

BOTANIST AND EXPLORER

2960. Cordin scahifolin A.

EDITED BY

M.R.D. SEAWARD AND S.M.D. FITZGERALD

## SPRUCE

( | 8 | 7 - | 8 9 3 )

### BOTANIST AND EXPLORER

Edited by M.R.D. Seaward and S.M.D. FitzGerald



### © 1996 The Board of Trustees of the Royal Botanic Gardens, Kew and authors of text and illustrations of individual papers

Production Editor: S: Dickerson

Typeset at the Royal Botanic Gardens, Kew, by Christine Beard, Dominica Costello and Margaret Newman

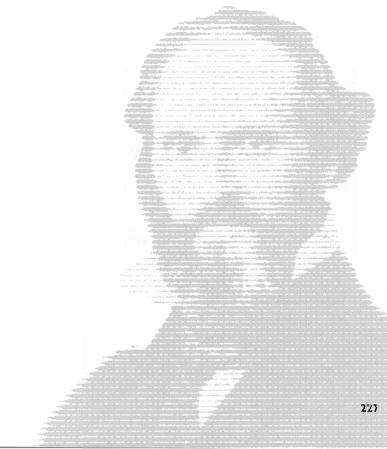
> Book design by Jeff Eden for Media Resources, Royal Botanic Gardens, Kew

> > ISBN 0 947643 94 X

Printed and bound in Great Britain by Whitstable Litho Ltd., Whitstable, Kent.

# Relevance of Spruce's work to conservation and management of natural resources in Amazonia

N. J. H. Smith



### Relevance of Spruce's work to conservation and management of natural resources in Amazonia

N. J. H. Smith LATEN World Bank, 1818 H St, NW, Washington, D.C. 20433, USA

Richard Spruce has provided us with revealing glimpses of landscapes and how people were using natural resources in the Amazon during the middle of the last century. I have plumbed Spruce's writings, particularly his *Notes of a botanist on the Amazon and Andes*, with two main purposes in mind: to glean observations on crop plants and their wild populations; and to extract interesting ethnobotanical observations as pointers to possible candidates for plant domestication.

Approximately half of the increased yield of major crops in this century is attributed to harnessing of genetic resources. Further productivity gains will only be possible if we conserve and utilise plant genepools. At the same time, we should be constantly seeking new crops to help us face the challenge of tailoring our suite of cultivated plants to difficult environments, and to provide novelty in the diet of industrial and developing countries alike. Novel crops, then, could play a vital role in boosting incomes for rural inhabitants in developing areas while delighting the palates of well-fed consumers in the industrial world.

As both industrial countries and developing nations seek ways to raise crop yields without damaging the environment, scientists constantly tap genes to develop crop varieties more resistant to pests and diseases. (1) Plant breeding alone is no panacea for agricultural woes, nor a complete blanket of protection for our farmlands, but when combined with fresh agronomic approaches, such as rotation cropping and biocontrol using parasites and predators of crop pests, the manipulation of genetic resources often holds the key to upgrading farm productivity.

Plant breeders tap three main genepools when working to improve crops. In descending order of importance they are: the primary genepool, consisting of material in the same species, such as traditional varieties; related genera; and finally, plants in different families.

With more sophisticated "genetic engineering" techniques, it is now increasingly possible to insert genes from one species to another. Such skills, however, rest on a thorough understanding of the relationships between crop cousins, and Richard Spruce made a number of important discoveries in this regard, especially in connection with rubber and cinchona. He also made numerous interesting observations on so-called minor, or little known forest products that could prove useful for the future development of plantations and agroforestry.

