PEOPLE AND PLANTS WORKING PAPER - MAY 1993

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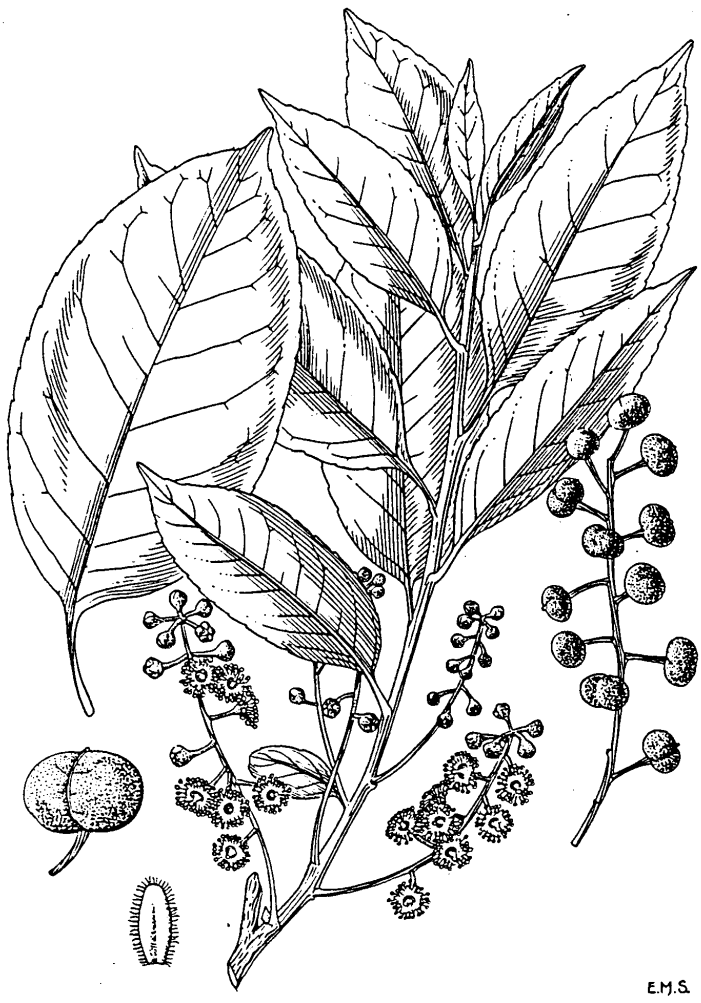
People and Plants

Sustainability of harvesting *Prunus africana* bark in Cameroon

A medicinal plant in international trade

A.B. Cunningham and F.T. Mbenkum



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Cover illustration: *Prunus africana*. Drawing prepared for the Flora of East Tropical Africa, Royal Botanic Gardens, Kew.

Published in 1993 by the United Nations Educational, Scientific and Cultural Organization, 7 Place de Fontenoy, 75352 Paris CEDEX 07 SP.
Printed by UNESCO Presse
on chlorine-free recycled paper.

Series editor: Alison Semple
Design and layout: Ivette Fabbri
Suggested citation: Cunningham, A.B.; Mbenkum, F.T. (1993). *Sustainability of Harvesting* Prunus africana *Bark in Cameroon: A Medicinal Plant in International Trade*. People and Plants working paper 2. Paris, UNESCO

Sustainability of harvesting *Prunus africana* bark in Cameroon

A MEDICINAL PLANT IN INTERNATIONAL TRADE

Abstract

The Afromontane hardwood tree *Prunus africana* (Rosaceae; African Cherry, Red Stinkwood) is a multiple-use tree species with local and international economic and medicinal value.

Bark is the major source of an extract used to treat benign prostatic hyperplasia, an increasingly common health problem in older men. All bark is taken from wild *Prunus africana* populations in Afromontane forests of Cameroon, Zaire, Kenya and Madagascar. Bark or processed extracts are then exported to Europe (primarily to France or Italy) for preparation of the drugs sold under the brand-names "Tadenan" (France) or "Pygenil" (Italy).

