PRODUCTION RATES OF MAJOR REGIONAL FLORAS

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> "All these co-operative works ought to be very carefully designed and will necessarily be of long to very long range. Therefore, their organisations should be set up in such a way that reasonable continuity is assured as much as is possible in the tumultuous world of today." C.G.G.J. van Steenis (1954)

The ambitious programme of major regional Floras for developing countries initiated in the late 1940's to 1960's is now mostly under serious reappraisal because of the slow rates of progress, coupled with political changes, financial restrictions and evolving technology. From our present viewpoint it is difficult to envisage the resurgence of optimism and confidence following the end of the Second World War, with plans for definitive accounts of the plant resources of large areas of dependent possessions in the tropics (Van Steenis 1954). The Flora of Tropical East Africa and Flora Malesiana were to a considerable extent the models for those that followed, departing markedly from the pre-war precedent of mostly local Floras and the more synoptic approach of, for example, the Flora of West Tropical Africa and the Flora of Java. Time schedules were not a primary consideration, but completion in one or two decades was generally anticipated.

The rates of production of major regional Floras dealing with vascular plants in the present era are indicated in Table 1 and Figures 1–3. The exemplary model is provided by Flora Europaea, with eleven and a half thousand species issued in five volumes over a period of just 15 years, a rate of 770 species a year. The achievement was obtained by the determination of a small team of energetic organisers, the successful planning and acquisition of sufficient manpower and resources, tight control of a carefully determined style, form and detailed content, and a successful involvement of no less than 187 authors, with wide international collaboration of contributors and advisers (Webb 1978). Much of the success should be attributed, nonetheless, to the editors and their assistants who wrote 45% of the text, one-third by just four people (Table 2). The Flora of Australia is modelled on similar lines, is publishing on average over 300 species a year and completion can be foreseen around the turn of the century, if a little more manpower is allocated, as anticipated.

The achievements of the Flora SSR and the Flora Reipublicae Popularis Sinicae are monuments of socialist organisation. Flora SSR, produced in 30 volumes between 1933 and 1964, covered one-sixth of the world's land surface and included 17,520

Table 1. Production rates of major regional Floras relating to vascular plants.

Flora	Started	First issue	Species publ.	Total	%	Species/ year	Actual or projected completion
Europaea	1958	1964	11,557		100	770	1978
SSR	1931	1933	17,520		100	515	1964
Australia	1979	1981	2,631	18,000	15	329	2043
West Tropical Africa	1951	1954	7,349		100	387	1972
Neotropica	1968	1968	4,624	90,000	5	220	2397
Southern Africa		1966	2,834	19,500	15	123	2124
Zambesiaca	1956	1960	3,215	9,300	35	110	2044
Tropical East Africa	1949	1952	6,425	10,500	61	173	2013
Malesiana	1947	1954	4,837	25,000	19	138	2135

Sources: FE: Webb 1978, Tutin et al. 1980; FSSR: Kirpicznikov 1969; FA: George 1981, Ann. Rep. 1987–88; FWTA: Hepper 1965, 1972; FN: Prance & Campbell 1988; FSA: Register of Southern African Plant Taxonomic Projects; FZ, FTEA: author; FM: Geesink, pers. comm.

Table 2. Percentage of species written by various classes of contributor for certain major regional Floras.

Flora	Outside specialist	Seconded staff	Hired personnel	Students
Europaea	55	45		
SSR		100		
Australia	70	16	13	1
West Tropical Africa	8	85	7	
Neotropica	100			
Zambesiaca	24	61	15	
Tropical East Africa	14	65	20	< 1
Malesiana	30	62.5	0.5	7

Sources as in Table 1.