### Major plantation crops

### A. Rubber

Six new species of Hevea, the genus that includes the most important source of natural rubber -H. brasiliensis were described on the basis of Spruce's collections in Amazonia. (2) Near relatives of rubber have already been used to improve the hardiness of rubber; for example, H. spruceana is grafted onto rubber trees to provide a crown resistant to South American leaf blight, caused by Microcyclus ulei, a widespread fungus in the Amazon Basin and the most serious disease threatening plantation rubber. Should South American leaf blight ever reach Southeast Asia, where most of the world's natural rubber is currently produced, a veritable scramble for resistance genes would ensue. Spruce's pioneer work on the taxonomy and distribution of natural rubber and its near relatives would thus become even more valuable. Richard Evans Schultes, who has done more than anyone else in this century to further our understanding of rubber's genetic resources, has emphasised how all consumers of rubber products are indebted to the work of Spruce.

Few people who drive cars with radial tyres realise that they contain sizeable amounts of natural rubber. Nor are aeroplane travellers generally aware that when they touch down, their landing is cushioned by tyres made entirely of natural rubber. Few appreciate, then, the contribution of Amazonia's forests and one of its great explorers, Richard Spruce, to modern life.

### B. Cinchonas

Spruce also furthered our understanding of another economically important tree: *Cinchona*, which grows in western Amazonia, in the forests cloaking the footslopes of the Andes. The bark of several species of *Cinchona* contain quinine, and long ago indigenous peoples found that they could relieve certain fevers by chewing pieces of the bark.

Spurred on by quinine's anti-malarial properties, the British government commissioned Spruce to prospect for *Cinchona* planting material in 1857. After securing permission from Ecuadorian authorities, Spruce set out over rugged terrain to collect botanical specimens and seeds of *Cinchona*, to obtain bark samples, and to note their distribution and natural history. Spruce's body was almost spent after the rigours of nearly a decade in the backwoods of Amazonia, yet he perse vered in his quest for specimens of widely spaced *Cinchona*. Spruce's work was fundamental to the success of *Cinchona* plantations in various parts of the highland, humid tropics, especially in India, Sri Lanka, and Indonesia.

At first glance, such travails may seem a rather quaint side-story in the annals of economic botany, except that quinine is re-emerging as an important pharmaceutical. Schoolchildren in England during the 1950s and early 1960s may remember swallowing, with great reluctance, bitter doses of quinine to treat colds. Such memories may create the impression that quinine is history. But the emergence of strains of *Plasmodium falciparum*, the most virulent species of malaria parasite, resistant to a range of modern drugs, has brought quinine back into the picture. Quinine is once again a routine part of malaria therapy in various parts of the tropics, sometimes in combination with other

drugs, such as Fansidar (a combination of sulfadoxine and pyrimethamine) or tetracycline. Hundreds of thousands, if not millions, of lives have been saved because of quinine over the last century or so, and part of the credit belongs to Richard Spruce.

### C. Brazil nut

As forests in Amazonia continue to fall and the once extensive populations of Brazil nut (*Bertholletia excelsa*) shrink (Figure 1), several entrepreneurs have recently begun experimenting with plantations of the nutritious nut. Cattle ranchers are spearheading the attempt to grow Brazil nut on a large, commercial scale, such as near Itacoatiara in Amazonas state (Figure 2). Many small farmers throughout the Brazilian Amazon are incorporating Brazil nut into their innovative agroforestry systems, such as around Tomé Açu in Pará and Nova Califórnia in Acre/Rondônia.

Brazil nut planting is not a new undertaking, however. Indigenous groups have long enriched various parts of the Amazon Basin with majestic Brazil nut trees, but this realisation is relatively recent. Careful readings of some of the natural historians of the last century and even earlier often reveal useful ethnobotanical findings, and Richard Spruce is no exception. Spruce noted, almost in passing, that Jesuits planted Brazil nut at Tauaú along the Acará River in Pará. Jesuits were operating missions in the Brazilian Amazon until expelled by Royal edict in 1759; so the dark-robed Fathers were evidently emulating some Indian horticultural practices in the early colonial period. Ancient groves of Brazil nut can be seen around various towns and villages in Amazonia today, such as Acará on the river of the same name, not far from the site visited by Spruce in the last century. Spruce also remarks that agoutis, pacas, and monkeys eat Brazil nuts; the agoutis are known to be dispersal agents for the forest giant.