Despite assurances from senior management of the two major companies involved in the harvest and processing of *Prunus africana* bark, considerable concern has been expressed by rural communities, traditional healers and government departments in East and Central Africa about the sustainability of this international trade. Similar concern has also been shown by international conservation agencies such as the International Council for Bird Preservation (ICBP) and Worldwide Fund for Nature (WWF). Cameroon has been the major source of *Prunus africana* bark since 1972.

Prunus africana has a remarkable ability to withstand bark removal. Despite attempts at sustainable bark harvesting from wild populations, however, tree die-offs and felling of trees are frequent in high conservation priority sites. This occurs in Afromontane forest "islands" surrounded by savanna that provide habitat for important endemic birds, mammals and plants in both Madagascar and Africa. *Prunus africana* is an important fruit-bearing tree in Afromontane forest providing a food source for endemic birds such as Bannerman's Turaco and Cameroon Mountain Greenbul, and endemic primates such as Preuss's Guenon. Research in Malaysian rain forests has shown that selective logging for hardwood timber results in reduced numbers and carrying capacity for fruit-eating birds such as hornbills. Destructive harvesting of *Prunus africana* may have a similar effect in Afromontane forest. This is made more serious by the limited area this forest type covers in Africa and Madagascar. Over the 6 yr period 1986-1991, an annual average of 1923 metric tons of bark were processed. This represents at least 63% of *Prunus africana* bark processed worldwide or an average of 35 000 debarked trees annually. Extrapolating from the density of *Prunus africana* trees on Mt Cameroon (5.5 trees larger than 20 cm DBH ha^{-1}) this would affect at least 6300 ha of Afromontane forest each year.

Concern about overharvesting of *Prunus africana* bark resulted in a partial ban on bark extraction in 1991. Despite the ban, during 1991 over 3898 metric tons of bark (twice the annual average) were processed.

An initial assessment is made of cultivation as an alternative source of supply and recommendations for practical action to promote the sustainable use of Prunus africana bark are given.

Contents

Introduction

"Pour notre part, et en parfaite entente avec les autorités locales, nous veillons à ce que la perennité des espèces végétales concernées soit assurée, notamment par d'importantes mesures de reboisement." [For our part, and in perfect agreement with the local authorities, we are careful that the sustainability of the species is ensured, notably through major reafforestation measures].

J. Debat, Laboratoires Debat, 1992

"There are insufficient resources in terms of personnel and vehicles to satisfactorily supervise exploitation and enforce the legislation."

Macleod and Parrott, 1990.

"He came here and paid a small amount to a few people. The result was major destruction of the forest, our cultural heritage. If he comes to this region he will not be welcome."

Message from the Fon of Nso to the owner of Plantecam Medicam, 1992

For over a decade, the conservation implications, economics and effects of tropical hardwood logging have been the focus of considerable attention. Until recently, however, similar interest has rarely been shown in the values, economics or conservation implications of harvesting "minor forest products". Bark from the Afromontane canopy tree *Prunus africana* (and probably also *Prunus crassifolia*) (Rosaceae) is one such product. *Prunus africana* bark extract was patented in 1966 (Debat, 1966) and processed to provide a treatment for prostate gland hypertrophy (Longo and Tira, 1981; Catalano et al, 1984). All of the bark harvested in Africa (Cameroon, Kenya, Zaire) and eastern Madagascar is taken from wild populations. As an internationally traded forest product harvested from the wild, it provides a useful case study with practical implications for policy on harvesting and sale of forest products.

Cameroon is the major source of *Prunus africana* bark, where it has been harvested since 1972. Over a six year period (1986-1991), 11 537 metric tons of bark were processed by Plantecam Medicam, a French owned company based in south-west Cameroon. *Prunus africana* bark is the most important medicinal plant material to this company, representing 88.6% of medicinal plant material acquired for export between 1985/86 and 1990/91.

