; Parnell *et al.* 2015). His collection number series runs to 24,409 with some gaps, and there are also some unnumbered collections making nearly 26,000 collections in all, the great ma-

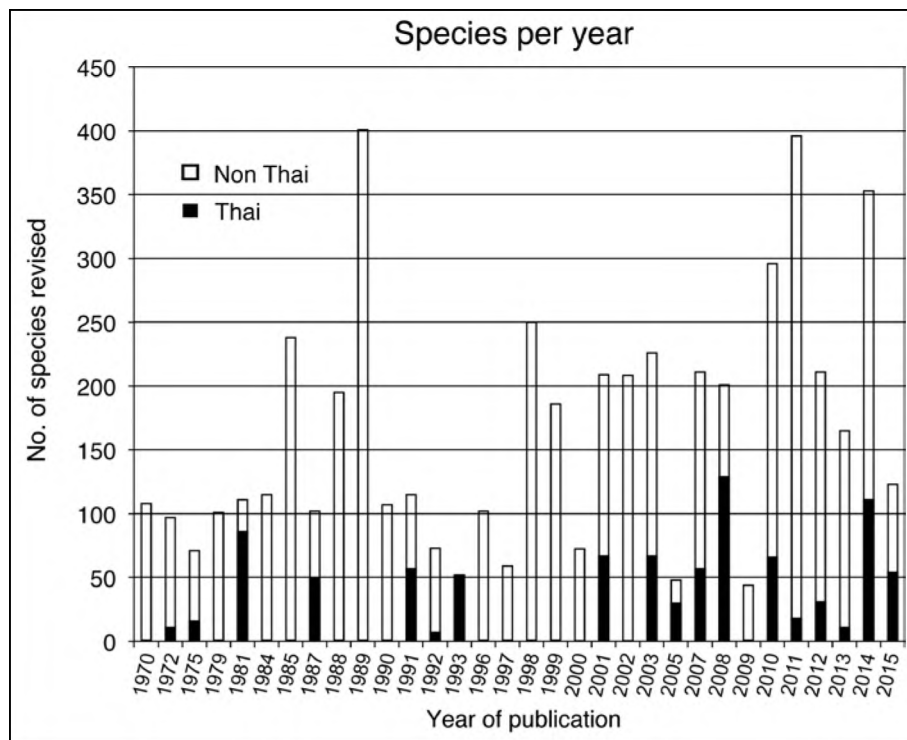
jority of them from Thailand (Parnell *et al.* 2015). Kerr's own set of specimens is in the herbarium of the Natural History Museum, London (BM) while the Thai set is at the Bangkok Herbarium (BK). Other sets of duplicates, in order of size and importance, are at the Royal Botanic Gardens, Kew (K), the University of Aberdeen (ABD), Trinity College Dublin (TCD), Aarhus University (AAU), the Royal Botanic Garden Edinburgh (E), and the Naturalis Biodiversity Centre (L).

Another Dane was the next European to be inspired by the plants of Thailand. Gunnar Seidenfaden was Danish ambassador in Thailand from 1955 to 1959 and a keen and highly competent amateur orchid specialist with a prolific scientific output on southeast Asian orchids. With his help, the first Thai-Danish expedition was organised from 1958 to 1959: the Danish participants were Thorvald Sørensen, Kai Larsen and Bertel Hansen. Sørensen did not work further on Thai plants but, from this date onwards, Bertel Hansen and Kai Larsen devoted much of their careers to the Thai flora. Kai Larsen is probably the most prolific collector of Thai plants. The exact number has not yet been counted, but his number series runs to more than 42,000.

In 1965, a meeting of botanists was called at Kew to discuss the formal founding of the *Flora of Thailand*. Representatives of Thailand (Forest Herbarium, Bangkok), Japan (Kyoto University) and six European herbaria (Aarhus University, Botanical Museum, Copenhagen, Muséum national d'Histoire naturelle, Paris, Royal Botanic Garden Edinburgh, Royal Botanic Gardens, Kew, and the Rijksherbarium, Leiden) were present. This marks the beginning of the *Flora of Thailand* project which, from its very inception, has been a North-South collaboration.