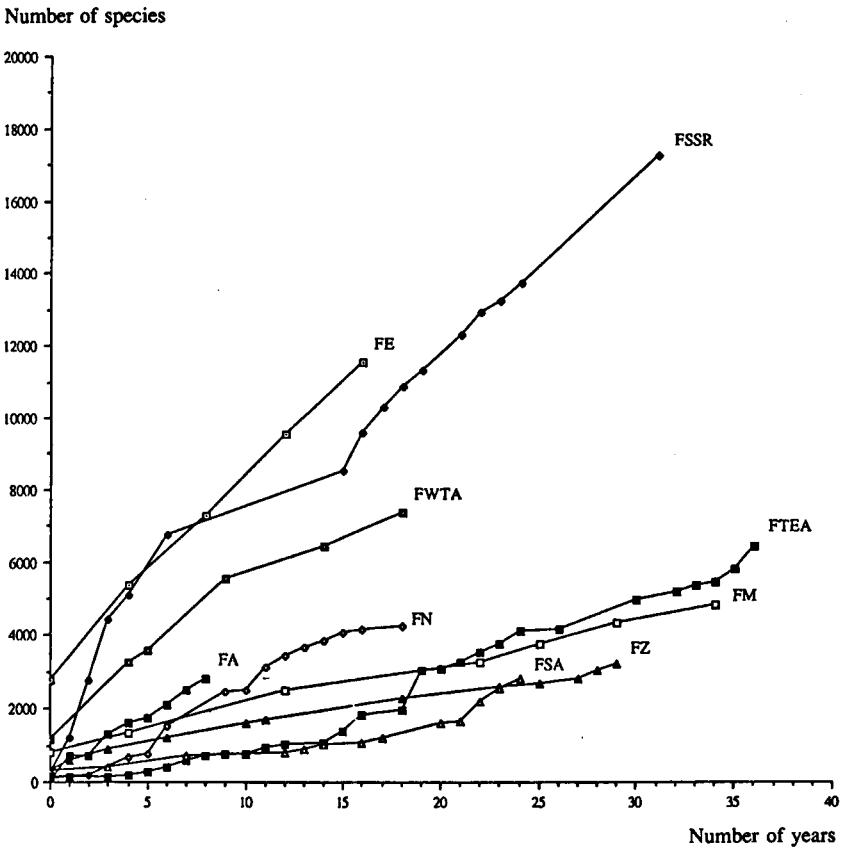

Fig. 1. Publication rates of major regional Floras. — FE = Flora Europaea; FSSR = Flora SSR; FWTA = Flora of West Tropical Africa; FA = Flora of Australia; FN = Flora Neotropica; FTEA = Flora of Tropical East Africa; FM = Flora Malesiana; FSA = Flora of Southern Africa; FZ = Flora Zambesiaca.

Komarovian species, produced by 92 authors and numerous technical workers (Kirpicznikov 1969). There was a long continuity of the editors and secretary staff and no limitation of resources for publication. It was, however, originally designed as a five-year project and had to be reassessed considerably in the early stages. Apart from a hiatus during the Second World War it maintained a high, steady rate of production comparable to Flora Europaea until completion. The Flora Reipublicae Popularis Sinicae, produced since 1959 in 80 volumes to cover 32,000 species, is apparently now for 80% complete, giving a rate of about 850 species a year.

