Selbyana 16(1): 94–98

EXPLORING FOR PLANT DIVERSITY IN THE CANOPY OF A FRENCH GUIANAN FOREST

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ABSTRACT. Climbing trees with the aid of French spikes has been highly effective for gathering the specimens needed to document the plant diversity of a lowland forest in French Guiana. Botanical exploration would have been incomplete without exploring the canopy because 64% of the vascular plant species are efficiently collected only from above the ground. More complicated canopy access methods (e.g., ropes, balloons, cranes, walkways, miniature helicopters, etc.) are either too expensive or not mobile enough to allow for complete botanical inventory. Although the use of spikes to enter the canopy damages some trees, mortality is probably low. The damage caused by occasional climbs probably adds little to the already high turnover time of lowland tropical forests and consequently is expected to have little negative impact on plant and animal diversity. The use of spikes to climb tropical trees, however, is not recommended for long term ecological studies or for studies in which the trees have to be climbed repeatedly.

INTRODUCTION

The diversity of plants is described in the two principal products of plant systematics—floras (including the checklists that lead to floras) and monographs. A flora treats all of the plants in a given geographic area and a monograph treats all of the species of a chosen group of plants throughout the group's geographic range (Mori 1992). The data for preparing floras and monographs come from the information provided by herbarium specimens.

In floristic studies, herbarium specimens serve as the vouchers that document the occurrence of a species in the area covered by the flora and thereby allow other workers to confirm or reject the plant's identification. The absence of herbarium vouchers invalidates the species determinations because without them there is no way to verify the identifications. Moreover, in the preparation of a flora, more than one specimen of each species is required to provide the data needed to prepare the descriptions of the species. Enough specimens must be available to show: 1) geographic distribution, 2) ecological preferences, 3) abundance, 4) all stages of the plant's life cycle, and 5) morphological variation (Mori 1989).

The purpose of this paper is to discuss the pros and cons of using French tree climbing spikes for collecting the specimens needed in the preparation of a manual of vascular plants of central French Guiana.

MANUAL OF VASCULAR PLANTS OF CENTRAL FRENCH GUIANA

The manual of vascular plants of central French Guiana is a joint project between The New York Botanical Garden and ORSTOM-Cayenne (Institut Française de Recherche Scientifique pour le Développement en Coopération). The purpose of the project is to document the species composition of the vascular plant flora (ferns and allies and the flowering plants) of central French Guiana and subsequently provide the descriptions, keys, and illustrations needed for plant identification.

The project centers around the village of Saül in the geographic center of French Guiana (3°37'N, 53°12'W) in mostly undisturbed, lowland, rain forest (Mori 1994). A checklist with 1,613 species of vascular plants has been published (Cremers *et al.* 1994), but each subsequent expedition adds species new to the flora—either as first records for the area, new species for French Guiana, or new species to science. A goal of the project is to publish the flora only after the number of new taxa added to the flora with continued exploration has been reduced to a minimum.

THE IMPORTANCE OF CANOPY EXPLORATION

In order to fully document vascular plant diversity, collections have to be gathered from all habitats at all times of the year. Canopy exploration in lowland, Neotropical forests is especially critical because a large share of the species of these forests is represented by trees, epiphytes, and lianas that are only efficiently collected from within the canopy itself. Our preliminary calculations indicate that 64% of all of the vascular plant species in the area of our flora are found in the canopy. Gentry (1982) has pointed out that the center of diversity of trees and lianas is in Amazonia and Guianas. Failure to adequately sample the canopy will, therefore, result in a gross

underestimation of species diversity everywhere, but especially in Amazonia and the Guianas.

Climbing with French Spikes

Lowland tropical forests such as those of central French Guiana possess: 1) high diversity, 2) low similarity in species composition from one hectare to the next even within similar habitats, 3) drastic changes in species composition from one habitat to the next, 4) a large number of species found at low densities, and 5) infrequent and unpredictable flowering and fruiting times of many species of vascular plants. Therefore, a mobile and inexpensive means of canopy exploration is needed to facilitate the collection of the plant specimens needed to document plant diversity. The plant collector has to be prepared to cover large distances and to climb into the canopy as efficiently as possible once a flowering or fruiting individual has been located. More elaborate means of canopy access such as balloons, cranes, walkways, miniature helicopters, etc. all have their place but are either to immobile, too expensive, or take too much time to use to allow for the efficient exploration for plant diversity in tropical forests. Even rope climbing, although relatively inexpensive and mobile, has its limitations in plant collecting because of the difficulty of getting the rope established in the canopy to make the initial ascents.

