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Development of Canopy Walkways by Illar Muul and Associates: A Brief History

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Abstract. Access to the canopy of tall tropical rain forests has been a challenge for scientists. Among the many methods used, the canopy walkway system has the advantage of being the least physically challenging, making the canopy accessible to people of all ages and of normal physical fitness. This system thus lends itself to research and nature tourism. The first canopy walkway for research was installed in Malaysia in 1968. Modified, lighter weight versions were developed by Andrew Mitchell in Zaire, Papua New Guinea, and Malaysia in the late 1970s. Beginning in 1988, canopy walkways were used by the author and his colleagues both for research and nature tourism in Malaysia, China, Peru, Ghana, Costa Rica, and Guyana.

Key words: canopy, walkway, history

Introduction

Mitchell (1982, 1986) has reviewed much of the history of attempts by scientists to reach the canopy of the tropical rain forests. To his reviews, I would like to add the work of Marston Bates and David Gillette. With support from the Rockefeller Foundation, Bates erected platforms at various heights in trees in Colombia to study mosquito vectors of the yellow fever virus. Gillette, who worked for the London School of Tropical Medicine and Hygiene, studied disease vectors in West Africa. Together with the work of Elliott McClure in Malaysia, the pioneering studies of the canopy by Bates and Gillette opened up a new frontier in research in the 1940s and 1950s.

In 1968, I had the privilege of being assigned to Malaysia. Lord Medway (now the Earl of Cranbrook) was still using McClure's platform. Reaching the crown of the gigantic Meranti tree (Dipterocarpacae) was an incredible feat for McClure. Platforms were built at 40-, 90-, and 147-ft heights. Mong bin Tahir, a forest dwelling Aborigine, participated in the construction, together with other native climbers. No modern climbing equipment was used, only safety ropes tied around their waists. Mong told me later that he and the other climbers refused to go up beyond the 90-ft platform, leaving McClure to complete the remaining 57 ft alone.

Climbing McClure's ladder in 1968 frightened me deeply and inspired me to develop an easier and safer way to access the canopy. The practice at the time was to free-climb the ladder, using no safety equipment. Early morning dew on the rungs of the narrow aluminum forestry ladders made footing very slippery. Moreover, since the installation 12 years earlier, the tree had grown considerably, stretching the chains that held the ladders to the trunk as tight as guitar strings.

The expanding trunk had all but absorbed the triangular spacers on the ladders that fixed them to the bark. This resulted in very little space between the rungs and the trunk for foot-hold (more like toe-hold). The inadequate foot-hold and the slipperiness of the aluminum led me to rely mainly on my arms, which most experienced climbers know is a mistake. Upon reaching the 90-ft platform, I would have given up, but my colleague Fred Dunn urged me on.

At about 120 ft, the ladders, which were straight and stiff, could not be used. McClure solved the problem by driving railway spikes into the trunk and the first branches that flared out. McClure, a tall powerful man, had placed the spikes within comfortable reach for him. I barely could reach them; plus they had been largely absorbed by the expanding trunk.

My problems were compounded by having to hang nearly upside down from these minimal supports to hoist myself around to the top of the gigantic branch. I would not even consider doing this now without a harness and safety rope. Youth is better known for its bravado than its wisdom.

Finally reaching the platform, I announced to Fred that I was not going back down, which is an even more difficult maneuver. I asked him to make arrangements with my family to send up provisions, and I would live up there forever.

Fred patiently instructed me on my way down, and I kissed the ground once I reached the base of the tree, thankful that I had not made the trip much faster in a free-fall. Reflecting back on this frightful yet exhilarating experience, I thought, "There must be a better way!"

While on the platform, I noted that the steep embankment we descended to reach the base of the tree seemed to be as close as the base from which we ascended. Pondering this, I thought, "Why not hang the ladders horizontally from the hillside, as a suspension bridge to reach the crown?" A few months later, we began installation of the first canopy walkway using this principle (Muul & Lim 1970).

Study Sites

Our work in installing canopy walkways using the suspension bridge principle has taken place in four phases characterized by funding sources.

