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A method of access into the crowns of subcanopy and canopy trees

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A method of access into the crowns of subcanopy and canopy trees is described. The design consists of a semipermanent wooden pole, erected adjacent to a tree canopy, which is ascended using a portable climbing stand. The technique permits safe canopy access up to 15 m. The advantages are that it can be transported and erected in dense vegetation, it is nondestructive to the habitat and tree crowns, and it is inexpensive and can be used by a single researcher.

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L'auteur décrit une méthode pour accéder dans les cimes des arbres des étages supérieur et inférieur des peuplements. Le design consiste à ériger près d'un arbre, au moyen d'un treuil portatif, un poteau de bois semi-permanent. Cette technique assure un accès sécuritaire jusqu'à une hauteur de 15 m et a l'avantage de pouvoir être déplacé et érigé parmi une végétation dense; elle est de plus non destructrice envers l'habitat et les cimes des arbres, coûte peu cher et peut être utilisée par un chercheur unique.

[Traduit par la revue]

Introduction

Mitchell (1986) has identified tree canopies as one of the last unexplored frontiers in many terrestrial biomes. The spatial heterogeneity of plant and animal species, along with numerous constraints associated with canopy access, have probably contributed to this lack of exploration. Perhaps more importantly, the study of plant–plant or plant–animal interactions generally requires a large number of replicates ($N > 10$) and, thus, single scaffolding structures have only limited utility. In addition to expense, large towers may contribute to habitat disturbance and are obtrusive to canopy fauna when certain types of studies are conducted (e.g., animal behavior).

As Perry (1978) notes, phenological observations of plant parts (i.e., flowers, fruits, and shoots) and their interaction (as food resources) with arboreal animals (i.e., predators, dispersers, pollinators, etc.) can be impossible in many situations due to obstructing lower vegetation. Easy access to tree crowns is imperative if we are to gain insight into crown architecture and physiological processes, as well as a better understanding of how pollen and seed dispersers may have coevolved in arboreal systems. Indeed, the interplay of canopy dwellers with their host species may be useful in elucidating the adaptive radiation and dominance of angiosperms (Regal 1977).

A number of criteria are important when considering a given system for canopy access. Is the system injurious to the local habitat or individual study trees? Will the system be safe for the researcher? How much effort and logistics will be required to gain crown access? How flexible is the system? What is the expense of the system? Generally, two tactics have been employed; they involve either climbing the tree trunk itself or climbing some adjacent structure that will permit access to the crown. Both have a number of limitations.

Climbing the bole of the tree (in the event that there are no branches within the first 4 m) has generally involved the use of climbing spikes (Hingston 1932), or large lag bolts