Two Thai botanists present at the foundation of the *Flora of Thailand* project were Tem Smitinand (1920–1995) and Chamlong Phengklai (1934–). Within a few years they were joined by Thawatchai Santisuk (1944–). All three spent their careers working on this project, making many collections themselves and with others, and supporting younger Thai botanists through their training and early years of work. Botanists from many

Fig. 1. The number of species accounts published each year in *Flora of Thailand*, showing the proportions revised by Thai and foreign experts.



countries have collected in Thailand so that the number of institutions actively working on the Flora has expanded since the early days and collection numbers have increased greatly. This level of international cooperation continues to this day.

### How does the Flora of Thailand work?

The number of species of vascular plants which occur naturally in Thailand is estimated at 10250-12500

(Middleton 2003). Roughly half have been revised in the *Flora of Thailand* or 104 species per year on average (Table 1, Fig. 1). While this may seem a slow rate of progress, it is faster than that of many other tropical floras.

The main goal of the *Flora of Thailand* is to describe the vascular plants of the country and give keys to their identification. The descriptions are brief, usually no more than 300 words to describe a species, and citation of synonyms is limited to those which are rele-

Table 1. Numbers of species revised and published in *Flora of Thailand*, compared to the total number expected. The row marked 'Finished Manuscripts' show the number of species revised but not yet published.

	Families no.	Family %	Species no.	Species %
Published	227	72	5536	51
Finished manuscripts	18	6	512	5
Under revision	69	22	4883	44
Total	314	100	10931	100

vant to Thailand. Obscure synonyms which may never be seen by Thai botanists are not given, especially in groups which have been revised in a more detailed format, such as *Flora Malesiana*. Specimen citation is kept to a minimum. Type specimens are only cited if they originate in Thailand and non-types are only mentioned in particular circumstances, for example, if a specimen is out of the usual range of morphology or distribution. The distribution in Thailand is given by floristic region and province, along with the global distribution by country. In addition, the ecological information relating to each species is critically compiled. Lastly, any uses and vernacular names in the languages of Thailand are recorded.

By working to a concise format like this, the *Flora of Thailand* has been able to proceed relatively quickly but it is also less exact in some ways. By contrast, the *Flore du Cambodge, du Laos et du Vietnam* cites types of all names and cites all the specimens studied. This forces the author of a revision to be more precise and to be sure about the application of names. It also allows curators in herbaria to curate their collections more easily.

One of the most important aims of the *Flora of Thailand* project is to increase the ability of Thai botanists to work at international standards so that Thailand can manage its own flora. This aim will be reached by Thai and foreign botanists working together so that, gradually, all attain the same standard. The revisions completed in the 1970s were almost entirely written by foreign botanists but the balance has tipped slowly towards Thai botanists (Fig. 1). In the last ten years, there has been only one year without a Thai contribution and the two most substantial Thai contributions have been made in this period. For the remaining part of the flora 46 families and 2591 species have been assigned to Thai authors and 47 families and 2914 species have been assigned to non-Thai authors. As a consequence the *Flora of Thailand* project has functioned as an exemplary North-South collaboration where the initial dominance by researchers from the north through extensive capacity building has slowly been substituted by a situation of almost parity in the contributions.

North-South collaboration works at two levels in the *Flora of Thailand* project. First, there are collaborating institutes which commit themselves to giving staff time to the project for long periods. While one or two institutes which collaborated at the beginning have had to withdraw, several more have joined in recent years.

## Institutions Collaborating in the Flora of Thailand

Sixteen institutions formally collaborate on the *Flora of Thailand* project (Table 2). Individual scientists undertake to revise families of plants for the *Flora of Thailand* but, in many cases, these individuals work in the collaborating institutes.

The funding of the *Flora of Thailand* also demonstrates North-South collaboration. Both in Thailand and the foreign collaborating institutes, governments maintain large herbaria and their staff. Since 1997, the Thai government has funded a great deal of training of taxonomists through the Biodiversity Research Thailand fund, something which has allowed a new generation of Thai botanists to be trained, many of them by spending periods abroad in the herbaria of the collaborating institutes. Likewise, the foreign institutes have accepted Thai and other nationals as students who have revised Thai plants as part of their training.