Phase I: Medical Research Walkway

In reviewing the use of canopy walkways, Mitchell (1982, 1986) apparently was provided some incorrect information: Our walkway was not designed by U.S. Army engineers, though the U.S. Army Medical Research and Development Command provided the funding to install it. The design came from the footbridges found all over Southeast Asia that are used by native inhabitants to cross rivers and steep valleys. We, however, introduced the use of modern, strong, durable, and lightweight materials. The "backbone," formed by aluminum ladders about 30 cm wide, was suspended horizontally from 12-mm polyester ropes and 12-mm high-grade steel cables. Planks were placed over the rungs for easier walking.

Another misconception in Mitchell's book (1986) was that because of its weight, the walkway created great strain on the supporting trees. Also contrary to what was stated, we did not lose any of the support trees in the time that the walkway was used (1968–1975). In 1975, having completed our studies, we offered the intact walkway to several local organizations. None accepted, so the whole system was disassembled. We concluded that, although the walkway was a wonderful tool for reaching and studying the canopy, if left without proper management, it had the potential to become a dangerous and possibly lethal "toy."

Dozens of scientists from Malaysia and around the world used our walkways in conducting research. On our own part, we captured hundreds of mammals in traps and mist nets in the canopy and on the ground directly below (Muul & Lim 1978b). Each specimen was identified, code marked on the ear and released after examination for ectoparasites and endoparasites. Blood samples were taken to isolate disease-producing rickettsia and viruses and antibodies. Vital statistics such as body measurements, weights, and age were recorded along with reproductive condition estimates.

Several problems in the epidemiology of scrub typhus were resolved (Muul et al. 1975) and useful information was gained about potential malaria vectors (Andre pers. comm.).

Fleas collected from the mammals were sent to Robert Traub who identified them, discovering many new species and a new genus. Lice were sent to K.C. Emerson, who also discovered new species and genera. Ticks were identified by Harry Hoogstraal; and chiggers by N. Nadchatram, who discovered an interesting forest species that harbors the infectious agent responsible for scrub typhus (*Rickettsia tsutsugamushi*). This disease caused tens of thousands of casualties during World War II.

Blood parasites were identified by Yap Loy Fong and C.P. Ramachandram. Yap discovered a new species of malaria parasite in a giant flying squirrel (*Petaurista elegans*) (Yap et al. 1970). Remarkably this parasite is similar in morphology to *Plasmodium falciparum,* which is responsible for the fatal cerebral malaria in humans. A French team headed by Irene Landau discovered dozens of new species of intestinal parasites including *Eimeria* and Coccidia.

Hundreds of publications resulted from this early probe into the canopy. Though most of the studies had direct or indirect medical implications, many involved basic science, such as the phenological studies conducted by Francis Ng of the Forest Research Institute of Malaysia. Frances DeSouza, University of London, studied tree shrews; and another example was our studies of intestinal morphology and types of diets of mammals (Muul & Lim 1978a).

The Bukit Lanjan canopy walkway in Malaysia can be considered as the first phase of our development of canopy walkways. Its sole purpose was to facilitate research. In addition to the dozens who worked there, hundreds of scientists from all over the world came to see this canopy walkway and gain their first access to a new frontier. So many came that an idea was born to use walkways in the future for nature tourism.

Phase II: Man and the Biosphere Walkways

The next opportunity to conduct canopy research came nearly 12 years later. In 1987 Robert Hoffmann, then the new director of the U.S. National Museum of Natural History, Smithsonian Institution, contracted me to establish new research stations in tropical China (Yunnan Province) and in Borneo (Sabah, Malaysia). Part of the research plan was to develop models of ecologically sustainable, economic development of the tropical rain forest (Muul 1989, 1993).

The idea was to demonstrate the potential economic value of tropical rain forests to encourage policies that would conserve much larger tracts of land supporting these ecosystems than what was possible through preservationist strategies (Muul 1993). Funding for this phase of multidisciplinary research and conservation was provided by the U.S. Man and the Biosphere (MAB) Program with the assistance of Roger Soles, executive director.

