

The Flowering and Fruiting of *Corypha elata* in South Florida

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The flowering of a specimen of *Corypha elata* Roxb., P.I. 74425, in the summer of 1972 at the Subtropical Horticultural Research Station, U.S. Department of Agriculture (formerly United States Plant Introduction Station, Chapman Field), Old Cutler Road, Miami, Florida, the first known flowering in the continental United States, permitted the following observations on the flowering process and a detailed analysis of inflorescence construction in the genus *Corypha*. Some account of the bioenergetics of the palm is also made which allows us to assess the extent to which biomass is diverted into vegetative and reproductive processes.

Although the *Corypha* inflorescence has been mentioned frequently in botanical texts as a dramatic example of flowering because of its overall size (see also Hodge, 1961), the branching pattern has never been described in detail. The present article in part does this and affords a comparison with inflorescence construction in two other hapaxanthic (once-flowering) palms, *Nannorrhops* (Tomlinson and Moore, 1968) and *Metroxylon* (Tomlinson, 1971). The overall appearance of the inflorescence of *Corypha* is indicated by Blatter (1926) and elaborated by Douglas and Bimontoro (1956) who made a point-by-point comparison of inflorescences in

C. elata and *C. umbraculifera* L. which established useful diagnostic features. There appears to be less information concerning other species.

The Specimen

The palm in question (Fig. 1) originated from a batch of seeds from the Philippine Islands received at Chapman Field on July 17, 1927, which germinated shortly thereafter, were moved to eight-inch flower pots in 1932 and planted out in 1935. At the time of flowering in June 1971 the palm was 44



1. Overall view of specimen in flower, July 27, 1971.

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Table 1. *Corypha elata* in flower, 46 years old at time of measurement (April 1973).

Overall height	19.3 m (63' 6")
Height to lowest inflorescence branch	14.9 m (48' 10")
Height of inflorescence	4.5 m (14' 8")
Diameter breast height (3' 6")	0.86 m (2' 10")
Diameter immediately below inflorescence	0.46 m (1' 6")
Total volume of palm (calculated)	5.1 m ³
Total number of leaf scars visible on above-ground part of trunk	c. 350

years old from seed. It is not known if other palms from the same seed source are in the Miami area. As indicated below, the period of flower presentation is quite short but the fruiting process is extended; seed continued to ripen for about 18 months. In March 1973 all fruits had fallen and the palm was felled so that the inflorescence could be examined before it decomposed. Previously, in February 1972, a single first-

order branch (9ax₁—see below) was cut to obtain a measurement of fruit weight. Unfortunately, no samples of flowers were obtained; the illustrations of flowers which are included (Fig. 9E, F) are from a collection of *Corypha* sp. (*Read s.n.*) supplied via Dr. H. E. Moore, Jr. Table 1 summarizes relevant dimensions.

Foliage leaves have an encircling leaf base, split down the back in the manner

Table 2. *Corypha elata*. Sequence of events in later stages of inflorescence development, 1971.

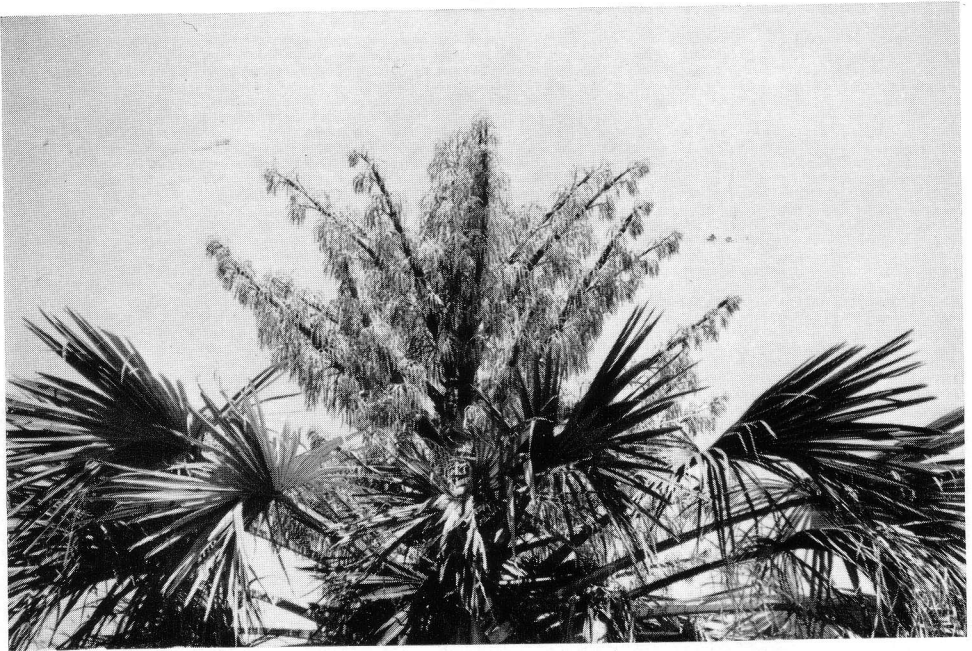
June 10	Main axis (ax ₀) extended well above crown which is still intact. First-order branches (ax ₁ 's) well extended. Few second-order branches (ax ₂ 's) exposed (Fig. 2).
June 16	First-order branches completely extended, numerous second- and third-order branches exposed; rachillae evident (Fig. 3).
June 18	Very first flowers at anthesis; crown still intact (Fig. 4).
June 21	Numerous flowers at anthesis.
June 22	Lower leaves pendulous, upper leaves beginning to droop.
June 29	Inflorescence in full flower; maximum number of flowers at anthesis.
July 2	Most leaves drooping.
July 18	Many flowers fallen, but flowering continues; some rachillae appearing bare.
July 25	Flowers still at anthesis; all leaves drooping.
July 27	Young fruits first evident (Fig. 5).
August 20	Crown completely collapsed, all leaves pendulous; young fruits conspicuous (Fig. 6).
September 15	Inflorescence densely covered with fruits of almost full size. Leaves shrivelled, no longer green.



