Can Hemiepiphytes be Useful in the Revegetation of Barren Sites?

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ABSTRACT

Hemiepiphytes, when they grow as epiphytes, must start life with minimal nutrition, and presumably, their physiology has evolved to cope with this situation. They should therefore be good candidates for revegetating barren areas. We tested this hypothesis with *Clusia minor*, *Ficus amazonica* and *Ficus trigonata*. Seedlings of each were grown in plastic bags and later planted out on two sites in the sand pit at the Arena Forest where their behaviour and survival were followed from 1993 to 2000. Of the three species, *Clusia minor* was much more promising than either of the other two. The reasons seem to lie in the evergreen habit of *Clusia* and its freedom from attack by leaf-cutting ants.

INTRODUCTION

Hemiepiphytes are plants that will grow free-standing as well as epiphytically. Among tree species, *Ficus* (Moraceae) and *Clusia* (Guttiferae) are the most important of the locally occuring genera. As epiphytes, they must be able to endure long periods of minimal water supply and mineral nutrition. It occurred to one of us (VCQ) that these very properties might make them useful in the revegetation of barren areas. In addition, the plants in both of these genera have fruit that birds or bats feed on, and the dispersal of seeds by these animals, once the plants begin to fruit, would be an additional benefit. We decided to lay down a small trial to test these ideas.

METHODS

Study area

The site we chose was an abandoned sand pit in the Arena Forest from which sand had been obtained for the construction of the Arena Dam in 1977-1982. The Forestry Division had attempted to revegetate the area after the dam had been built. They tried many species and had only a little success. With their permission we had put in a small trial of *Vismia falcata* and *Pentaclethra macroloba*, but we had abandoned that after a couple of years. In 1993 when we began this new trial much of the area was still treeless though growing a cover of weeds and grass.

We decided to give our plants the most severe test they could possibly be given by planting them at two sites on the slopes of the pit where almost nothing had grown since the pit had been abandoned. Fig. 1 shows the location of the two sites relative to the entrance road, and Figs. 2 & 3 show the appearance of each on 11 October 1998. The sites were not only mostly bare but also subject to rapid erosion and leaching out of nutrients. They had both been terraced many years ago. At site 2 where the soil holds together a bit better than it does at site 1 the terraces are still visible. At site 1 where the soil is extremely loose the terraces have been effaced by gullies, in spite of efforts to shore them up with wooden supports.

Planting and recording procedures

Plants were grown from seed in plastic bags and planted out when they were big enough, mostly over 20cm for the two *Ficus* species and 13-17cm for *Clusia minor*. At planting out they were watered once but no fertilizer or compost was used and the plants during subsequent growth received no fertilizer. Each was labelled with a yellow plastic tag bearing the plant's name, the date of planting, the letters TTFNC and a number. Maps were prepared giving the location of each plant. The dates of planting were as follows: Nos. 1-7 10/VI/1993, Nos 8-9 11/VII/1993; No. 10 10/X1993, Nos 11-12 14/XI/1993; Nos 13-23 12/VI/94. To begin with, heights were measured with a steel tape every month but when we saw how slowly growth was taking place they were measured less frequently after 1994. For the correspondence between numbers and species see Table 1.