The sustainable development strategy included developing part of the forests under study in China and Malaysia for nature tourism (ecotourism). In each area, two separate canopy walkway systems were installed–one for research only and another primarily for nature tourism. The ecotourism set also was used for research, in part to determine the effects of tourists on the ecosystems providing the attraction.

Because of the multiple use made of these walkways, additional safety measures were taken. The basic design remained the same as that used earlier in Bukit Lanjan, Malaysia (Muul & Lim 1970). The walkway, however, was enclosed with strong fish netting. The netting extends from the supporting horizontal ropes like a giant hammock. The vertical support ropes are woven through the mesh to stabilize the netting horizontally. Vertically the netting is wrapped around and tied to the horizontal support ropes at waist height or greater. One scientist remarked that, "It would require great imagination to be able to fall off."

Safety has always been the primary factor in installation, maintenance, and management of our canopy walkways. As a result, our walkways may seem "overbuilt." The design and materials selected, however, should allow the systems to be used for decades with minimal maintenance and repair.

Again dozens of scientists with international interests joined the studies, particularly in Malaysia. Most came from various universities in Germany. Studies by German researchers were coordinated by Eduard Linsenmaier, University of Wurzburg, who was president of the German Tropical Ecological Research Society. In China, logistical problems limited the use of the walkways for research by many outsiders. After completing our own studies in 1992, we added materials from the research walkway to extend the walkway used for tourism.

I cannot determine whether research use of the walkways or use for tourism has been more successful. Each of these uses has different objectives.

The research purpose of our own studies, supported by the National Geographic Society and GEO, involved comparisons of canopy and ground-dwelling mammals at geographical extremes on a north-south gradient, of the most prevalent types of tropical rain forests (Dipterocarp) in Southeast Asia (Whitmore 1975). The highest diversity of species in these types of forests occurs on the island of Borneo. One of the study areas was established in Borneo at the edge of Kinabalu Park, Sabah, Malaysia. Borneo has more than 3600 identified species of trees and 230 species of mammals.

The other study area was set up in the southernmost tip of the Province of Yunnan, China. At this northernmost distribution of Dipterocarp forests, the number of species is less than half that in Borneo. Yet because of the relatively high diversity in these Dipterocarp forests, the Province of Yunnan has more species in most families of plants and animals than all the other provinces of China combined.

Among the mammals captured in China, we found a new species in the canopy and possibly a new species and genus from the ground level. Both the numbers of species and individuals captured were remarkably lower than those captured by the same methods in Malaysia. The scarcity of animals also was corroborated through direct observations in the canopy, both during the day and night.

These meager results, however, are extremely informative. The documented relative scarcity of mammals both in the canopy and ground levels of the Dipterocarp forest in China is probably the result of the recent (last 100 years) fragmentation of these forests. The largest intact area we could find was about 35 ha. The total of the remaining fragments may not add up to more than 200 ha. By contrast, Kinabalu Park in Borneo consists of about 75,000 ha, of which lowland Dipterocarp forest comprises about 7000 ha (still not very much for long-term survival of the diversity now found there). These are valuable clues to what is likely to occur in the future, as forests increasingly are fragmented and reduced into smaller parcels.

Phase III: Local/International Walkways

Based on the success of the Yunnan and Kinabalu demonstration sites, requests came to us for additional walkways to be developed primarily for nature tourism and education. These included two additional sites in Malaysia: the Forest Research Institute of Malaysia near Kuala Lumpur (1991) and the Taman Negara National Park (1992), with its more than 1200 square miles of uninterrupted rain forests. The Taman Negara walkway was fully funded by the Malaysian Government. Modified versions of these canopy walkways were developed by others in

Danum Valley in Sabah (Borneo) and in Sarawak in 1992.

Other government-supported and internationally funded tourism walkways were designed and installed by our group in Peru (1990) and in Ghana (1994). These walkways have been a major factor in promoting tourism to tropical rain forests.