2. June 11th: first-order branches well extended and completely enclosed by tubular bracts.



3. June 17th; extension of first-order branches complete, second-order axes extended to expose the rachillae.



4. June 18th; overall view of inflorescence shortly before beginning of flower opening; crown still intact and leaves erect.



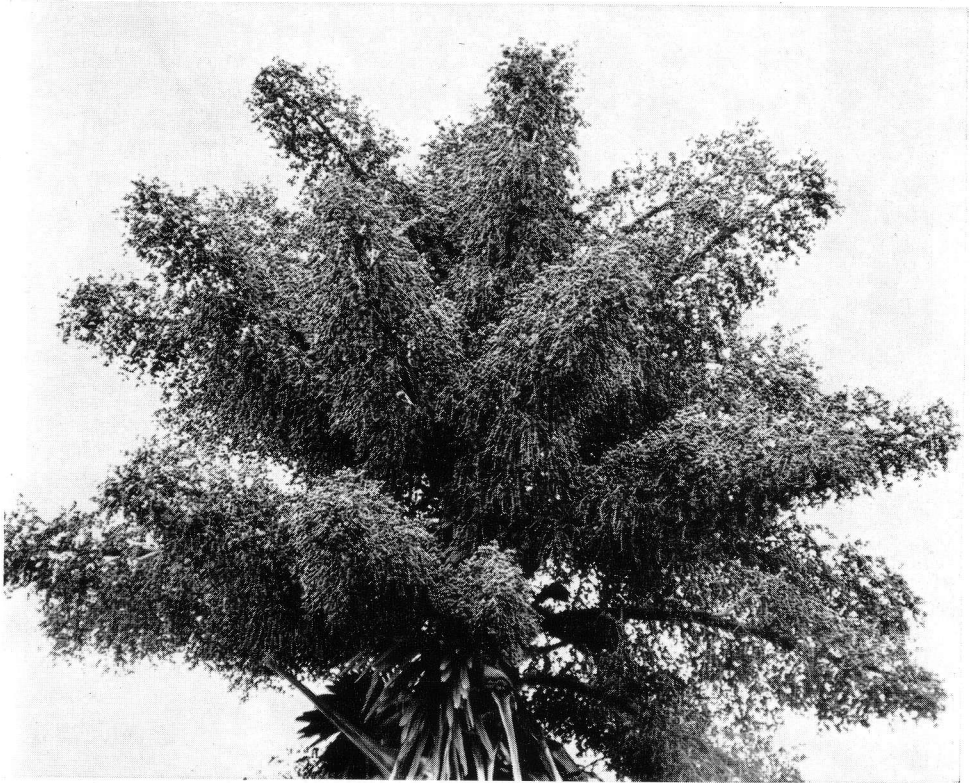
5. July 27th; late stage, most flowers fallen; crown collapsed, leaves pendulous.

of a number of fan palms (*Sabal*-type leaf base of Tomlinson, 1962). The petiole is grooved adaxially and has stout, coarse, marginal teeth, in contrast to the finer teeth of *C. umbraculifera* (Douglas and Bimontoro, 1956). The blade is costapalmate.

Flowering

The series of photographs (Figs. 1-6) illustrate the later stages of inflorescence development which began in early 1971 but for which we have no precise date. The time sequence of significant events is provided by Table 2.

These observations show that the period of actual anthesis (pollen presentation) for the whole inflorescence is quite short in comparison to the palm's total life. Beginning on June 18th, all flowers seem to have completed their expansion and pollen shedding by the end of July. *Corypha elata* is clearly self-compatible since this was the only palm in flower



6. August 20th; young fruits approaching full size.

in South Florida and viable seed was set in abundance. We have no precise knowledge of the pollinators; bees visited the flowers in considerable numbers, but the odor is described as "offensive" by Douglas and Bimontoro.

Fruiting

Fruit enlargement was rapid, but the overall fruiting period was quite lengthy. Although fruits of apparently full size were present from mid-September (three months after the peak period of anthesis) at which time the inflorescence branches were densely crowded with green fruits, these remained on the tree for another year before they began to fall, suggesting a long period of embryo maturation. We have no further de-

tailed observation to support this suggestion. The proportion of viable seeds in the crop seems very high and probably approached 100 percent. Details of total productivity are given later. An illustration of the amount of fruit on one branch of the inflorescence is given in Figure 7.