To summarise, the characteristics of the *Flora of Thailand* project are the following:

- it has been a North-South collaboration from the outset
- it is driven by practical goals
- it is supported by a number of institutes in terms of staff time
- financial support comes both from Thailand and from overseas, especially Denmark
- revisions of large families are frequently led by a coordinator

**Table 2.** Institutions cooperating on the Flora of Thailand project. The participants in the founding meeting in 1965 are marked with asterisks.

Institution	Herbarium code
Aarhus University, Denmark *	AAU
Bangkok Herbarium, Thailand	BK
Natural History Museum of Denmark, University of Copenhagen, Denmark* (withdrawn 2017)	C
Botanische Staatssammlung München, Germany	M
Chulalongkorn University, Thailand	BCU
Forest Herbarium Bangkok, Thailand*	BKF
Khon Kaen University, Thailand	KKU
Kyoto University, Japan*	KYO
Muséum national d'Histoire naturelle, Paris, France	P
Naturalis Biodiversity Centre (formerly Rijksherbarium), Leiden, the Netherlands*	L
Queen Sirikit Botanic Garden, Thailand	QBG
Royal Botanic Garden Edinburgh, UK*	E
Royal Botanic Gardens, Kew, UK*	K
Singapore Botanic Gardens, Singapore	SING
Botany Department, Trinity College Dublin, Republic of Ireland	TCD
National Museum of Nature and Science, Tsukuba, Japan	TNS

### The Administrative Structure of the Project Until 2014

Two editors preside over the *Flora of Thailand* project, one Thai and one Danish (Table 3). Working for the editors are an assistant editor and a production editor. The assistant editor worked mainly on the scientific content of revisions and corrected the English, while the production editor oversaw typesetting, illustration, publication and distribution. The first *Flora of Thailand* meeting in 1965 has been mentioned above. Since then, the editorial board has met frequently,

usually every three years, to discuss progress (Table 4). At first, the meetings were for board members only, but they soon evolved into open meetings where all aspects of Thai taxonomy were presented. The board would meet privately and report to a plenary session at the end of the meeting. *Flora of Thailand* meetings normally alternate between Thailand and Europe, and frequently attract more than 200 delegates. They are a valuable proving ground for young researchers wishing to present their work to an international audience.

At a *Flora of Thailand* board meeting, the status of

Table 3. Editors of the *Flora of Thailand*.

Editors [Editors-in-Chief]	Thai editors	Tem Smitinand (1965-1995)
		Thawatchai Santisuk (1996-present)
	Danish editors	Kai Larsen (1965-2012)
		Henrik Balslev (2014-present)
Assistant editors [Editors]		Bertel Hansen (1970-1985)
		Ivan Nielsen (1987-2007)
		Mark Newman (2008-present)
		Anders Barfod (2014-present)
		Hans Joachim Esser (2015-present)
		David Simpson (2016-present)
Production editors		M.R. Sukshom Kashemsanta (1970-1972)
		Tem Smitinand (1973-1993)
		Thawatchai Santisuk (1993-1996)
		Kongkanda Chayamarit (1997-present)

each family revision is discussed and progress is noted. Many large families are revised by a team of botanists working with a coordinator. The coordinator is critical to rapid progress, catalysing the work and setting deadlines for completion of tasks. The use of coordinators is certainly among the reasons for efficient and timely production of published revisions in the *Flora of Thailand*.