As early as 1976, the government of Cameroon first expressed concern about over-exploitation of internationally traded medicinal plants (United Republic of Cameroon, 1976). This resulted in establishment of a nursery and large-scale enrichment planting of *Prunus africana* in West Cameroon. Despite this concern, harvesting from the wild continues. In 1987, the ICBP (International Council for Bird Preservation) drew attention to the problems that over-exploitation of *Prunus africana* bark posed to important Afromontane forests in NW Cameroon (MacCleod, 1987; Macleod and Parrott, 1990) and was instrumental in working together with the Forestry Department to address the problem. This resulted in a partial ban on the trade in *Prunus africana* bark in February 1991 (Ministry of Agriculture, 1991). This ban was lifted in February 1992 (Ministry of Agriculture, 1992a). Neither the uncontrolled harvesting of wild *Prunus africana* populations, nor the implementation of cultivation as one of the alternatives, are easy problems to resolve. Much can be learnt however from an assessment of the extent of the trade in *Prunus africana* bark and a review of Prunus africana cultivation.

We hope that this paper will provide a basis for recommendations for future action that will lead to a balance between bark harvesting, forest conservation and economic development. The research for this paper followed three approaches: first, a review of published papers, government reports and weighbridge data from the Plantecam Medicam factory at Mutengene, Cameroon; second, discussions with harvesters, foresters and senior management of Plantecam Medicam, the sole processor and exporter of *Prunus africana* bark or bark extract from Cameroon; third, field visits to the main areas where harvesting has taken place or where cultivation has been implemented in Cameroon. Although *Prunus africana* bark has been traded for twenty years, published information on the extent of the trade is scanty. Forestry Department records are a valuable source of information and we are extremely grateful for the assistance that we received in obtaining copies of them. Despite this assistance, however, we were not able to locate reports prior to 1979.

Geographical distribution and values of *Prunus africana*

Prunus africana (Hook.f) Kalkman (Rosaceae)(formerly *Pygeum africanum* Hook.f) is a widespread Afromontane forest tree in mainland Africa, Madagascar and the islands of Grand Comore, Sao-Tome and Fernando Po (Kalkman, 1965; Vivien and Faure, 1985; this study; Figure 1). By contrast, *Prunus crassifolia* (Harm.) Kalkm. is endemic to Kivu (Zaire) although more specimens are required to confirm the status of this species (Kalkman, 1965). In Cameroon, *Prunus africana* occurs in three major areas (Figure 2a) which have volcanic soils and a cooler highland climate. These factors have resulted in dense human populations in these areas (Figure 2b), with clearing of forest for farming purposes the primary cause of Afromontane forest destruction. As Afromontane forest "islands" have become smaller, the damage caused by destructive bark removal and felling of Prunus africana has become increasingly serious.

Prunus africana is an important multiple-use species throughout its range, primarily for its bark (traditional medicines) and hard timber. In south-west and NW Cameroon, where most bark harvesting has taken place, *Prunus africana* is known as iluo (Kom), vla (Oku), alumty (Bamenda), wotangue (Bakweri) or kirah (Banso). *Prunus africana* and *Prunus crassifolia* are the only African species in the genus *Prunus*, and are wild relatives of plums (*Prunus domestica*), cherries (*Prunus avium*), peaches (*Prunus persica*), almonds (*Prunus dulcis*) and apricots (*Prunus armeniaca*). Due to the economic importance of these tree crops, the genus *Prunus* has been identified as one of the priority genera for *in situ* and *ex-situ* conservation by the International Board for Plant Genetic Resources (IBPGR). Overexploitation of *Prunus africana* and *P. crassifolia* has consequences not only for forest habitat and genetic resource conservation, however. These trees are also valuable and increasingly scarce resources for rural communities.