### Minor products from forest and other habitats

Spruce hints that some forests and other habitats in Amazonia have probably been enriched by indigenous groups. He remarks, for example, that the forests around San Carlos on the upper Rio Negro are liberally sown with patauá palm (*Oenocarpus bataua*). (4) The superior qualities of oil from fruits of patauá palm have long been recognised, and the potential for planting the moisture loving palm as a commercial crop is now being explored by Brazil's agricultural research system (EMBRAPA — Empresa Brasileira de Pesquisa Agropecuária) in Pará. So fine is patauá's oil that shopkeepers in Belém used to mix it in equal proportions with olive oil during the last century, and sell it to unsuspecting customers. If water-loving patauá takes off as a commercial crop, breeders and growers will be interested in a wide selection of material to test. What better place to begin the search for promising germplasm than anthropogenic forests where indigenous people may have selected for more productive forms?

Another oil-bearing palm, mucajá (*Acrocomia aculeata*), has undoubtedly been sown around homes and villages for millennia. The smooth, creamy pulp surrounding the seed is still relished as a snack food by rural peoples in Pará

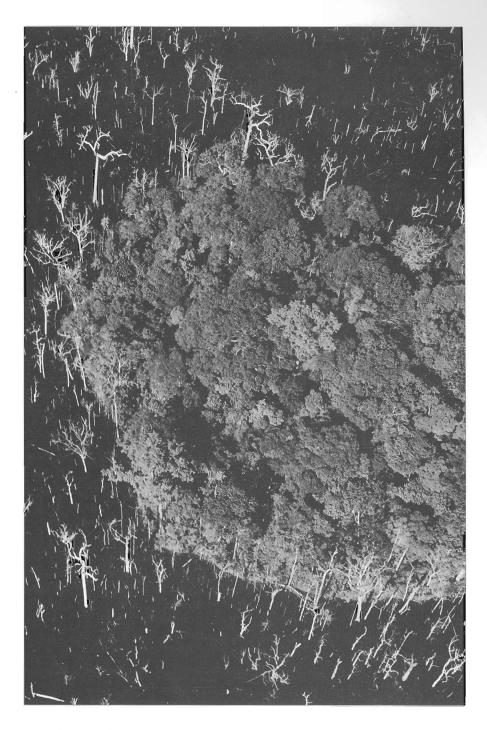


Fig. 1. Forest with Brazil nut trees (*Bertholletia excelsa*) drowned by the Tucurui reservoir, Tocantins River, Pará, Brazil. In 1986, the dam began generating much-needed hydroelectric power, but has eliminated extensive populations of Brazil nut trees and other economically-valuable species. Picture taken in August 1988.



**Fig. 2.** A grafted Brazil nut (*Bertholletia excelsa*) plantation at Fazenda Aruanā, km 215 Manaus-Itacoatiara, Amazonas, Brazil, 15 November 1992. The 4,000 hectare Brazil nut plantation has been established on degraded pasture and the grove depicted here is six years old. Strips of forest have been left as havens for bee pollinators.



Fig. 3. Farm boy snacking on creamy fruit of mucajá (*Acrocomia aculeata*), collected from the ground under a spontaneous palm on the border of a field, Belterra, Pará, Brazil, 29 September 1992.

and is fed to small livestock, such as at Belterra, on the *planalto* south of Santarém (Figure 3). Mucajá's sweet-tasting mesocarp contains 33 percent oil;<sup>(5)</sup> little wonder that people have sought the nutritious palm and enriched their home sites with it. Interest in fully domesticating the species is growing in Brazil and in growing it on a larger scale for oil production.<sup>(6)</sup> Mucajá populations have probably built up from discarded seed, although some individuals, or their ancestors, may also have been deliberately planted. Spruce<sup>(7)</sup> speculated that the palm, also known locally as macaúba, had been planted inland from Belém, since it is only found in open habitats near dwellings.