### The Flora of Thailand at a Crossroads

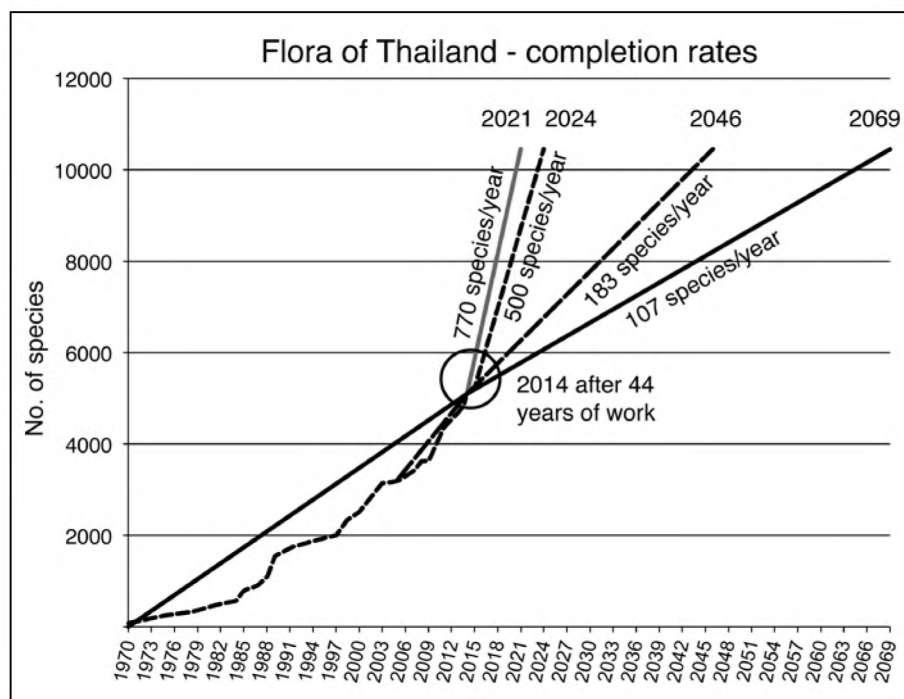
The editorial board of the *Flora of Thailand* met during the 16<sup>th</sup> *Flora of Thailand* meeting at the Royal Botanic Gardens, Kew in 2014 and discussed the speed of completion of the project. While progress has been relatively fast, it has not been fast enough to attract additional funding to allow the project to be completed. The choice facing the board, therefore, was to carry on as before or to accelerate the rate of revision of species. Since most funding bodies work in cycles of

3-5 years, it was felt that a target of seven years to completion might help to bring in additional funds. A number of completion dates were calculated according to various rates of progress (Fig. 2).

It was accepted by the editorial board that funding bodies would not consider supporting projects of very long duration so the two slower options were rejected. Every effort will be made to publish by 2024, though it is already clear that certain large, complex groups such as the Orchidaceae cannot be completed by then.

The structure of the editorial board was enhanced so that the two editors are now called editors-in-chief and the assistant editor is called editor. Three more editors were appointed in order to cope with the increased amount of editing, and added technical assistance is now based at Aarhus University. It was decided to meet annually, rather than every three years and the first of these annual meetings took place in Chiang Mai in August 2015.

Fig. 2. Recorded and projected rates of progress and estimated dates of completion of the *Flora of Thailand*, with different estimates of productivity.



## New Activities Following the 2014 Flora of Thailand Meeting in Kew

Following the 16<sup>th</sup> *Flora of Thailand* meeting at Kew in 2014 a relatively substantial grant of 15 million DKK (approx. 2 million €) was obtained from The Carlsberg Foundation to support the completion of the flora.

The budget allows for visits of Thai researchers to Danish or other relevant European herbaria for periods of 1-3 months duration. The granting of these visits is administered with a focus on those researchers who already have advanced manuscripts, and who need some 'quality time' to be able to finish their manuscripts. The Thai flora writers often find themselves engulfed in administrative and teaching obligations at their home institutions, and spending time away is usually advantageous in the situation where a concentrated effort is needed to complete a treatment. This scheme has been very successful and 21 Thai taxonomists have visited Aarhus University herbarium and some other European herbaria since the programme started. More visits are already planned,

and this budget line will remain open for the next several years so more Thai botanists can take advantage of it.