I have found French telephone pole climbing spikes in combination with tree pruners to be an efficient and safe way to gather specimens from the canopy.

The spikes are metal hemispheres with three prongs at the apex and three prongs and a small foot platform at the base (Figure 1). The spikes are available from Ets Lacoste, Avenue Pasteur, 24160 Excideuil, France (fax no. 53-62-93-46) and come in various sizes and models. Trees are climbed by alternately moving one foot above the other such that when weight is applied to a foot, the prongs bite into the back and the front of the tree. The climber is secured to the tree by a climbing belt and at least one lanyard. However, two lanyards are recommended because the climber can then always be secured in position even when climbing over limbs. In smaller diameter trees, the lanyards will not break a fall and therefore it is recommended that an extra loop be made around the tree.

The pruner consists of a set of telescoping poles that can be attached one to the next with a pruner head at the end. I use aluminum poles developed by collectors of the Missouri Botanical Garden and a light pruner head available from suppliers of forestry equipment. Each pole is 1.75 m long and I can work with six poles attached end to end. Therefore, a collector can reach 10.5 m plus his or her height from the highest point of a climb. The aluminum poles should never be used near high power lines or during an electrical storm. These poles conduct electricity and I know of at least two serious accidents as a result of using aluminum poles next to power lines! A light pruner head is extremely important because manipulation of excess weight at the end of a pole 10.5 m long is difficult and fatiguing. The tradeoff, however, is that the lighter the head, the smaller the branch that can be cut. The Snap-cut pruner head that I use (model 345-15 in the Forestry Suppliers, Inc. catalog) allows me to cut branches up to 2.5 cm diam. It is better, however, to never attempt to cut branches greater than 2 cm diam. because the larger branches tend to get stuck in the pruner head and the entire branch may fall attached to the pruner head and poles. Not only is this dangerous, but there is also a strong possibility that the poles will be bent to such an extent that they are useless for subsequent pruning.

The advantages of this method are 1) relatively low price, the entire set-up (a small and large set of spikes, belt, lanyards, poles, pruner head, etc.) can be purchased for ca. $600.00, however cost of transportation and customs fees may increase the cost of the spikes, 2) maximum mobility as all of the equipment can be carried by a single person, 3) ease of climbing because little leg effort is needed to plant the spikes as this is done by simply putting weight onto the platform of the spike, 4) ease of climbing around limbs, and 5) a secure platform to work on once the maximum height is reached.

A less obvious advantage to spike climbing is the collection of specimens from the bottom up. This enables complete notes on tree size and trunk characteristics to be recorded and it also allows the collector to search for other collections as one climbs through the strata of the forest. Top down access methods, such as balloons and walkways make it more difficult to make complete notes on the features of trees and are somewhat limited in the collection of plants found in lower strata.

Disadvantages of the French tree spikes are 1) the limited size of trees that can be climbed with a given pair of spikes, 2) limited access within the canopy itself, and 3) the damage caused by the spikes to the trunk of some of the trees climbed.

Mori and Boom (1987) summarize data on tree diameter for six lowland, Neotropical forests in which trees ≥ 10 cm DBH (diameter at breast height) were sampled. In these forests, 89.8 to 97.9% of the trees possessed diameters less than 50 cm DBH. Even in central French Guiana,