Although Spruce was primarily concerned with describing flora in wild places, he took the trouble to point out cultural uses of plants; for example, he noted that the durable fronds of ubím palm (*Geonoma*) were used for thatching houses on the lower Amazon. Another palm used for construction purposes along the lower Amazon is bussú (*Manicaria saccifera*). Both rural and urban folk along the lower Tocantins continue to use the generous fronds of bussú to cover their houses and huts used to make manioc flour (*casas de farinha*). Spruce<sup>(8)</sup> noted that leaves of the latter palm are entire, thus forming long "tiles" when laid out on a roof, ideal for dispelling rainwater.

People in Amazonia collect plant products from a wide variety of vegetation communities, not just forest, and Spruce was clearly attuned to this wide-ranging dependence of rural people on nature. A tall, handsome grass (*Gynerium sagittatum*), which resembles a slender sugarcane, adorns some open parts of the

banks of the Amazon and its side-channels. Called *flecheira* on the Amazon floodplain today, Spruce noted its Tupí name, *uíwa*, and pointed out its use to make arrow shafts. Spruce often included both the local name (mostly *lingua geral*, in his day) and the indigenous name (usually Tupí) when talking about plants and animals. Such information is helpful, and he also took pains to point out how place names have changed over time. His *Notes of a botanist on the Amazon and Andes*, lovingly put together by one of his admirers, Alfred Russel Wallace, is thus of considerable historical importance in addition to being a fountain of knowledge about plant geography and ethnobotany.

In other open habitats, fisherfolk used to collect leaves of ajarí (*Tephrosia nitida*) to stupefy fish. Spruce<sup>(9)</sup> remarked on how the leaves of the leguminous herb were crushed in water to facilitate fishing. Several other plants are collected or are grown for that purpose in Amazonia, and Spruce noted that *Tephrosia toxicaria* was cultivated for its piscicidal properties around Santarém. The practice of cultivating plants with an ability to stupefy fish is now much less common, in part because of the advent of more "efficient", but far more destructive, fishing methods, such as gillnets and the illegal use of dynamite.

Spruce's ethnobotanical notes point to some intriguing candidates for plant domestication. Along the Tapajós, women used to grate the seeds of the acapurana (*Campsiandra* sp.), a low, spreading leguminous tree, to make a flour, which served as a substitute for manioc flour when supplies of the starchy root crop were running low. (10) The genus *Campsiandra* is being revised, and it appears that several species produce fruits that are consumed in southern Venezuela and in the Brazilian Amazon (B. Stergios, pers. comm.). Fruits of acapurana are still occasionally used in folk remedies, (11) but this denizen of the banks of clear and blackwater rivers, as well as open sandy soils, is apparently little used today as a 'famine food'. Encouragingly, Venezuelan researchers at the Universidad Nacional Experimental de los Llanos Occidentales are investigating the current use and potential of protein rich *Campsiandra* flour. (12) This perennial legume, which once served as emergency rations, might prove suitable for agroforestry on floodplains, or in areas with poor soils.

### Wild populations of crop plants

Wild or feral populations of crop plants sometimes contain useful genes absent in domesticated genepools. Breeders are increasingly interested in the location and status of wild or naturalised populations of crops, because they may have been lost after prolonged breeding and selection in cultivated populations, or they may not have been present in the initial material used for domestication. Spruce remarks on the presence of several wild populations of crop plants, potentially useful leads for future collecting efforts.