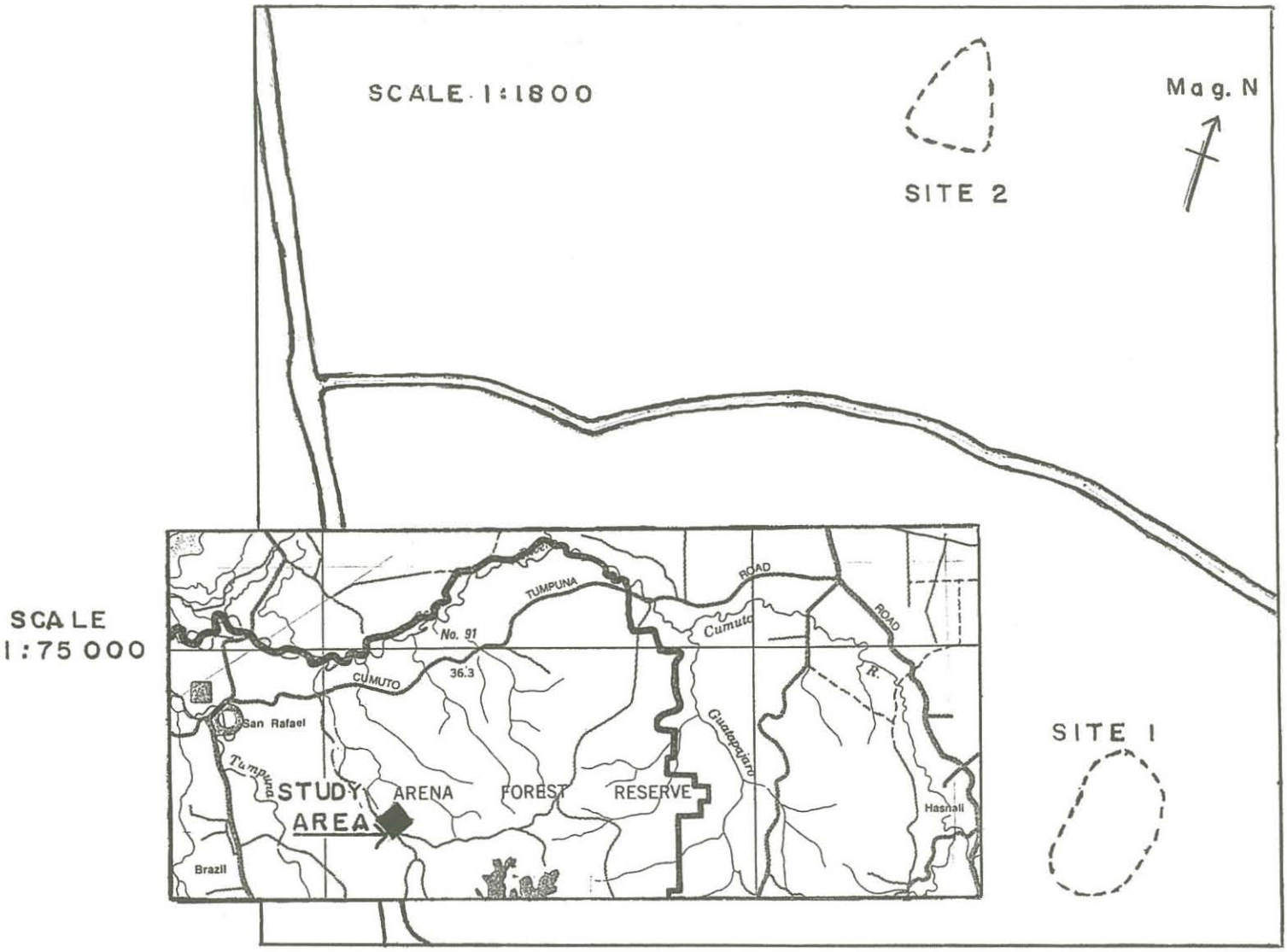

Fig. 1. Study Area

Fig. 2. Site 1 as it was on 11 Oct 1998.

Fig. 3. Site 2 as it was on 11Oct 1998.

TABLE 1.Growth of the plants over the seven years from 1993 to 2000. Measurements are in cm. A = alive D = dead ND=nearly dead NF = not found NR = not recorded

			1993		1994		1995	1996	1997		1998		2000	
Sp	No.	Site	11/7	12/12	21/8	27/11	9/3	11/2	8/1	31/12	20/1	11/10	4/1	28/9
F.am	1	2	40	40	37.5	37.5	-	NF	NF	NF	-	NF	NF	NF
F.am	2	2	36	43	43	42.5	-	40.5	A	NF	-	NF	NF	NF
F.am	3	2	27	35	39.5	40	-	D	-	-	-	-	-	-
F.am	4	1	41	38	38	-	A	NF	A	NF	NF	NF	NF	35.5
F.am	5	1	36	31	31	38	A	NF	A	NF	NF	NF	NF	28
F.am	6	1	40	52.5	64.5	89	-	76	A	A	A	D	-	-
F.am	7	1	23	24	27	-	-	NR	A	A	A	NF	A	61
F.am	8	2	16	34	36	33	-	18	A	NF	-	NF	NF	NF
F.am	9	2	23	49	52.5	51	-	52	A	NF	-	NF	NF	NF
F.am	10	1	-	41	40.5	41	-	44	NF	NF	A	NF	NF	NF
F.trig	11	2	-	23	28	26	-	ND	ND	D	-	-	-	-
F.trig	12	1	-	20	-	20.5	ND	D	-	-	-	-	-	-
F.trig	13	2	-	-	51	52	-	55.5	A	NF	-	NF	NF	NF
F.trig	14	2	-	-	55	59.5	-	60.5	ND	NF	-	NF	NF	NF
C.min	15	2	-	-	17	20	-	24	A	24	-	NF	A	20
C.min	16	2	-	-	13	15.5	-	23	A	43	-	59	A	58
C.min	17	2	-	-	-	17	-	21	A	21	-	NF	NF	NF
F.trig	18	1	-	-	47	49.5	-	49	A	A	A	NF	A	50
F.trig	19	1	-	-	44.5	49.5	-	61	A	A	A	76	A	66
C.min	20	1	-	-	14	16	-	D	-	-	-	-	-	-
C.min	21	1	-	-	14	16	A	20	A	A	26	28	A	30
C.min	22	1	-	-	17	18	-	21.5	A	A	40	43	A	45
F.trig	23	1	-	-	-	37	-	NF	A	A	A	56	A	54

Fig. 4. *Clusia minor* No. 22 as it was 11 Oct 1998.