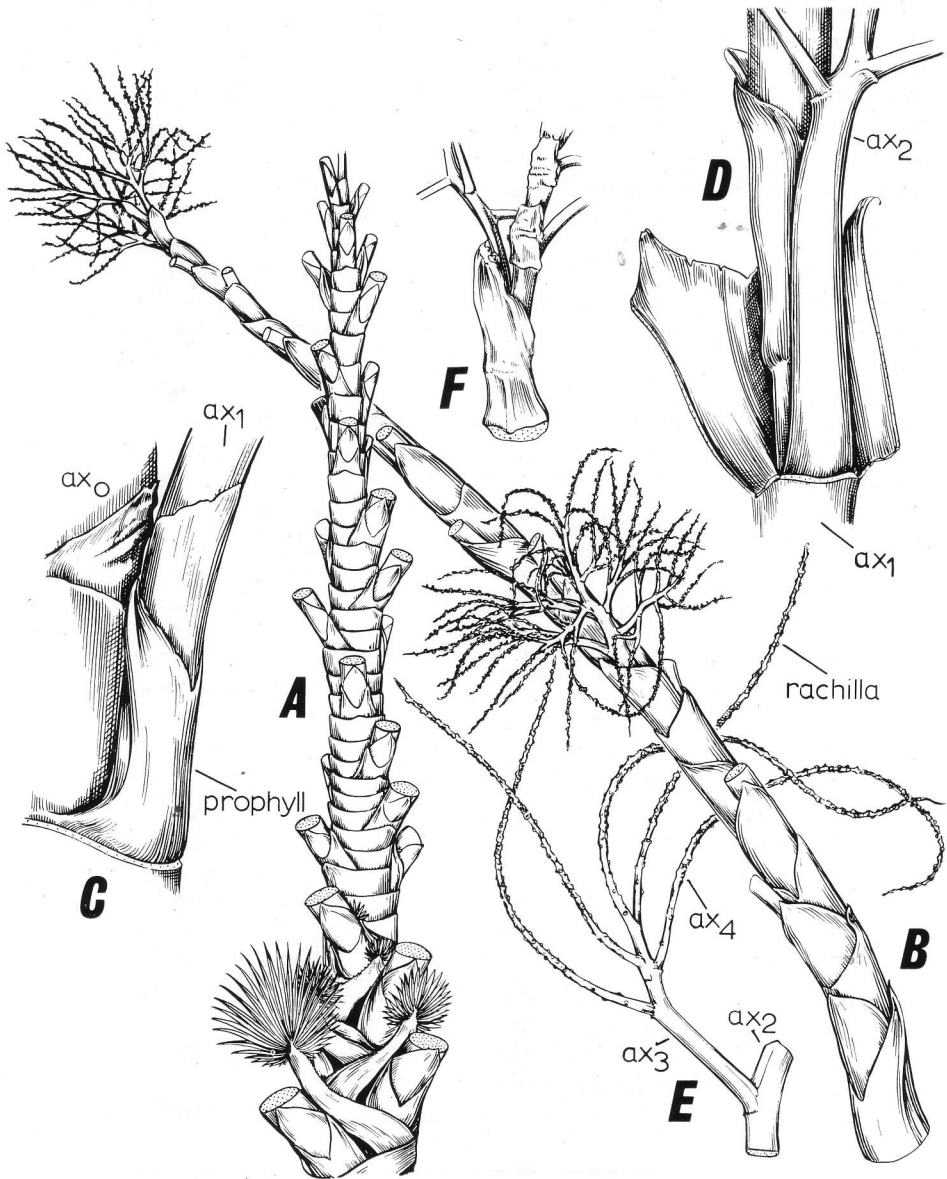
Inflorescence Construction

The *Corypha* inflorescence has the same simple principle of construction as has been described for *Nannorrhops* (Tomlinson and Moore, 1968) and *Metroxylon* (Tomlinson, 1971). The vegetative axis is continuous with the main axis of the inflorescence and there is a transition from foliage leaves through leaves with reduced petiole and blade



7. February 9, 1972; fruiting branch (9 ax_1) cut from the palm. The "crop" is in the two galvanized buckets. Photo by M. H. Zimmermann.

8. *Corypha elata*, details of inflorescence construction. A. Main axis (ax_0) of entire inflorescence, with all first-order branches cut off near their insertion ($\times \frac{1}{24}$ approx.). The distal end of this



is drawn in detail as Fig. 9A. B. Entire first-order branch (13 ax_1) with all large second-order branches except one removed ($\times \frac{1}{16}$). C. Details ($\times \frac{1}{6}$) of insertion of a first-order (ax_1) branch on the main axis (ax_0), subtending bract (br_1) removed (its scar represented by the stippled band). This shows the overlapping prophyll (1 br_2) and second bract (2 br_2), both of which are empty. D. Details ($\times \frac{1}{6}$) of insertion of a second-order (ax_2) branch on a first-order axis (ax_1), subtending bract (br_2) split down back; the base of the branch shows no modified prophyll. E. Details ($\times \frac{1}{4}$) of a third-order (ax_3) branch inserted on a second-order branch (ax_2). There are fourth- but no fifth-order branches on this system. All axes end in flower-bearing rachillae. F. Details ($\times \frac{1}{6}$) of a distally inserted first-order branch (38 ax_1) in which the prophyll (1 br_2) subtends a second-order branch (ax_2)—cf. Fig. 8C.

to modified leaves or bracts (Fig. 8A). Any of these organs, whether modified or not, that subtends a first-order branch of the inflorescence is here considered a bract for purposes of numbering. Bract is also an appropriate term to refer to modified leaves on second and subsequent orders of branching.

It is convenient to refer to the parts of this system of branches by symbols; ax for axis or branch, br for bract. Parts may be indicated by numbers, e.g. ax_0 —main axis, ax_1 , ax_2 , ax_3 . . . etc. for first, second, third . . . etc. order of branch. Bracts may similarly be designated according to the order of branch which they subtend, e.g. br_1 is a bract on the main axis (ax_0) subtending an ax_1 , br_2 would subtend an ax_2 . . . etc. Any axis can then be identified by numbering from the base, e.g. $9ax_1$, the ninth first-order branch.

Internode length along the main axis changes little in the transition from the vegetative to the reproductive phase, except that distal internodes are shortest. There is, however, a rapid decrease in diameter of successive internodes. In Figure 10 internodes have all been drawn of equal length. There is a rapid increase in rate of extension relative to the vegetative phase so that in a matter of a few months the panicle stands above the old leafy crown. The reduction in leaf size previously mentioned, resulting in tubular, sheathing bracts, is clearly correlated with decrease in internode diameter.