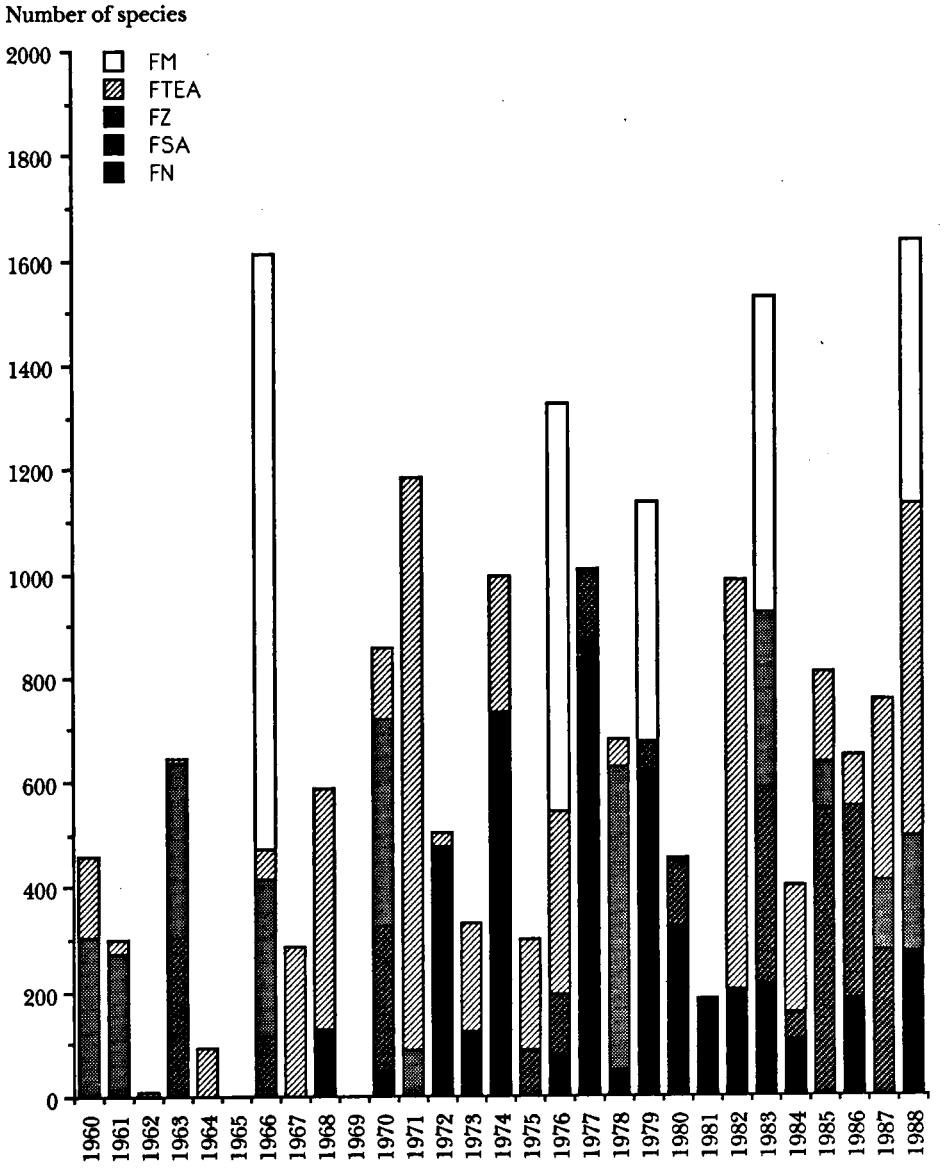

Fig. 2. Number of species published 1960–1988 by major regional tropical Floras. Abbreviations as for Figure 1.

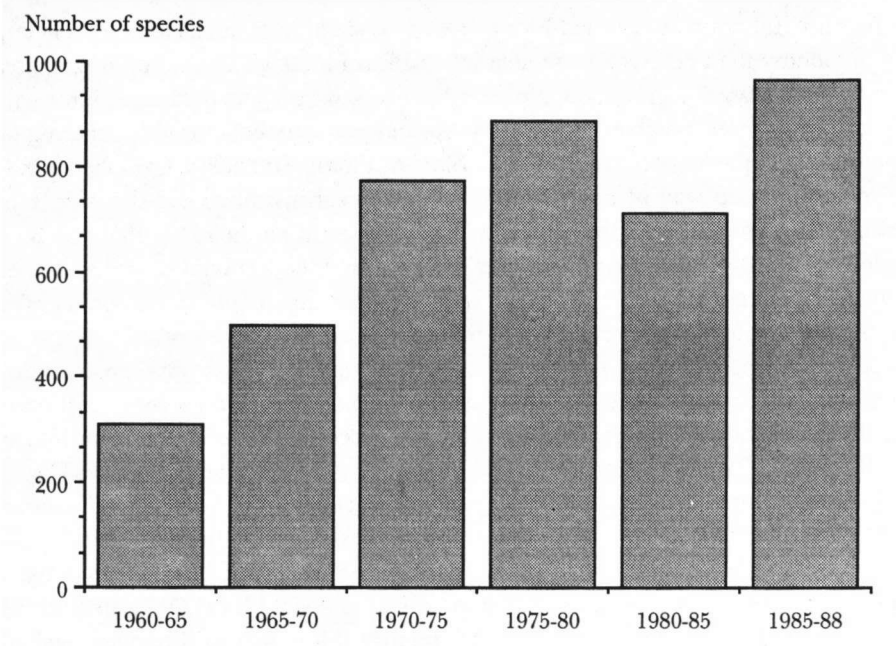

Fig. 3. Aggregated number of species published in the Floras shown in Figure 2 averaged over five yearly periods.

By contrast, the major descriptive regional Floras of the tropics are maintaining a rate of no more than 110 to 220 species a year (Table 1). The most notable impression from Figure 1 is the similar patterns of consistently slow progress. The annual product (Fig. 2) is somewhat irregular, but on a five-yearly average (Fig. 3) there is a step-wise increase as Flora Malesiana, Flora of Southern Africa and Flora Neotropica came into production, but over the last fifteen years there has been only a small fluctuation around 850 species a year. The projections for completion in Table 1 look most unrealistic for the large Floras, with figures of 150 to 400 years. Even if averaged out of the total of 154,000 species, or say 120,000 allowing for 20% overlap of species between Flora areas, it would take more than a century at present rates.