RESULTS

Table 1 gives a representative sampling of the measurements we made, omitting most of those made during 1993 and 1994, and indicates the presence or absence of plants when we did not measure them. The omitted measurements were those of the dry season months and the middle of the wet season so that the measurements in Table 1 are near the beginning and end of the growing season. Overall, 10 of the 23 plants survived to 28/IX/00 for a percentage survivorship of 43.5. By species, survivorship was 3 out of 10 (30%) for *Ficus amazonica*, 3 out of 7 (42.9%) for *F . trigonata* and 4 out of 6 (66.7%) for *Clusia minor.*

Of the three surviving *F. amazonica* Nos 4 & 5 were shorter on 28/IX/00 than at planting because, in the gullies where they were planted, sand washed from above had accumulated around them and because leaf-cutting ants had cut the stems below the

growing point. No 7 had grown; the original stem had decayed, but two branches had grown, the taller of which at 61 cm was more than double the height at planting out. All had relatively few leaves, No 4 four, No 5 five and No. 7 eleven, seven on the taller branch and four on the shorter one.

Two of the surviving *F. trigonata* (Nos 19 and 23) were about 50% taller than they were at planting out but had just two leaves each. The third (No 18) was virtually a short side shoot with two leaves on a leafless, seemingly dead but not dried, main shoot. It seemed unlikely to survive much longer.

Of the four surviving *Clusia minor*, one (No 15) was seemingly shorter than it was three years before, but this is probably due to the accumulation of sand at the base. The other three (Nos 16, 21, 22) were flourishing with at least four branches each in addition to the main stem, which itself was substantially taller than at planting. No 16 is in a small gully where sand has accumulated and where it gets more water than Nos. 21 and 22, which are exposed on a terrace. Fig. 4 shows No 22 as it was on 11/X/98. It is clear that as a group, the *Clusia minor* plants have grown much better than the *Ficus* species, and seem likely to keep on growing.

DISCUSSION

There were various problems. Labels faded and became hard to read, sometimes even difficult to find as they were covered by sand. At some locations, sand was deposited and at others washed away so measurements from the existing substrate at these locations gave false impressions about the growth of the plant. Height was measured to the terminal bud but all measurements must be regarded as approximations only, and in any case, height is a poor representation of the vigour of the plant since it may be growing side shoots which are not acknowledged. All six plants of *Clusia minor* (nos 15-17 and 20-22) were so bent over at planting that the measure from substrate to terminal bud was significantly shorter than the length of the main stem. Also, there was evidence on at least three occasions that leaf-cutting ants (*Atta cephalotes?)* had cut not only the leaves of some plants but the stems too, so reducing the height. However, none of these difficulties prevented us from collecting the data we needed. They are mentioned here as guidance to others who may want to repeat or extend our work.

It is clear that of the three species in the trial, *Clusia minor* is the only one that can be considered as promising for revegetating barren areas. It is a fairly slow-growing plant even under good conditions, so the fact that the largest of the four plants was only 58 cm tall at six years of age cannot be considered a disadvantage. Slow growth may well be one of the characteristics that makes it suitable for this kind of project. When consideration is given to the fact that nothing has grown naturally on the actual spots where the plants were put in, a height of 58 cm in six years must be considered a feat.

Both *Ficus* species are deciduous and, as far as we can determine, shed their leaves twice a year, as do other *Ficus* species. The cost in energy to replace these leaves must be a significant factor in their failure to grow well. In addition, however, they face defoliation by leaf-cutting ants. Normally, latex is a deterrent to leaf-cutting ants (Stradling 1978) and *Ficus* should be immune from attack. However, it is known that leaf-cutting ants will cut wilting leaves even if they contain latex (Stradling 1978). We never saw the ants in the act of cutting the leaves, but surmise that in the difficult conditions in which these plants were growing their leaves could not remain turgid at all times and were attacked when flaccid.

Clusia, because it is evergreen, needs to replace leaves only occasionally, and is presumably free from attack by ants since it has never been seen to be cut even around VCQ's home (unpub. obs.) where it is abundant. Presumably, these are the features that make it grow better than *Ficus* spp in the conditions obtaining at the chosen site. A larger trial with different *Clusia* species would seem to be the next logical step.

We have also noticed that *Xylopia cubensis* (Annonaceae) and several shrubs in the Melastomataceae seem to be colonizing the area around our study sites. A detailed inventory of these colonizers might reveal potentially useful species that could be incorporated into the proposed *Clusia* trial.

REFERENCE

Stradling, D.J. 1978. The influence of size on foraging in the ant, *Atta cephalotes*, and the effect of some plant defence mechanisms. *J. Anim. Ecol.*, 47: 173-188.