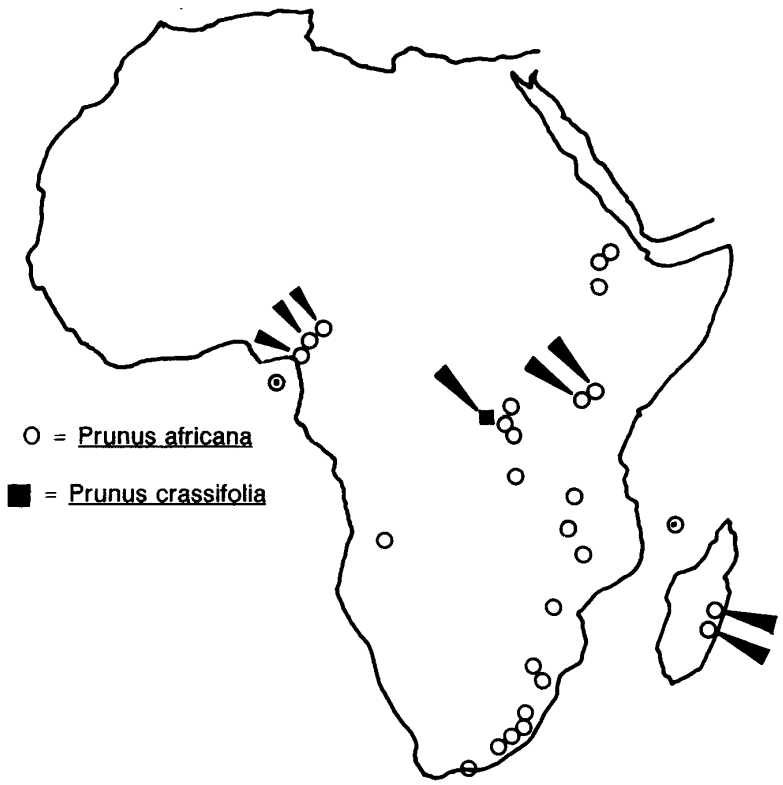


Figure 1. World distribution of *Prunus africana*, showing its occurrence in Afromontane islands, where it can be a locally common tree (from Kalkman, 1965; Vivien and Faure, 1985 and herbarium records (Kew)). Arrows indicate where commercial bark harvesting is taking place.