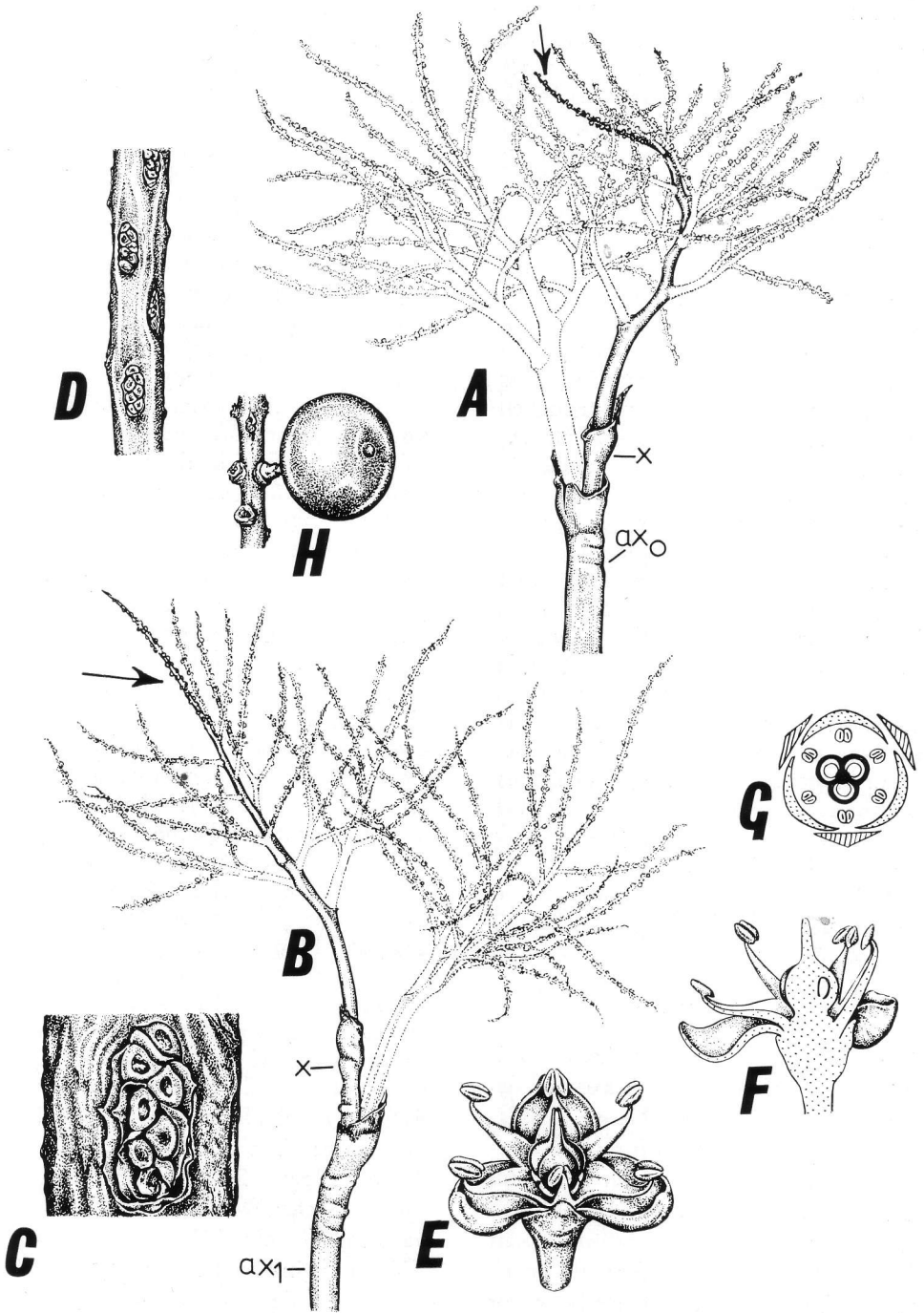
The lowest leaves on the main axis of the inflorescence have a dorsal cleft through which the subtended branch protrudes. This observation is contrary to that of Douglas and Bimontoro (1956) who emphasized that in *Corypha elata* the first-order branches protrude through the mouth of the sheath, in contrast to *Corypha umbraculifera* where they protrude through the dorsal cleft. This is probably not a good diagnostic feature by which to distinguish the two species since both conditions can occur on one axis. Bracts on the first-order branches (br_2 's) are tubular and papery, and resemble the distal bracts (br_1 's) on the main axis.

To give an accurate impression of the skeleton of the inflorescence, it is represented diagrammatically to scale in Figure 10. Here all the branches are drawn in one plane, whereas, in fact, they are arranged in a spiral which corresponds to that of the $3/8$ phyllotaxis. The most evident features of this spiral are certain parastichies. One series of these can be seen clearly in Figure 8A, which represents most of the main axis with each first-order branch cut off a little above its base. These parastichies probably correspond to those which are evident on the vegetative trunk and which serve as a diagnostic feature for this species (Douglas and Bimontoro, 1956).

Almost every bract subtends a single branch; the exceptions are empty bracts at the base of each first-order axis (Fig. 8B, C). On the proximal first-order

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9. *Corypha elata*, further details of inflorescence construction. A. Termination ($\times 1/6$) of main axis (ax_0); its continuation into a rachilla is shown (arrow). Branches are shown in dotted outline. B. Termination ($\times 1/6$) of the first-order branch ($13 ax_1$) illustrated in Fig. 8B; its continuation into a rachilla is shown (arrow). Branches are shown in dotted outline. C. Single flower cluster ($\times 8$) with flowers represented by their scars; bracteoles evident. D. Portion of a rachilla ($\times 2$) with spirally-arranged flower clusters. E-G. Flowers of *Corypha* sp. ($\times 9/2$), from above (E), in longitudinal section (F), and as a floral diagram (G). These flowers are from a separate collection, *Read s.n.* Kingston, Jamaica. H. Ripe fruit attached to flower cluster on a rachilla ($\times 1$).



branches the first two bracts are commonly empty (Fig. 11). The first (1 br_2) is a distinct bicarinate prophyll (Fig. 8C). Second-order branches (ax_2) lack such a modified prophyll (Fig. 8D). There is an abrupt transition in bract shape from first- to second-order branches. On the first-order branches, bracts are tubular, except for distal ones; on second-order branches, the bract is represented merely by a short scale or even a ridge of tissue (Fig. 8D, E). An entire first-order branch with all but one ax_2 cut off is shown in Figure 8B; similarly, a single first-order branch is shown to scale in Figure 11, but with the second-order branches along it shown in one plane.