The eastern slopes of the Andes abound with wild relatives of succulent papaya (*Carica papaya*). Two near relatives of papaya have also been domesticated. Spruce observed chambúru (*Carica pentagona*) under cultivation up to 3,000 metres in the Ecuadorian Andes, where people ate the fruits and boiled the leaves like cabbage. (13) Other species might eventually be domesticated, or their genes incorporated into cultivated forms. In eloquent prose, Spruce

expresses his respect for nature and his awe of its biodiversity when discussing the papaya family:

"Where Papayaceae most abound is on the wooded slopes of the Andes, both on the eastern and western sides, up to 8,000 feet elevation; and it is there that travellers and sedentary botanists may confidently expect to find not only materials for the more perfect elucidation of the species already partially known, but also many new species, which doubtless still remain hidden in the savage recesses of the oriental Andes". (14)

Cacao (Theobroma cacao) is native to western Amazonia, and was taken to Central America in pre-contact times where it was developed as a crop to produce chocolate. This understorey perennial does not appear to have been an important economic plant in Amazonia prior to the arrival of Europeans. The shade-tolerant tree was mostly enrichment planted in forest near villages and camps for its sweet pulp. In the 18th century, cacao planting received a boost as an export commodity and large areas were planted along the middle and lower Amazon. By the mid-18th century, however, cacao had lost some of its former commercial importance and was in decline. Spruce(15) noted a large plantation on Careiro Island near Manaus being overrun by forest. Cacao was apparently the predominant species in floodplain forest of the Amazon south of the massive Ilha dos Tupinambás, near the present-day town of Parintins. Cacao may not be indigenous to that part of Amazonia, suggesting that some parts of the várzea forest have been cleared in the past and are therefore anthropogenic. Cacao populations in floodplain forests should be a high priority for collecting because woodland on the várzea is the most threatened forest type in Amazonia, and pockets of feral cacao may still be encountered.

The tart fruits of pitomba (*Talisia esculenta*) are a welcome treat in Pará during the rainy season. The marble-sized fruits are commonly sold in bunches in street markets in such cities as Belém and Santarém. Mostly grown as a backyard tree and occasionally in polycultural fields, pitomba is one of many regional fruits in Amazonia that warrants further study. Pitomba is apparently indigenous to western Amazonia, where it may occur in the wild. (16) Spruce (17) spotted wild, or at least naturalised, populations of pitomba on stony slopes of the Tapajós valley, in the central part of the Amazon Basin. Such populations — if they have been spared from the axe and chain saws of small farmers and ranchers — could prove useful sources of germplasm for tolerance to especially poor soils. Agroforestry systems suitable for rehabilitating degraded areas in the tropics are in high demand, and observations on the location and habitat of wild populations of crop plants are thus especially important.

### Lessons for sustainable development

Spruce's vibrant writings allow us to see plant life, people, and landscapes of Amazonia in the middle of the last century. Modern scientists and policymakers may well ask what an eccentric botanist of yesteryear has to offer us today in the quest for more rational models for occupying and developing the Amazon.

Spruce's keen observations on the natural history of some plant species that may be tomorrow's key crops in Amazonia and his extensive collections serve as a valuable foundation for sustainable development in the region and other parts of the humid tropics.

A major lesson that can be extracted from Spruce's life and work was his dedication to prolonged field work and the quality of the information he recorded. An intimate knowledge of people and their resources is essential for rational development of any region.

After collation and analysis of existing literature and statistical manipulation of available data (essential ingredients of any modern research programmes) ground-truthing and uncovering primary information are still essential for a better informed picture of a region's potential for development and conservation, particularly in the humid tropics where official statistics are frequently unreliable or non-existent, and other data incomplete. Although rural populations may know a great deal about their environment, they are sometimes wrongly perceived as ignorant, with little information to offer in efforts to raise living standards in a region. The push for "desk-top" syntheses and computer model simulations can be almost irresistible as a supposed cost-saving device. The value of field work is often poorly appreciated by scientific directors and administrators of government agencies and development organizations; and it can be hard to get funding for field work because it is sometimes considered less prestigious or important than laboratory and computer-based work. But although field work is costly, the ultimate price for not understanding the natural resource base of a region and how people interact with nature before interventions are planned can be very much higher.