The grant has also made it possible to fund several training courses in Thailand. The first series of courses has focused on the use of electronic media in the production of taxonomic work. Specifically courses in the use of the ScratchPad software have been held in Bangkok, Chiang Mai, Khon Kaen, and Ubon Ratchathani. Between 20 and 30 young taxonomists have participated in each of these courses and they have all created their own taxon specific pages, where they can present the results of their taxonomic work as it is under way to become final products in the *Flora of Thailand*.

The actual production of the printed volumes of *Flora of Thailand* is done at the Forest Herbarium in Bangkok, and has been funded by institutional support to the salaries of staff involved in the process, and also for the actual printing costs. With the ambition of publishing more species every year the annual cost increases, and that activity is therefore also supported by the grant, both for the printing and for some staff expenses.

**Table 4.** The year and location of each *Flora of Thailand* meeting.

	Year	Location
1 <sup>st</sup>	1965	Kew
2 <sup>nd</sup>	1967	Leiden
3 <sup>rd</sup>	1972	Paris
4 <sup>th</sup>	1975	Aarhus
5 <sup>th</sup>	1978	Kyoto
6 <sup>th</sup>	1984	Edinburgh
7 <sup>th</sup>	1988	Chiang Mai
8 <sup>th</sup>	1991	Kew
9 <sup>th</sup>	1994	Aarhus
10 <sup>th</sup>	1996	Phuket
11 <sup>th</sup>	1999	Leiden
12 <sup>th</sup>	2002	Bangkok
13 <sup>th</sup>	2005	Dublin
14 <sup>th</sup>	2008	Copenhagen
15 <sup>th</sup>	2011	Chiang Mai
16 <sup>th</sup>	2014	Kew
17 <sup>th</sup>	2017	Krabi

The coordination of the project is also supported by the grant for technical and other support staff at Aarhus. The budget includes a postdoctoral salary which was initially for work at Aarhus, but as things have progressed these funds are now being diverted to employ postdocs at the three large Thai herbaria (BKF, QBG, CMU) with the intention of making the large collections there more readily available to authors who work on the treatments of various families for the flora.

Finally the budget also allows for relevant field-work and travel related to the coordination of the project and participation in scientific meetings that are relevant to the *Flora of Thailand* project.

## Can the Flora of Thailand Serve as a Model for Other Flora Projects?

The fact that the *Flora of Thailand* is guided by an international editorial board and supported by herbaria in a number of countries has led to a relatively rapid speed of progress. Other revisions of tropical floras may be able to work faster by emulating the structure of the *Flora of Thailand*. One feature of the *Flora of Thailand* must be noted here, as it gives this work a significant advantage over some others. This is that the *Flora of Thailand* treats the plants of a single state. Attempts to revise the flora of multinational areas, such as the *Flore du Cambodge, du Laos et du Vietnam* and *Flora Malesiana* do not attract as high a level of support from the countries involved, perhaps because they do not clearly present the information needed by the participating nations.

Any country wishing to follow the example of the *Flora of Thailand* must make a number of commitments. The speed at which a flora can be revised is closely linked to the number of expert botanists available. While modern technology has streamlined parts of the process of revision, nothing can substitute for detailed examination of thousands of herbarium specimens by trained botanists.

On the part of the home country, there have to be students to be trained in taxonomy and revision of plants. This implies that there should be jobs to go to because students will not train in a subject which leaves them without the possibility of employment. There must also be strong government support to the institutes in which this work is carried out.

On the part of the foreign contributors, there must be a clear recognition that this is an important contribution to world science, and an adequate allocation of research time.

On both parts, there have to be taxonomists in employment who can undertake to complete revisions. Another factor which must be recognised is that revising plants for the *Flora of Thailand* does not result in publications that are measured using research metrics such as an impact factor. It is critical, therefore, that institutions which carry out taxonomic



work measure the output of taxonomists fairly, taking into account their productivity even when it does not attract an impact factor.

## Thai Contribution to the Flora of Thailand

Throughout the *Flora of Thailand* project, the Thai government has given financial support to the Bangkok Forest Herbarium (BKF) which is the institute that publishes the flora. Originally part of the Royal Forest Department, it is now part of the Department of National Parks, Wildlife and Plant Conservation. The Thai government paid for the building in which BKF is now housed and has maintained staffing levels over a long period. In addition, the government's Biodiversity and Training Programme funded a number of studentships at MSc level aimed at producing the next generation of Thai botanists. These studentships were held at universities with strong interests in taxonomy, such as Chulalongkorn, Kasetsart, Khon Kaen, and Mahidol.