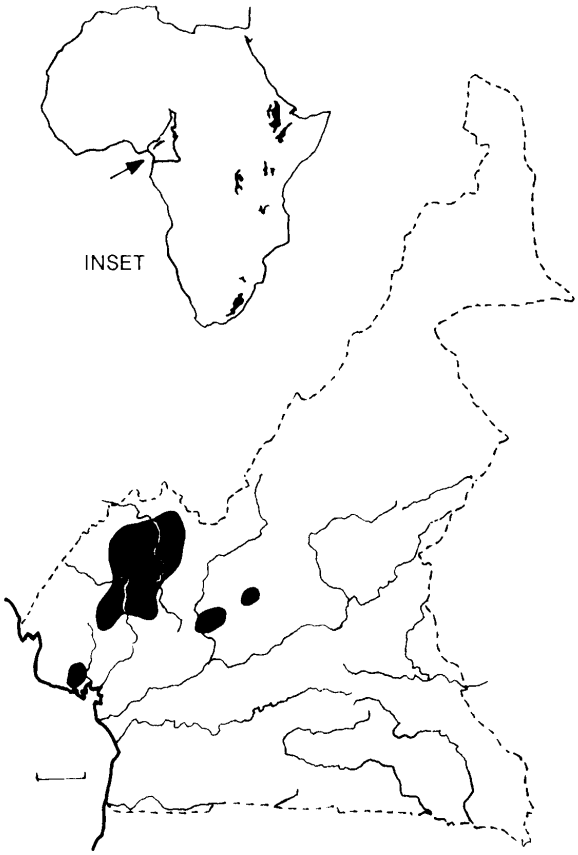
Prunus africana timber

The hard, durable timber of *Prunus africana* makes it a favoured of wood for household purposes, the type of use being dependent on tree diameter and form (straightness) and local lifestyle. Small trees are a source of axe and hoe handles (Kom area, NW Cameroon) (Nsom and Dick, 1992) and grinding pestles (Bwindi forest, Uganda) (Cunningham, 1992). In western Uganda, large *Prunus africana* trees are a popular source of "beer boats" for making banana beer (Cunningham, 1992). In southern Africa the wood has been used for timber and wagon making (Palmer and Pitman, 1972).

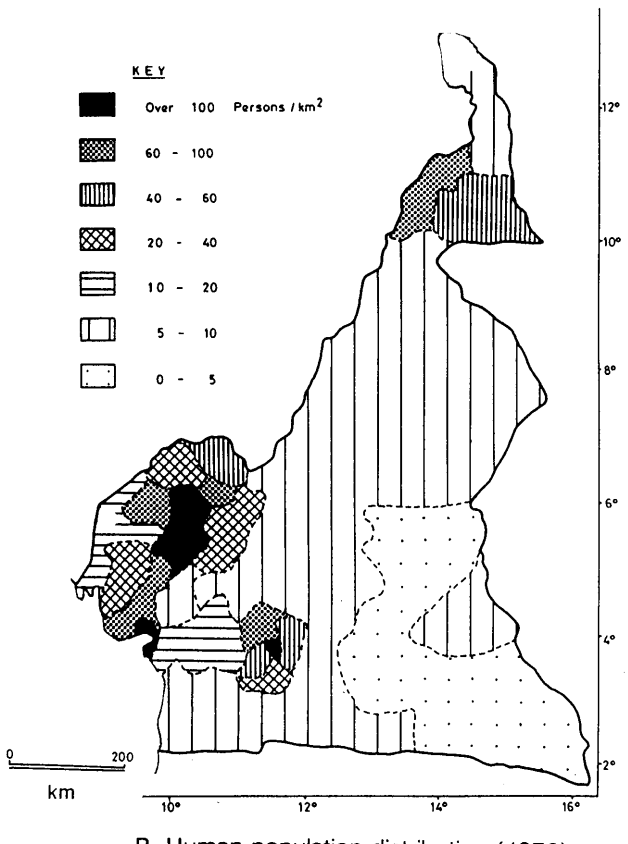
Traditional medicinal uses

Prunus africana is widely used in traditional medicine in southern, east and central Africa (Watt and Beyer-Brandwijk, 1962; Jeanrenaud, 1991). The bark is not only used by traditional healers, but also by local people collecting their own medicinal plants, including for use as a purgative for cattle (Kalkman, 1965). In the Mount Cameroon area, for example, 88% of people collect traditional medicines including *Prunus africana* (Table 1). There are no published records on the traditional uses of *Prunus crassifolia*.

Prunus africana was the fourth most popular medicinal plant species amongst people interviewed around Mount Cameroon, and was collected by 14% of households surveyed (Table 2) (Jeanrenaud, 1991). Similarly, it is an important medicine in the Ijim montane forest area, where it is used to treat malaria, stomach ache and fever (Nsom and Dick, 1992).



A. Prunus africana distribution, Cameroon



B. Human population distribution (1976)

Figure 2.
Location of Cameroon (inset) showing African montane "islands" surrounded by savanna and rural farmland which in (A), the three main localities for *Prunus africana* in Cameroon (Vivien and Faure, 1985) have a population density of well over 100 people km^{-2} (from Neba, 1982).