SIZE OF FLORAS

The time to complete a Flora depends essentially on the number of species, the format (scope and design) and the manpower (De Wolf 1964). The problems of traditional Floras aggregate for areas including more than 10,000 species. As the size of a Flora increases, the problem of large under-researched groups becomes more intractable (Jacobs 1969). The useful life of any Flora is about 40 years, so some sort of replacement system of successive editions or compendia has to be envisaged.

A prime function of regional Floras is to provide a more consistent nomenclature and taxonomy than emerges from a series of local Floras given, but monographs are sparse and costly. The introduction of word-processed texts and databased information now allows a more flexible response for various end-products in which the regional Flora may become less central. The local Flora or Florula (Prance & Campbell 1988) is the most effective way of collaborating with tropical institutes and devising a programme of plant exploration, education and short-term publications that can be upgraded as occasion arises. From the user's viewpoint Floras should be as local as economically viable and written for use in the field (Symington 1943). Swapping of text and figures should aid the production of more local and national Floras.

The co-ordination of a consistent nomenclature and, as far as possible, a common taxonomy could be attempted by soliciting the widest international collaboration in a worldwide synthesis, ideas for which are currently being circulated as a Plant Information System, a Species Plantarum Project or a series of continental databases. The gaps could be filled by revisionary studies targeted at critical groups of economic importance and biological complexity, with broader-based studies at generic to family level.

The cycle of monographic and floristic eras (Stafleu 1959; Frodin 1984) and the single stepwise refinement from routine to critical regional Floras (Van Steenis 1954) should be broken. Nonetheless the concise regional Flora may still remain a valuable frontline synthesis (Heywood 1984). The continental area provides the most practical level to revise large and critical groups. From a knowledge at that level it is relatively easy to check representatives of a group in adjacent regions to see if they are conspecific or congeneric (Jacobs 1969). Generic studies on a broader scale do not need detailed floristic knowledge of individual species. The floristic richness and relatively poor state of knowledge of the neotropics present special difficulties that imply an even greater need to identify and target special problems (Prance & Campbell 1988; Raven 1989).

SCOPE AND DESIGN

The scope and design of the Flora affects the production rate by a factor that is difficult to quantify. There is some conceptual link between a concise Flora that aims to record what is already known and a semimonographic Flora that envisages considerable fieldwork, original research and detailed citation of bibliography and specimens. There is no logical connection; all Floras envisage precursory papers, so concise Floras can be backed up by research papers as detailed as the taxonomic problems warrant. In future that part of the information of interest only to other taxonomists could be stored on disk or issued as cheap limited editions. Furthermore most species (perhaps 80% except in very poorly known regions) are taxonomically relatively straightforward in any Flora and detailed documentation (e.g. of bibliography and minor morphological details) is not cost-effective.

The synoptic format of the Flora of West Tropical Africa was rejected for the current series of tropical regional Floras. The restriction of text almost entirely to keys and an extended citation of specimens markedly reduces its value in the field. It was, however, economic of manpower, two botanists working successively nearly full-time accounted for 5,129 of the 7,349 species of the second edition in just 21 years, a rate of 244 species a year.

The other African regional Floras are somewhat fulsome and have tended to become more elaborate over the years. Certainly the economies established in the Flora of Australia, with short descriptions, minimal specimen citations and the bare essentials of bibliography would have been sensible. For this sort of format middle grade botanists at Kew would be expected to write about 60 species a year with about half their time allocated to that job. Only the most dedicated Flora writers achieve that rate, but do make significant inroads, one-quarter of the Flora of Tropical East Africa written by one botanist. De Wolf (1964) gave a general estimate of 50–100 species a year and Van Steenis (1979) revised an earlier estimate of about 80 species a year to 15–20 in view of experience with Flora Malesiana. Taking 50 species a year as a reasonable half-time contribution to a regional Flora, the rates of 110 to 220 species a year achieved by all the major tropical regional Floras imply either a manpower allocation of only 2 to 4 botanists, or a major dissipation of effort into activities other than Flora writing.