Additional walkways have been discussed for other areas in Malaysia, the Philippines, Irian Jaya, Thailand, and Burma.

Phase IV: Private Ecotourism Walkways

The most gratifying trend lately has been the interest shown in nature tourism and use of canopy walkways by private investors. Privately funded development began in Costa Rica in 1995 with the Rainmaker Group, which has purchased 1500 acres of rain forest for conservation near Manuel Antonio National Park. The group has plans to purchase more land for rain forest conservation and sustainable development in the future.

In another project begun in 1996 in Guyana for the Hotel Tower Group, investors leased land in the spectacular Great Falls area on the Demarara River. The canopy walkway is built, and completion of trail systems and accommodations awaits additional funding.

Plans are underway for privately funded canopy walkways to be used primarily to support nature tourism in Uganda, Peru, and Belize.

Discussion

Canopy walkways have proven themselves a valuable research tool. By providing easy access to the canopy level, the walkways also have become a popular tourist attraction.

In both China and Malaysia (Kinabalu Park), the canopy walkways are visited by more than 10,000 tourists per year. At this level of visitation, they have the potential to bring in large amounts of revenue. In China, tourists pay an admission fee equal to a day's wage for a government worker. At that rate, rain forest tourism has the potential to earn more money, per hectare of land use, than logging operations or conversion of the land to rubber plantations. Confirming this potential, the Yunnan Provincial Government decided in 1991 to stop deforestation being carried out to clear the land for rubber estates. Instead investments were concentrated in building the tourism infrastructure. Currently, the provincial government is interested in developing additional sites for nature tourism, including canopy walkways.

In Malaysia the national parks are used as a magnet to attract tourism. Admission charges are minimal and do not reflect the true local economic situation. The growing number of canopy walkways being installed evidences government recognition of the value of nature tourism. The walkway at Taman Negara in Malaysia has been visited by that country's King and Queen and by the prime minister. A wedding was performed on the walkway at Kinabalu Park.

The canopy walkway in Peru receives fewer visitors, but is the best known in the world because of its use as an advertising centerpiece by International Expeditions (IE), the largest nature tourism company in the world. IE provided much of the support to install this system on the Napo River, near the Amazon, and helped create the Amazon Center for Environmental Education and Research (ACEER).

Richard Humphrey, a developer of luxury rain forest resorts in Guyana, immediately recognized the value of canopy walkways as part of nature tourism facilities. He has said, "Any nature tourism attraction in the tropical rain forest is as incomplete without a canopy walkway as would be a beach resort without a swimming pool and tennis courts."

In providing consulting and design services, we always stress that the canopy walkway is only the "hardware" part of a package. Development of a strong nature interpretation program provides the "software." Both need to be developed together. Our demonstration projects in training nature interpreters were funded by the United Nations Educational, Scientific and Cultural Organization (UNESCO) MAB Program with the assistance and guidance of Malcolm Hadley, executive director.

In most cases, the nature interpreters we train are former poachers. This ironic situation yields several advantages. Since the nature interpreters are local forest inhabitants, a participatory atmosphere is established in the local community; and the project is not viewed as entirely foreign. Income to the local people provides tangible evidence of the economic value of the conservation efforts. Time and effort formerly devoted to poaching are now used to earn better income. Also poachers usually know more about the forest and its inhabitants than do others, including academically trained people with only book knowledge who do not feel comfortable in the forest.

From among potential candidates for the training programs, we try to select those with good communication skills. Naturally, training increases the value of nature interpreters in the minds of the tourists. We try to put the interpreters' specific knowledge into the context of scientific information about the forest and to empower them to discuss conservation matters from various sides of the issue.

Satisfied tourists, after experiencing interpretive programs, have been heard to say, "We never realized how much is going on in these forests," and "We are going to encourage our friends to make such a trip." Such satisfied customers are instrumental in making nature tourism (ecotourism) the fastest growing segment in the tourism industry.

The growth of ecotourism is an essential part of any strategy to demonstrate the economic value of ecologically sustainable development in tropical rain forests.

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