International medicinal uses of *Prunus africana* bark

Prostate gland hypertrophy and the closely related but more serious condition benign prostatic hyperplasia (BPH) are common diseases affecting older men worldwide. They are expected to become more common amongst the ageing male population of western Europe and the USA. It is now expected that one out of every two men in western countries will live longer than 80 years, with the result that 88% have the chance of developing histologic evidence of BPH. In the USA, for example, a 40 year old man has at least a 10% chance of needing surgery for BPH, and in a recent survey in Scotland, 30.2% (492) of a random sample of otherwise healthy men aged between 40 and 79 years had prostatic enlargement and symptoms of BPH (Anonymous, 1992).

Table 1 **Frequency of households, men and women collecting plant products from forest in the Etinde area of Mount Cameroon (after Jeanrenaud, 1991)**

FOREST PRODUCT	% HOUSEHOLDS	% MEN	% WOMEN
Fuelwood	99%	51%	49%
Mushrooms	96%	50%	50%
Medicines	88%	51%	49%
Wild fruits	84%	52%	48%
Leaves for wrapping	72%	54%	46%
Building poles	63%	66%	34%
House timber	61%	63%	37%
Nuts/seeds	61%	43%	57%
Furniture timber	48%	71%	29%
Craft materials	32%	42%	58%

Treatments for this disorder include surgery, balloon dilation, hyperthermia (using urethral probes), phytotherapy and pharmaceuticals containing anti-androgens and 5-alpha reductase inhibitors. Although surgery is common and effective, it is expensive, can cause impotence and is potentially dangerous, with a 1-3% post-operative mortality (Anon, 1992). For this reason, medical therapy and phytotherapy are popular alternatives.

Nearly thirty years ago, *Prunus africana* bark extracts were identified and patented as active in the treatment of benign prostatic hypertrophy (Debat, 1966). Bark extracts contain fatty acids, sterols and pentacyclic terpenoids (Longo and Tira, 1981; Catalano *et al*, 1984; Uberti *et al*, 1990). The sitosterol glucoside content of *Prunus africana* bark is 11 mg $100g^{-1}$ bark (Longo and Tira, 1981). Extracts of *Prunus africana* bark have been shown to be effective on rats (Thieblot *et al*, 1971, 1977) and in recent clinical trials conducted in Austria (Barlet *et al*, 1990). Capsules containing bark extracts have been marketed in Europe (mainly Austria, France, Italy and Switzerland) for over 20 years. By contrast with an earlier, small clinical trial which showed no significant difference between patients treated with "Tadenan" and a

Table 2. **The nine most frequently cited traditional medicinal plant species used by rural people living around Mount Cameroon (after Jeanrenaud, 1991)**

Family	Species	Bakweri Name	Percentage households	Use
Bignoniaceae	*Kigelia africana*	woloulay	21%	malaria, snakebites
Poaceae	*Pilea* spp.	esosomailja	19%	stomach ache, purgative
Meliaceae	*Khaya* spp.	wokaka	16%	for worms/purgative
Rosaceae	*Prunus africana*	wontangue	14%	?
?	?	lisavou*	14%	stomach ache
Asteraceae	*Vernonia anthelmintica*	massepo	14%	?
Meliaceae	?	efefe	10%	purgative
Myrtaceae	*Psidium guajava*	-	10%	stomach ache
Sterculiaceae	*Sterculia tragacantha*	ndototo	9%	worms, purgative

placebo (Donkervoort *et al*, 1977), the recent, detailed clinical trial conducted by Barlet et al (1990) showed that 66% of patients treated with "Tadenan", containing *Prunus africana* bark extract, had improved urine flow compared to 31% with the placebo. Five patients out of the 263 patients involved in the study showed gastro-intestinal side effects.