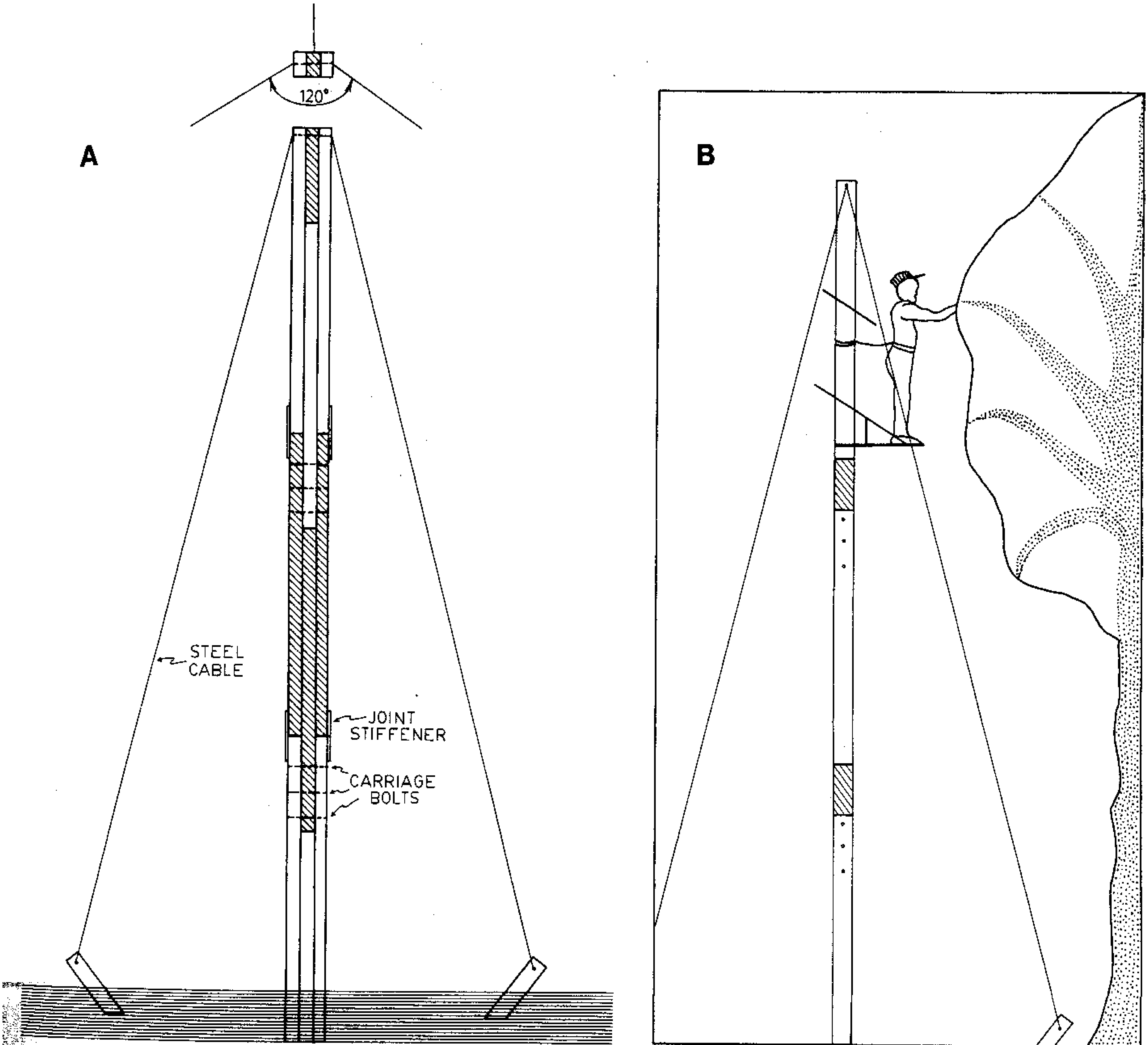

FIG. 1. (A) Details of pole construction (not drawn to scale). (B) Pole in use with climber/stand and safety harness for sampling tree crowns.

driven or screwed into the trunk to facilitate climbing (Denison et al. 1972). While both techniques are simple and inexpensive, they render the tree susceptible to fungal or insect infestation because of the holes punched into the tree. More importantly, once in the tree crown, it is extremely difficult (often impossible) to get to the slender young shoots that bear flowers and fruits. This method may be useful only for small-scale destructive branch samples, or the construction of small platforms for long-term environmental monitoring.

Structures adjacent to the tree have generally involved the use of scaffolding (Heichel and Turner 1983), large multi-tonne hydraulic lifts (Hutchison et al. 1986), or large self-supporting aluminum tower ladders (Tallescope; Maillette 1982). Because of the expense, scaffolding usually must be kept to a minimum. Hydraulic lifts (cherry-pickers) are extremely destructive to the habitat and cannot be maneuvered on the forest floor. Tallescopes, while potentially a happy medium, must be rolled on wheels and are thus limited to flat areas. Morris (1955) and Harcombe and Marks (1977), however, have used a system consisting of a guyed 11-m aluminum extension ladder. This system is very good except where repeated measurements must be performed (e.g., studies of bud demography or experimental pollination) because the ladder must be continually erected and guyed every time it is moved. Similarly, Maillette (1987) has employed a lightweight alloy ladder system, which is very versatile (i.e., easy to transport, adjusts to any terrain, and good for large sample sizes), but again, it must be continually moved. Also, it is restricted to a maximum working height of 7 m, requires two people, and the incorporation of a safety harness is impossible (L. Maillette, personal communication).