In the early years of the tropical African Flora projects considerable field work was undertaken by the staff and was stimulated locally, more original research was undertaken than anticipated, temporary staff were repeatedly lost to more secure jobs and when absorbed on the permanent complement in the mid-1960's other duties were imposed. Although a lot of preparatory work had been done for Flora Malesiana (Van Steenis 1954) the core team continued to put much time into bibliographic research for fear of overlooking names that might have priority, in plant exploration, naming and listing specimens. After the Flora Malesiana Foundation was absorbed by the University of Leiden more time was spent on teaching. The Flora of Southern Africa project made a major investment in the 1970's databasing the primary collections. This is of lasting value but deflected resources, despite judicious efforts to identify Flora and curatorial teams and to streamline the Flora production, effects of which are now apparent (Figs. 1 & 2).

Flora Neotropica employs no staff, but maintains an umbrella organisation and publication facilities for regional monographs. It provides a useful service for dedicated monographers despite a more rigid format than appropriate for revisionary work at that level. There is some tendency for the monographic style to percolate down to smaller regional Floras. Team work is needed to tackle large complex groups, exemplified by current progress on Annonaceae, but resources are woefully inadequate. For large groups there is increased risk of a series of monographed fragments. Such is proposed for Leguminosae, whereas useful legume books for each country would seem the proper goal now, exchanging materials, skills and local knowledge as appropriate. Checklists, such as already available in this case for the whole area through the International

Legume Database and Information System, provide a good start. The argument that monographs are needed before Floras can be written is outmoded and untenable at present rates of investment.

MANPOWER

Organisers of Floras have relied on four sources of manpower

1) a pool of specialists, variously employed or superannuated in museums, botanic gardens, teaching establishments and overseas government services, or amateurs;
2) core staff of major institutes seconded part-time, often providing the administrative and senior editorial services;
3) personnel hired, often on a temporary basis, for the project, and
4) post-graduate students.

The proportions contributing to certain Floras are shown in Table 2. Organisers rely mostly on seconded staff before they are promoted overly to administration and on hired personnel so long as they can be retained. Outside specialists are fickle, indirectly managed and prone to monographic tendencies. Their contribution free of cost is a bonus, but there may be penalties in a competitive market and the stream of requests for their time is often constraining. Postgraduate students are transient and untrained. They are most effectively used to fill the gap between floristic and monographic studies, rather than as Flora writers, but will be used significantly for University-based projects.

The earlier regional Floras of the current era were reasonably staffed. In 1960 the Flora of Tropical East Africa project directly employed two senior botanists, two assistant botanists and three technical staff apart from part-time secondment of several senior Kew employees and involvement of botanists in East Africa. Flora Zambesiaca also had a small staff and support from several collaborating institutes. Over the last two decades the Flora Malesiana Foundation employed a staff of eight to ten. As these projects were absorbed into mainstream activities of their respective institutes competing pressures have sapped the resources. The proportion of Flora Malesiana contributed by staff and students at Leiden has fallen over the years (Geesink 1990).

The funding of long-term regional Floras, unless also national Floras, is currently disfavoured both by national and international agencies and reliance is made increasingly on the vision of institutional directors releasing scarce resources to an old ideal. It is planned to complete as much as possible of the residual African Floras undertaken at Kew by the mid-1990's, but a limit has to be put on official commitment thereafter. In the interim, however, these projects have a high priority. An effort should be made to reinstate the staffing for current Floras that pertained in the 1960's, but more than that is unrealistic.

CONCLUSIONS

The chief cause of delay in the production of major regional Floras in the tropics has been a lack of organisation. The organisers allowed resources to diffuse too readily into plant exploration, detailed documentation, precursory research and unnecessarily complex formats, at the expense of actual Flora writing. In so far as investment can be restored to the level of the 1960's, the information and experience gained, combined with new technology, should permit at least a doubled rate of production if that is the corporate wish of institutional directors. The encouraging factor is the idealism of botanists, who have a remarkable record of collaborating and adapting their working practices to the visions of their leaders.

"Avec de rares exceptions la presque totalité des botanistes est pénétrée du sentiment de la justice et des convenances. Les botanistes sont ordinairement et devraient être toujours des hommes paisables, inoffensifs, indulgents pour les erreurs de leurs confrères, et occupés bien plus de l'avancement de la science que de leurs intérêts ou de leurs petits glorioles." (A. de Candolle 1880).

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