Volume and economic value of the bark trade

At least four European companies have interests in *Prunus africana* bark for medicinal purposes: Laboratoires Debat (France) and its subsidiary company Plantecam Medicam in Cameroon; Madaus (Germany, Spain); Prosynthese (France); Inverni della Beffa and Indena Spa (Italy). Bark is bought for 150-170 CFA kg-1 (US$ 0.6-0.7) in Cameroon and for 11 French francs kg-1 (US$ 2) from Kenya. Capsules containing the bark extract are marketed in Europe, a 15 tablet box costing US$ 7-8. The market value of this trade has been roughly estimated at US$ 150 million a year (A. Hamilton, pers. comm., 1992). The Italian companies import bark extract from Madagascar and the other European companies import processed or unprocessed bark from Cameroon, Kenya, Uganda and Zaire. Extract in tablets or capsules are marketed under two main trade names: "Tadenan", produced by Laboratoires Debat (France) and "Pygenil" produced by Indena Spa (Italy).

Prunus africana and medicinal plant trade from Cameroon

Internationally, Cameroon is the most important source of *Prunus africana* (Table 3). All bark harvested in Cameroon is processed and exported by Plantecam Medicam, a subsidiary of the French company Laboratoires Debat. Since 1972, Plantecam Medicam has focused on four main medicinal plant species and is currently licensed to export a number of other species with medicinal value (e.g. *Tabernanthe iboga*, *Myrianthus arboreus*) or potential sources of oils and fats from seeds (e.g. *Allanblackia floribunda*, *Carapa procera*).

In the mid-1970s, the mass of *Voacanga africana* (Apocynaceae) seed exports exceeded the mass of *Prunus africana* bark exported. In 1976, for example, 500 tons of *Voacanga* seed were sold (for production of the alkaloid *tabersonine*, used to depress central nervous system activity in geriatric patients; Mabberley, 1987) compared to 10 tons of *Prunus africana* bark (United Republic of Cameroon, 1976). This situation has changed in response to changing world demand for medicinal plant material (E. Legendre, pers. comm., 1992). According to data from annual reports, 88.6% (9309 metric tons) of plant material brought to the Plantecam Medicam factory from 1985/86 to 1990/91 was from *Prunus africana* (Table 4). The annual report data are adequate to show the importance of *Prunus africana* bark harvested relative to other species. It should be noted, however, that more accurate weigh-bill data showed that a total of 11 537 tons of *Prunus africana* bark was sold during the six year period 1986-1991, compared to only 9 309 tons indicated by annual reports over the period of six financial years (1985/86-1990/91).

Historical background

Plantecam Medicam first started harvesting bark from forests on Mount Cameroon before expanding into NW Cameroon (Macleod and Parrott, 1990). According to discussions with villagers during this survey, Plantecam Medicam visited Ntingue village, between Dschang and Santchou in western Cameroon in 1972, where they recruited at least 180 workers. Twenty years later, many of the bark harvesters working for Plantecam Medicam are still from the Dschang area. Minimum sized bundles of 40 kg were expected from each

Table 3. **Proportionate sources of supply of *Prunus africana* bark from different Afromontane forests in Africa (Cameroon, Kenya, eastern Madagascar). Bark exploited in Kivu, Zaire is probably a mixture of *Prunus crassifolia* and *Prunus africana* bark. (Anon,1993; Rasoanaivo, 1990; this study).**

Source country	Locality of forests	Annual bark mass (tons yr^{-1})	Importing country
Cameroon	Mt Cameroon, Mt Kupe, Bamenda highlands, including Mt Oku and Nso	1116-3900 (mean = 1 923)*	France
Kenya	Mau and other Afromontane forests in western Kenya (new tea estates etc)	193 (n=10yr)	France
Uganda	Bushenyi district, including over-exploitation within forest reserves	96	
Zaire	Mt Kivu, eastern Zaire	300	Belgium, France
Madagascar	Montane forests in eastern Madagascar	78 - 800	Italy

* over a 6 yr period (1986 - 1991)

worker, with bonuses paid for heavier bundles. Harvesting was systematic and controlled, with bark removal on two opposing sides of the tree trunk to avoid girdling (or ring-barking) the trees. Felling was not allowed. With this approach, some trees died, but the majority survived.