A third type of technique gives canopy access via mountain climbing techniques (Perry 1978; Mitchell 1982). This involves rigging canopy trees with climbing ropes and ascending with seat harness, leg loops, and climbing ascenders (Ferber 1975). This method has the advantage of being relatively inexpensive, highly mobile, and easy to use by one person. However, it is extremely energy intensive (personal observation) and may be hazardous if an unsound branch is accidently selected for the ascent. However, this technique remains as perhaps the best method for gaining access to canopies higher than 20 m.

Technique description

I report in this paper a climbing technique that attempts to retain as many of the positive attributes of the previously described techniques as possible, while eliminating some of their drawbacks. The method combines the use of a tree climber and stand apparatus, an adjacent structure (wooden pole) at the canopy edge, and the use of technical (roped) climbing techniques. I have used this methodology during the field seasons of 1985, 1986, and 1987 to study the pollination biology (McCarthy and Quinn 1987), the fruit survivorship and fruit–shoot resource relationships (McCarthy and Quinn 1986), and the arthropod guild structure (Gurien and McCarthy 1987) of *Carya* spp. in a New Jersey (U.S.A.) mixed-oak forest.

The system involves the construction of a single wooden pole placed at the edge of a canopy (Fig. 1). The poles are constructed from standard commercially available 5 × 10 cm (2 × 4 in.) lumber and are built (i.e., nailed together) in easily managed subsections. Each subsection is three 2 × 4's thick; it can be any desired length that is easily carried by a single individual through a forest. The ends of the 2 × 4's are offset, so that subsections interlock or interdigitate (Fig. 1); the subsections can be easily assembled in the field using 15 × 1.3 cm carriage bolts through predrilled holes. The subsection that makes contact with the soil *must* be constructed from wolmanized® (i.e., preserved or treated) lumber; all other subsections should be constructed from untreated lumber which is much lighter and easier to transport. Addition of 2-m long (2 × 10 cm) wood strips around the joints was found to greatly enhance stability. After final assembly and addition of guy wires at the top, the pole can be tipped vertical by three or four people. The base of the pole is sunk 0.5–1 m below the ground surface and the pole is guy wired out with three 65-mm (0.25 in.) diameter steel cables, placed at 120° increments about the top and attached to wooden or steel anchors (Fig. 1). I have used 12 such towers, ranging in height from 8 to 14 m. Greater heights (up to 18–20 m) might be achieved although intermediate guy wires would be needed for structural stability. These structures are meant to be semipermanent (unfortunately they are potential targets for vandals) and numerous poles can be built and erected for a very reasonable cost (ca. $65.00 (U.S.A.) each). Also, the poles may be marked in decimetre intervals and thus provide an ideal fixed spatial framework for doing branch or bud mapping.

These poles are later ascended by a single researcher (the presence of a field assistant may be desirable for safety) with the aid of a two-piece alloy and wood climber/stand (available from Baker Manufacturing, P.O. Box 1003, Valdosta, GA, U.S.A.). A small platform (60 × 45 cm) is strapped to the feet, and in combination with the separate barlike hand climber, one can climb the pole in a fashion analogous to doing chin-ups on a bar. The platform can be deployed at any point along the pole and swiveled 360° for full access. Addition of a seat harness and safety ropes permits the user to lean out, or pendulum out, from the pole to grab branches of interest. I have been able to sample a significant fraction of the total canopy surface area in this fashion (20–40%). Rope climbing techniques can be used to link together nearby towers or link the tree bole with the pole.

The advantages of this system are that (*i*) it is noninjurious to the habitat and study trees, (*ii*) there is a high degree of user safety and minimal expenditure of effort, (*iii*) the system can be easily transported to, and erected in, inaccessible areas of a forest, (*iv*) after erection, the pole can be ascended by a single researcher, (*v*) it is moderately inexpensive, considering many of the alternatives, and permits a satisfactory number of replicates for most ecological studies, and (*vi*) it provides access to the crown surface for examination of flowers, fruits, leaves, etc.

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