The Plant Genetic Conservation Project under the Royal Initiation of Her Royal Highness Princess Maha Chakri Sirindhorn (RSPG) also supports biodiversity research in Thailand, particularly at Queen Sirikit Botanic Garden and through the research carried out under the auspices of the Royal Society of Thailand, Academy of Science.

## Risks

The greatest risks to the successful completion of the *Flora of Thailand* are the same as those faced by every large floristic project. It is very widely accepted that it is necessary to have inventories of the biota of each country in the world (Plants2020 2015 – <http://www.plants2020.net/> – accessed 9 November 2015). The Global Strategy for Plant Conservation has as its very first 2020 target, 'An online Flora of all known plants' but the means of achieving this target have not been put in place. The Taxonomic Impediment is the term for the world-wide shortage of important taxonomic information, gaps in our taxonomic knowledge, and shortage of trained taxonomists and curators (CBD

Secretariat 2015 – <https://www.cbd.int/gti/problem.shtml> – accessed 16 Nov. 2015). Efforts have been made to address these problems but the results are mixed. In particular, there is much debate as to whether the science of taxonomy is productive enough to meet the world's needs or not. While authors such as Bebber *et al.* (2014) think taxonomy is stagnant at a time of great need, others such as Costello *et al.* (2012, 2013a,b) believe that taxonomic output is increasing. In Thailand, there are certainly more people studying taxonomy than there were at the beginning of the *Flora of Thailand* project but there are still not enough of them to write a complete floristic account in a reasonable time, relative to the disappearance of natural vegetation. Furthermore, Thailand still relies heavily on input from European taxonomists and it is precisely in Europe that the number of active taxonomists is falling very fast. The Natural Environment Research Council of the United Kingdom investigated the numbers of taxonomists in employment and found, among other things, that taxonomy has declined very steeply in the university sector and that succession-planning is a significant cause for concern (Boxshall & Self 2011 – <http://www.nerc.ac.uk/research/funded/programmes/taxonomy/uk-review/>).

## Consequences

One may well ask whether there is much to be lost by not finishing the *Flora of Thailand* soon. The underlying question is whether Thailand has the professional capacity to manage its flora in ways which have been laid down in international agreements. Thailand ratified the Convention on Biological Diversity in 2003 and became a party in early 2004, committing itself to the conservation of its flora for future generations. If the plants are to be conserved, they must first be known and this is where the *Flora of Thailand* comes in. The complete Flora will be Thailand's most comprehensive list of vascular plants, their names, descriptions, distributions and overall habitat requirements. Without such a vital baseline, many species may be lost unwittingly.

This is recognised in Thailand's Fifth Report on the National Biodiversity Strategy and Action Plan (<https://www.cbd.int/doc/world/th/th-nr-05-en.pdf>) which includes a target to increase the number of taxonomists employed by agencies involved in biodiversity work and the establishment of a national taxonomic institution to complete the *Flora of Thailand* project. The other half of the equation, the contribution made by foreign botanists, is less certain. The various programmes of the Convention on Biological Diversity give little weight to the idea that certain rich countries with relatively poor biodiversity may need to help poorer countries with very rich biodiversity. European countries focus very much on their own problems which include the spread of alien species, the introduction of new diseases, and food security, and give scant attention to the needs of tropical countries where the greatest number of extinctions is likely to occur in the coming decades and centuries.

## Conclusion

The *Flora of Thailand* is an excellent example of North-South collaboration which has resulted in relatively rapid revision of half the vascular plant flora of a diverse, tropical country. Its composition, with an international editorial board from the outset and a high degree of commitment from Thai and foreign participants, is a model that other tropical countries may follow. The editorial board has recently made strenuous efforts to increase the speed of work with the aim of completing the Flora by 2024.

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