Branching continues to the fourth order on most second-order branches (Fig. 8E); branching to the fifth order is uncommon and occurs only on the lower parts of second-order branches, as shown in Figure 12. To indicate further the constructional principles, a first-order branch ($9ax_1$) is drawn out to scale in Figure 11 while a second-order branch* is shown diagrammatically in Figure 12. Comparison of the diagrammatic figures (Figs. 10–12) with the actual representation of parts in Figures 8 and 9 should allow one to reconstruct mentally the overall architecture of this inflorescence.

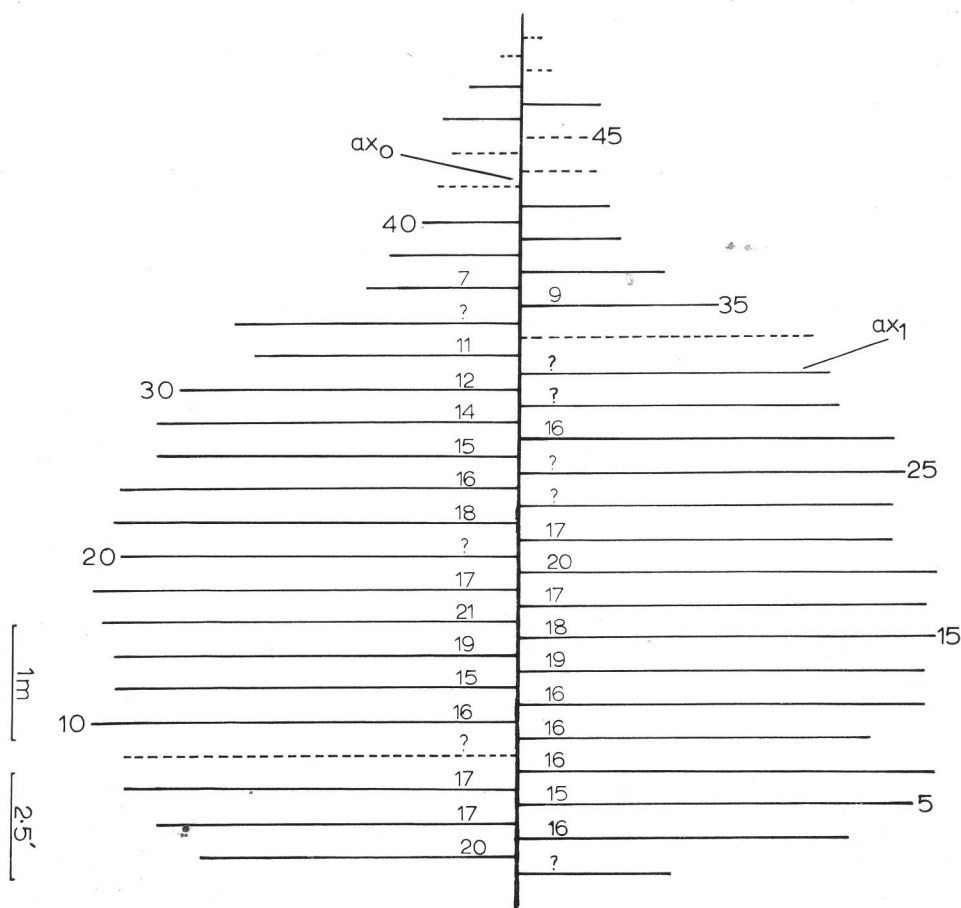
Rachillae

All axes end in rachillae, i.e. the ultimate visible flower-bearing axes, as defined by Tomlinson and Moore (1968). They are surprisingly uniform and average 25 cm. in length, which is helpful in subsequent calculation (Fig. 8E).

Distal parts of both the main axis and all first-order branches are much modified and resemble a second-order branch system, as is evident in Figures 9A, B. Similar modifications may be

seen in the first-order branches themselves. A distal first-order branch (38 ax_1) is shown in Figure 8F; here the prophyll subtends a branch and the bracts are scarcely tubular. Details of the end of the main axis (ax_0) itself is shown in Figure 9A, and of the end of a first-order branch (13 ax_1) is shown in Figure 9B to indicate the degree to which massive axes become reduced distally. There is usually a single empty bract below the ultimate branch system (x in Fig. 9A, B). Each axis terminates in a rachilla, following the rule we have pointed out; this terminal rachilla is shown in Figure 9A and 9B (arrows) with the branches in dotted outline to contrast with the parent axis. It is remarkable that the apical meristem of the palm, which in the vegetative condition generates an axis up to three feet in diameter, finally terminates in the narrow flower-bearing axis indicated by the arrow in Figure 9A.

The flowers are borne in clusters whose detailed morphology represent modified cincinni (Uhl, pers. comm.) of the type which occurs in other coryphoid palms (e.g. Uhl, 1969). The significant functional unit may be the flower cluster itself as much as the individual flower, and we largely restrict ourselves to a consideration of this unit in subsequent analysis. Flower clusters are elongated and arranged in regular spirals along the rachilla (Fig. 9C, D). Bracteoles are associated with the flower clusters, on the basis of one bracteole to one flower; the whole cluster itself is subtended by a single bract, represented by little more than a crescentic ridge of tissue. Figure 9C represents an old flower cluster from which all flowers have fallen, only their scars remaining without setting fruits. There seem to be from 5–10 flowers per cluster, but the number of functional flowers is difficult to establish.