As I read through Spruce's epic book of travels in Amazonia, I was awed by how much time he spent in the field. He would sometimes spend two or three months waiting for a sail-boat to take him and his supplies up-river. Rather than remain house-bound, however, Spruce launched off almost daily into surrounding fields and forest to collect plants and observe the landscape. Heavy rains hardly deterred him, nor biting black flies and mosquitoes. Now there are as many as two jet flights a day from Santarém to Manaus, and the journey takes an hour. Spruce spent two months sailing from Santarém to Manaus. Modern travel is both a blessing and a bane. Jets allow us to reach our destinations so much quicker, but we miss much of the countryside on the way. May the example of Spruce's life help kindle a passion for field work in young scholars and all those committed to safeguarding and more effectively using the biodiversity of Amazonia.

### **ACKNOWLEDGEMENTS**

I am grateful to the World Bank for supporting my participation at the Spruce meetings at the University of York in September 1993, and for preparing prints from some of my slides. The views and conclusions in this chapter are mine and do not necessarily represent those of the World Bank or any other organization.

### NOTES

- (1) T. T. Chang. 'Availability of plant germplasm for use in crop improvement', in *Plant breeding in the 1990s* (eds H.T. Stalker and J.P. Murphy), Oxford, 1992, 17-35; J.G. Hawkes, *The diversity of crop plants*, Cambridge, Mass., 1983; N.J.H. Smith, J.T. Williams, D.L. Pluckett and J.P. Talbot, *Tropical forests and their crops*, Ithaca, 1992; G. Wilkes, 'Germplasm preservation: objectives and needs', in *Biotic diversity and germplasm preservation: global imperatives*, (eds L. Knutson and A.K. Stoner), Dordrecht, 1989, 13-41.
- (2) R.E. Schultes, 'Richard Spruce still lives', Northern Gardener (1953), 7, 20-27, 55-61, 87-93, 121-125. [Also issued as repaginated reprint, pp. 1-27.]
- (3) R. Spruce, Notes of a botanist on the Amazon and Andes (ed. A.R. Wallace), London, 1908, vol. 1, 16.
- (4) Ibid., 479.
- (5) C. Pesce, Oil palms and other oilseeds of the Amazon (ed. and transl. D.V. Johnson), Algonac, Mich., 1985, 28.
- (6) L. Coradin and E. Lleras, 'Coleta de germplasma de macaúba: situação atual', Newsletter: Useful plants of tropical America (FAO/CENARGEN) (1986), 2, 5-6.
- (7) R. Spruce, 'Palmae Amazonicae, sive Enumeratio Palmarum in itinere suo per regiones Americae aequitoriales lectarum', *Journal of the Linnean Society, Botany* (1869), 11, 65-183.
- (8) Spruce, op. cit. (3), 59.
- (9) Ibid., 86.
- (10) Ibid., 149.
- (11) M.F. da Silva, P.L.B. Lisbôa and R.C.L. Lisbôa, Nomes Vulgares de Plantas Amazônicas, Manaus, 1977, 12.
- (12) B. Stergios, 'La etnobotanica del arbol "chiga" (Campsiandra, Leguminosae, Caesalpiniaceae) en la region llanera de la cuenca del medio Rio Orinoco en el Suroeste de Venezuela', *Biollania* (1993), **9**, 71-90.
- (13) J.C. Mello and R. Spruce, 'Notes on Papayaceae', Journal of the Linnean Society, Botany (1989), 10, 1-15.
- (14) Ibid.
- (15) Spruce, op. cit. (3), 233.
- (16) P.B. Cavalcante, Frutas comestíveis da Amazônia, Belém, 1991, 193.
- (17) Spruce, op. cit. (3), 162.