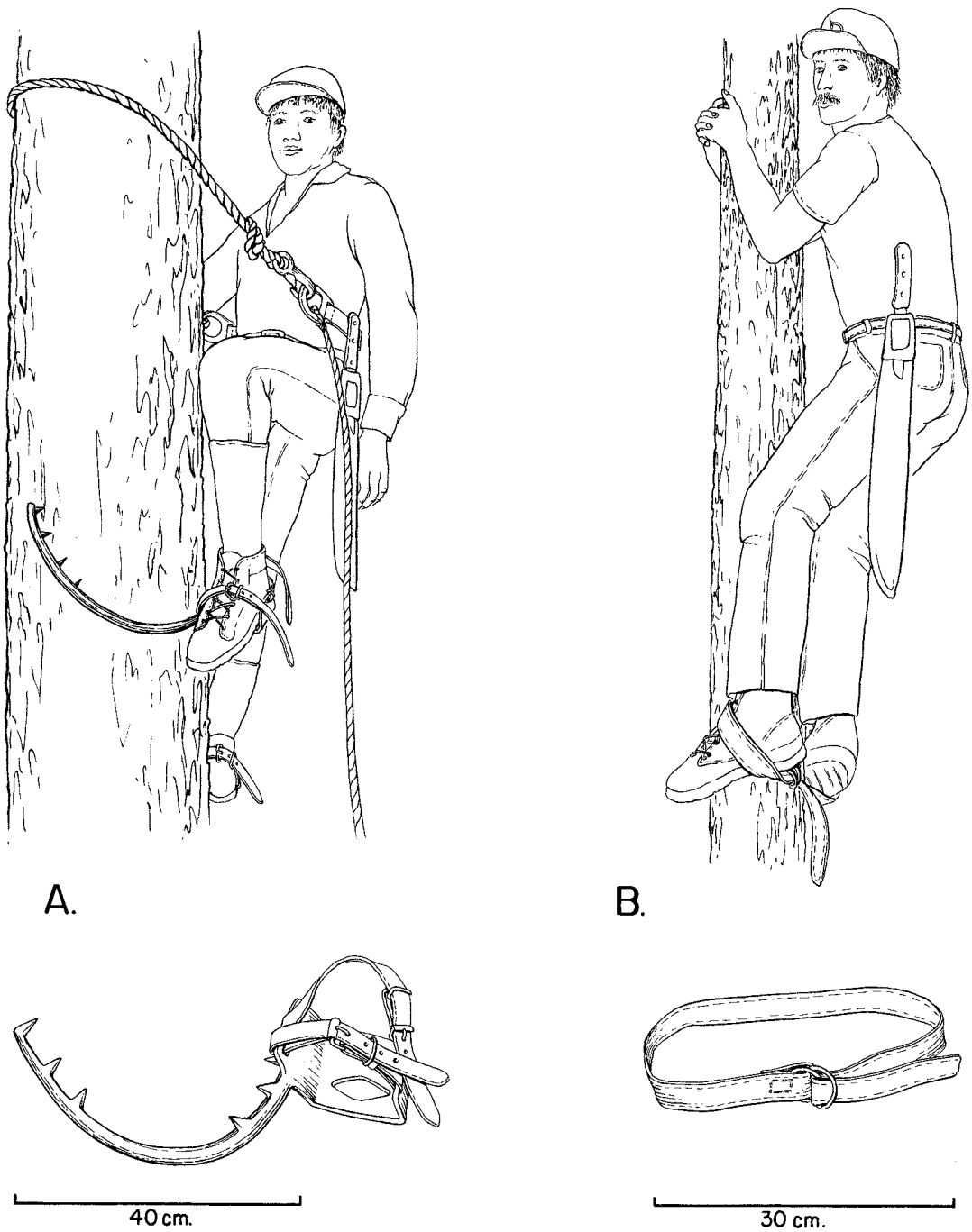

FIGURE 1. Tree climbing methods. A. Use of French tree climbing spikes. Note the safety belt, at least one belt, preferably two, is recommended for all climbers. The rope hanging to the ground is attached to the pruner pole which will be hoisted into the tree when the climber is ready to collect specimens. B. Use of the Brazilian "peconha" which is employed for climbing trees of small diameter. Illustration by Bobbi Angell, reprinted with permission from the Mem. New York Bot. Gard. 44.

where tree size was the largest, only 10.2% of the trees could not be climbed with the French spikes. Moreover, even with the largest trees, it is often possible to make a collection by climbing an adjacent tree from which specimens can be cut from the target tree by using the pole pruners.

Because the trunk of tropical trees decrease in diameter within the canopy, it is often not possible to use the same size French spikes to climb within the canopy as were used to ascend the main trunk. However, for specimen collecting, further movement within the canopy is usually not needed because specimen bearing limbs can be reached with the pruner. When needed, larger spikes can be exchanged for smaller spikes while in the canopy which then allows further ascent up the canopy trunk.