10. *Corypha* inflorescence *in toto*. The main axis and first-order branches (ax₁) drawn to scale. The branches are all represented in one plane (not in the shallow spiral on which they are actually inserted—cf. Fig. 8A). Dotted lines represent incomplete branches or those which were not measured. Numbers to far left and right number axes successively, counting lowest as 1. Numbers near the insertion of each branch represent the total number of branched second-order branches (ax₂) on each first-order branch (ax₁), i.e. corresponding to the one drawn into Fig. 8B.

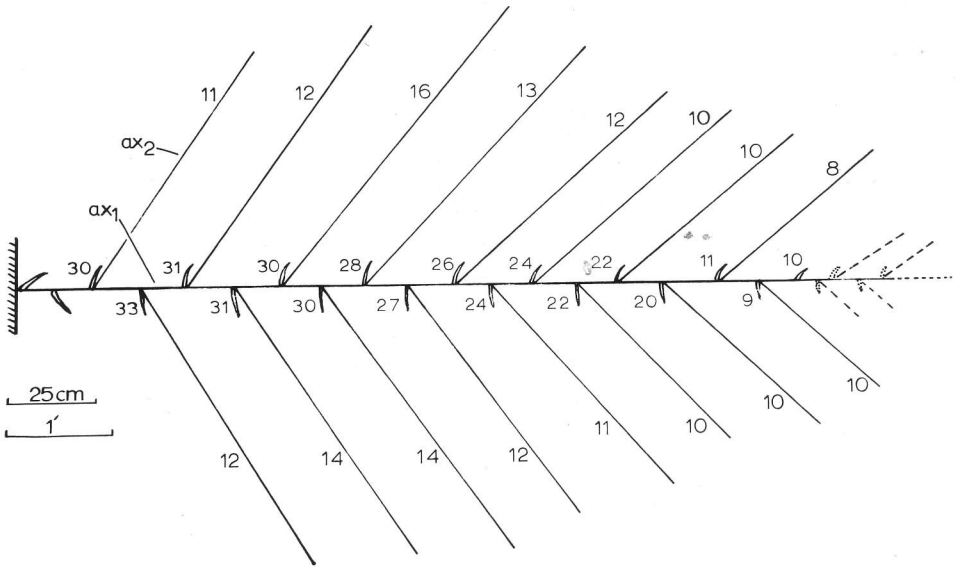
Flowers and Fruits

Flowers are perfect, with the parts in 3's but with 6 stamens. An example is shown from above, in vertical section and as a floral diagram in Figure 9E, F, and G respectively. The three carpels are fused; each contains a single ovule but normally only one of the three functions. Usually only one fruit per flower cluster matures (Fig. 9H); rarely are there two. Fruits are about 1.5 cm. in

diameter at maturity with an average dry weight of 2.3 gm. In old rachillae the sites of ripened but fallen fruits are easily identified by the persistent, enlarged and flattened calyx. These fruit scars are used in the counts presented subsequently.

QUANTITATIVE ASPECTS

So far we have established the constructional principles of the *Corypha*



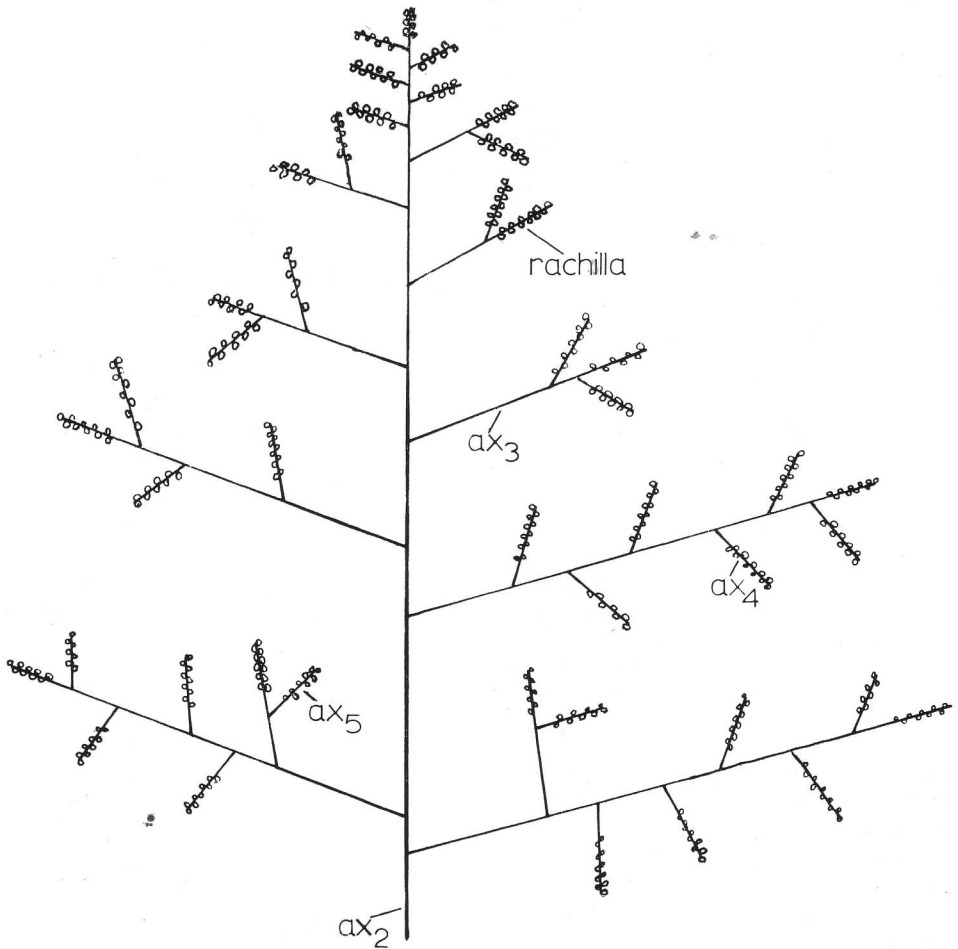
11. One first-order branch (9 ax_1) drawn to scale, showing the length of all branched second-order branches (ax_2). Branches are shown in one plane, not in the irregular spiral they actually describe. Numbers towards the end of each branch indicate the number of third-order branches (ax_3) on each second-order branch. Numbers at the base of each branch indicate the length (in cm.) of the subtending bract. This branch corresponds to the entire unit illustrated in Fig. 8B.

inflorescence on a qualitative basis. A series of measurements were made of quantitative features from representative samples which permit us, by a series of approximations, to arrive at the overall reproductive potential of this inflorescence. The calculations are a little involved, and only the results, with some indication of how they were arrived at, are included here.

Flower Number

Flower number is obtained from information about the total length of flower-bearing axes on the inflorescence; effectively an estimate of the total length of all rachillae was made. This is provided by the following information, added to an estimate of the total number of first- and second-order branches (omitting branches 49-51) taken from Figure 10, as follows:

Total number of first-order branches	=	48
Total length of all first-order branches	=	97.65 m. (320.3 ft.)
Average number of second-order branches per first-order branch	=	13.3
Total number of second-order branches	=	640
Average number of rachillae/second-order branch	=	33
Total number of rachillae	=	21,120
Average length of one rachilla	=	25 cm.
Total length of all rachillae	=	5,280 m.
Average number of flower clusters/rachilla	=	75
Estimated total number of flower clusters	=	1.58×10^6



12. *Corypha* inflorescence, ultimate branch complex, an actual example, but not drawn to scale. This corresponds to the single branch unit drawn in detail in the middle of Fig. 8B. Ultimate units (rachillae) are represented diagrammatically.

Estimated range of
 numbers of possible
 functional flowers = $3-15 \times 10^6$

The total number of flowers is not easily obtained, regardless of how precisely one is able to estimate total number of flower clusters, because the number of actual flowers in each cluster varies, but more importantly because a knowledge of the number of flowers in each flower cluster which reach functional maturity is quite imprecise (Fig.

9C suggests seven flowers on the basis of their scars). We have seen that each flower cluster normally produces, at most, one fruit, so that it may be hypothesized that the successful fertilization of one flower in a cluster causes the inhibition of further maturation of all younger flowers. In the above calculations we have used a range of 2-10 flowers per cluster in arriving at a range of final figures.

On this hypothesis the total number of flowers reaching anthesis per cluster

is simply a function of the age before successful pollination of any flower within each cluster. This is why it is biologically most meaningful to consider the flower cluster as the significant reproductive unit.

Estimating flower number on this basis we have arrived at a figure of the order of 10×10^6 for the total number of flowers per inflorescence (i.e. 10 million). This figure, having been arrived at by a series of approximations, can give us no more than an indication of the order of magnitude in the number of flowers produced, but the very large number involved can be grasped. Of particular interest is the total length of flower-bearing axes (i.e. rachillae) on this inflorescence; our figure is 5,280 m., i.e. if all the rachillae were laid end to end they would stretch more than three miles!!!

A more precise figure is obtained for the total dry weight of the fruits in this inflorescence, since a whole first-order branch (9 ax₁) with fully enlarged fruit was cut from the palm on February 1972 (Fig. 7). The total weight (wet) of fruits from this branch was measured together with the dry weight of a smaller sample. An estimate of the fraction of the total inflorescence represented by this axis is easily obtained from the information in Figure 10 and, assuming a continuous proportion between axis length and numbers of fruit borne, allows a calculation of total fruit weight (wet and dry). The value for the total fruit weight (dry) obtained in this way is 817.2 kg.

We have calculated the total number of fruits produced by two different means. On the one hand, by obtaining an average of the number of fruit scars per rachilla (11.5), and multiplying this value by the total estimated number of rachillae and, on the other hand, by dividing the average weight of a single

fruit (2.3 gm.) into our estimate of total fruit weight. The values arrived at are 242,800 and 355,290 fruits respectively. These figures are sufficiently close to suggest that our approximations represent something more than well-educated guesses and indicate that the inflorescence produced about a quarter of a million fruits. The values arrived at for fruit weights are: a) from dry weight of a large sample = 817.2 kg.; b) from an estimated 15 percent of flower clusters which form fruits = 545.1 kg.

Bioenergetics

We have so far established reasonably accurate figures for the total amount of dry matter (or "energy") which goes into the production of fruits in the flowering of this hapaxanthic palm and have produced a minimum value of 545.1 kg. It is interesting to ask "What proportion of the total biomass produced by the palm in its lifetime goes into its reproductive effort?" A series of measurements as follows gives us some indication of this value:

Total trunk biomass	= 863.5 kg.
Total leaf biomass	= 2,023 kg.
Total root biomass	
(estimated)	= 288.6 kg.
Total inflorescence biomass	= 49.3 kg.
Total biomass of fruits	= 545.1 kg.
Total biomass	= 3,769.5 kg.

These values are obtained crudely, as follows:

Trunk biomass. From an estimate of the total volume of the trunk (calculated from its dimensions and treating it as a regular truncated cone) and a knowledge of the dry weight of a small sample of calculated volume.

Total leaf biomass. From an estimate of the approximate total number of

leaves (counts of visible leaf scars, plus estimated 10 percent for leaf biomass produced in juvenile stages, i.e. before a visible trunk is developed) and a knowledge of the dry weight of a leaf taken from a cultivated specimen.