I use two pairs of French spikes to enable me to climb trees from 5 to 49 cm diam. A pair of smaller spikes (24 cm diam.) for trees 5 to 25 cm diam. and a larger set of spikes (35 cm diam.) for trees 26 to 49 cm diam. The more irregular the trunk of the tree climbed, the larger the diameter tree that can be climbed because the French spikes are able to bite into the irregularities as if they were separate trunks. Buttresses often present special problems as they are often difficult to climb over in order to reach the bole. For trees smaller than 5 cm diam., an adjustable canvas loop called a "peconha" by Brazilian tree climbers (FIGURE 1) is utilized. The "peconha" is used to effectively climb trees up to 35 cm diam., but the method is so fatiguing that it can not be used to climb large numbers of trees each day unless the collectors are experienced and in excellent physical condition. Spikes with a single prong have the advantage of providing access into all sizes of trees, including those with very large diameters. However, I have found single-pronged spikes to be more fatiguing and more difficult to use in combination with the pole pruners.

A serious limitation to the use of spikes for canopy access is the damage that the spikes make in the trunks of some of the trees climbed. The amount of damage is related to the thickness of the outer bark and to the presence or absence of saps, latices, and resins of the species climbed. Because outer bark is dead tissue, the spikes do not bite into the living tissue of species with very thick outer barks and therefore these species can be climbed with no damage to the tree. In species with saps, latices, and resins, the exudate immediately fills up the wounds and apparently inhibits the entry of insects, bacteria, and fungi into the tree. However, repeated climbing of trees with exudate will eventually limit the trees ability to produce sufficient exudate to defend itself and therefore even these trees will be attacked by wood consuming organisms if they are climbed with spikes too frequently.

Tropical trees are characterized by very shallow root systems and are therefore prone to falling as a result of natural disasters such as unusually strong winds. When a tree falls, nearby trees may also fall because individual trees are often bridged by lianas. The opening in the canopy caused by trees falling is called a gap and may be small or very large in area. The formation of gaps in tropical forests is so frequent that a number of plants have adapted to the conditions caused by gaps and, therefore, natural gaps may promote plant diversity (Denslow 1980, Hartshorn 1989). The climbing of occasional trees to collect the specimens needed to document diversity probably increases gap formation at some as yet undetermined rate. However, because gaps are a natural part of tropical forests, a small increase in gap formation as a result of climbing trees with spikes probably does not negatively impact plant and animal diversity.

On the other hand, climbing of many trees as part of long-term ecological studies or the repeated climbing of trees for ecological or physiological studies will certainly have an impact on the mortality of the trees climbed. Therefore, the use of spikes for these kinds of studies is not recommended.

ACKNOWLEDGMENTS

I am grateful to Bernard Riera, French botanist, who first introduced me to the use of French climbing spikes in 1982. I thank Bobbi Angell for preparing the figures, and Carol Gracie, John Mitchell, and Bob Weber for reviewing the manuscript. My thanks to Bart Bouricius and Mark Moffet for making my participation in the *First International Canopy Conference* possible.

LITERATURE CITED

CREMERS G., C. FEUILLET, C. A. GRACIE, J.-J. DE GRANVILLE, M. HOFF, AND S. MORI. 1994. Liste des phanérogames et des ptéridophytes de la région de Saül, Guyane Française. Pages 89–104 *in* Forêt Guyanaise: Gestion de l'écosysteme forestier et aménagement de l'espace régional. Nature Guyanaise, Cayenne.

DENSLOW J. 1980. Gap partitioning among tropical rain forest trees. Biotropica 12(suppl.): 47–55.

GENTRY A. W. 1982. Neotropical floristic diversity: phytogeographical connections between Central and South America, Pleistocene climatic fluctuations, or an accident of the Andean orogeny. Ann. Missouri Bot. Gard. 69: 557–593.

HARTSHORN G. S. 1989. Gap-phase dynamics and tropical tree species richness. Pages 66–73 *in* L. B.

HOLM-NIELSEN, I. C. NIELSEN AND H. BALSLEV (eds.), Tropical forests. Academic Press, New York.

MORI S. 1989. Eastern, extra-Amazonian Brazil. Pages 427–454 *in* D. G. CAMPBELL & H. D. HAMMOND (eds.), Floristic inventory of tropical countries. The New York Botanical Garden, New York.

———. 1992. Neotropical floristics and inventory: Who will do the work? Brittonia 44(3): 372–375.

———. 1994. The flora of Saül. Pages 79–87 *in* Forêt Guyanaise: Gestion de l'écosysteme forestier et aménagement de l'espace régional. Nature Guyanaise, Cayenne.

——— AND B. M. BOOM. 1987. Chapter II. The forest. *In* The Lecythidaceae of a lowland Neotropical forest: La Fumée Mountain, French Guiana. Mem. New York Bot. Gard. 44: 9–29.