Total root biomass. A rough estimate of 10 percent of total leaf and trunk biomass.

Total inflorescence biomass. From a knowledge of the dry weight of samples of the inflorescence and the information contained in Figure 10. No account is taken of the weight of flowers, which were not available in our sample.

It is well known that starch accumulates in the trunk during the vegetative period and is rapidly mobilized and utilized during the flowering process, offering an interesting subject for study by translocation physiologists (van Die and Tammes, 1975). *Corypha* itself has been used extensively as a source of sugar and eventually alcohol by artificial tapping (Gibbs, 1911).

We can divide this mobilized reserve into that part which goes into the construction of the skeleton of the inflorescence and that part which goes into the fruits. On this basis we have the following figures:

Total biomass of the	
<i>Corypha</i> palm	= 3,769.5 kg.
Total biomass of fruits	= 545.1 kg.
Total biomass of	
inflorescence	= 49.3 kg.
Total reproductive	
biomass	= 594.4 kg.
Percentage of total	
biomass in repro-	
ductive biomass	= 15.77%

[If the higher value of fruit biomass (817.2 kg.) is used, the result is about 22%]

From these calculations, we can see that, if our measurements are at all reliable, the *Corypha* palm expends about 15 percent of its total energy budget on reproduction. The value should be corrected by a factor which accounts for loss of energy via respiration during the vegetative period of growth, i.e. the total biomass is underestimated by this factor but the value (e.g. 10 percent) would reduce the final percentage by a small figure.

CONCLUSIONS

From the above calculations, it can be concluded that about 15–20 percent of the total dry matter produced by the *Corypha* palm during its lifespan of about 50 years is eventually directed into its reproductive effort. These figures may seem inordinately high and could suggest that our measurements and the calculations based on them are suspect, which is possible in view of the small samples obtained and the approximations made. However, some corroborative evidence is available. Burkill (1935) records some 200 pounds (about 90 kg.) of starch in a palm which may be extracted as sago. This isolated figure seems too low to account for the dry matter which is finally incorporated in fruits but since we do not know the size of the palm measured, it is not very helpful.

The productivity of *Corypha* is more helpfully indicated by Gibbs (1911) who measured 2,699 liters of sap tapped from a tree with a volume of 2.71 cubic meters in a period of 132 days. The sap contained 252 kg. of sucrose. Average yields for other trees ranged from 180–324 kg. These values are somewhat lower than our calculated figures but it must be remembered that they are based on trees manipulated artificially in order to induce mobilization of reserves; this mobilization is likely to be less efficient

than during the natural process of fruit development. Also the tree measured in detail was much smaller than the one we have measured (2.71 cubic meters compared with 5.1 cubic meters). Our results thus seem to be of the right order of magnitude.

Furthermore, when other plants are considered, the values we have produced seem to represent gratifyingly close estimates. Long-lived woody plants which are monocarpic (once-flowering) are uncommon. The condition is familiar in a number of monocotyledons (e.g. some palms, *Agave*), a few dicotyledons (Hallé and Oldeman, 1970, p. 20), and has recently been described by Veillon (1971) for a branched apocynaceous tree, *Cerberiopsis candelabrum* Vieillard, native to New Caledonia. Otherwise, one has to turn to annual weeds for a comparable reproductive strategy. Here, since the continued survival of the species is entirely dependent on seeds, with the vegetative life span of each individual very short, a large percentage of the total biomass of each plant is expended on reproduction, i.e. the "reproductive effort" of the plant is high. For annual, weedy species, values of the order of 14–35 percent seem typical (Harper and Ogden, 1970). In perennial plants, e.g. trees, the values are much smaller than these although there seem to be no accurate measurements (Harper and Ogden, 1970). In its reproductive effort therefore, *Corypha* is comparable to an "annual" weed, but is unusual for the time span between successive flowerings (more than 40 years) and the stature that the plant achieves (about 20 m.).

It is worth making a more direct comparison with other palms. Precise figures for the African oil palm (*Elaeis guineensis* Jacq.) have been provided by Corley *et al.* (1971), Hardon *et al.* (1972) which show that higher values

(of the order of 50 percent) on the annual basis may be measured, i.e. in any one year the amounts of dry matter partitioned between fruit bunch, on the one hand, leaf and trunk, on the other, are about the same. On this scale, *Corypha* is seen to be less efficient than at least one other palm. The figures quoted for *Euterpe globosa* by Bannister (1970) are less complete but we have used them to arrive at a value of 4.5 percent for the reproductive biomass in this species.

Seed predation is known to be a significant factor in survival of plants with large seeds (Harper *et al.*, 1970). There was some evidence of beetle attack on fallen (and even attached) fruits of *Corypha*, but the high viability of seeds and the enormous numbers produced would seem to ensure survival of the palm. Production of large numbers of seeds at wide intervals is probably an effective way of combating seed predation. However, measurements need to be made on natural populations of *Corypha* with an understanding of the ecology of palms in wild sites.

For the present, our very tentative measurements suggest that despite its massive size, *Corypha* has to function essentially as an annual weed in order to survive.

SUMMARY

A *Corypha elata* palm which flowered and fruited during 1971–72 after 44 years of vegetative growth was estimated to have produced on the order of 10 million flowers on flower-bearing axes of a total length of 5,280 m. (more than three miles). The total number of ripe fruits was about a quarter of a million, with a total estimated dry weight of between 545 and 817 kg. (about 1,200–1,800 lbs.) which represented between 15 and 22 percent of the total dry weight produced by the palm during its total life span.

The palm is comparable to an annual weed in its division of biomass between reproductive and vegetative phases and its massive fruiting over wide intervals of time is probably a very effective way of surmounting seed predation.

Acknowledgements

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