Harvesting by Special Permit holders

For fifteen years, Plantecam Medicam employed its own workers to harvest *Prunus africana* bark. Harvesting was controlled, with most trees surviving. This system broke down in 1985 when about 50 additional licences were provided to Cameroonian entrepreneurs. Bark harvesting was no longer under monopoly control of Plantecam Medicam although the company remained the sole exporter of *Prunus africana* bark and bark extract. Although licensing of local contractors was intended to stimulate industry, it also encouraged over-exploitation of wild stocks. This has been a particularly serious problem in NW Cameroon, where bark harvesting has been in the hands of local businessmen since 1987. In 1991/92, twenty-four entrepreneurs supplied Plantecam Medicam with *Prunus africana* bark (Table 5; Divisional Section of Forestry, 1992). All Special Permit

Table 4. **Species, parts used, total mass and relative percentage of medicinal plant material brought into the Plantecam Medicam factory, Mutenguene, SW Cameroon from 1985/86 to 1990/91.**

Species used	Part used	Total mass (t) (1985/86 - 1990/91)	% of total
Prunus africana	bark	9309.2	88.6%
Voacanga africana	seeds	900.6	8.6%
Pausinstylia johimbe	bark	285.9	2.7%
Strophanthus gratus	seeds	6.7	0.1%

holders, including Plantecam Medicam, pay a "Regeneration Tax" (2% of the value of the raw material) and a "Transformation Tax" to the Forestry Department. These are supposed to cover forest regeneration costs.

Data from annual reports for each financial year (July to June) usually give an underestimate of bark mass harvested compared with weighbridge data (Figure 3). This is probably because the completion dates of these reports vary (July to January the following year). There is no doubt, however, that the quantity of bark exploited has generally increased over the past 12 years. The highest mass of *Prunus africana* bark was sold during the 1990/1991 financial year, when the harvesting ban was supposed to be in place (Figure 3). Most of this bark was from NW Cameroon (Figure 4).

Bark sources: Cameroon

Total annual quantities of bark processed in Table 4 are based on weighbridge data, which is more accurate than that in Forestry Department annual reports (Ministry of Agriculture, 1981-1992, Divisional Section of Forestry, 1986-1992). It is also more accurate than the weighbills kept by entrepreneurs buying *Prunus africana* bark from local people for supply to Plantecam Medicam, as it is a record of entering the factory as it is weighed and suppliers are paid (S. Eben Ebai, pers. comm., 1992). Annual bark masses (January-December) recorded on Plantecam Medicam weighbridge returns to the Forestry Department show that whilst there has only been a slight increase in quantity of bark harvested from Mount Cameroon (primarily by Plantecam Medicam), there has been a sharp increase in bark supplied from the NW province (Bamenda-Banso highlands) (Figure 4). There has also been a marked increase in bark quantity supplied from Bangem (South-West province), but this represents a small proportion of total bark mass harvested.

Views of local bark harvesters

Apart from the permanently employed *Prunus* bark harvesters working from Plantecam Medicam, local villagers are also employed to show harvesting teams where to find the *Prunus africana* trees or to collect and carry bark. One of the aims of this survey was to work with local assistants to interview bark harvesters in NW Province and Mount Cameroon. For two reasons, this was only partly successful. First, at the time of this survey, the NW Province was under a State of Emergency in the period following the 1992 presidential election. This precluded interview surveys at a time of social tension and suspicion. Second, although meetings were held and permission obtained from traditional leaders in three villages around Mount Cameroon (Bokwango, Bwassa and Mapanja), bark harvesters were very reluctant to discuss this issue with Mr Stephen Ekema, a local villager and experienced interviewer. This reluctance was a result of three factors: (i) commercial harvesting by Plantecam Medicam was due to start at Mapanja, adjacent to Etinde Reserve; (ii) villagers had been promised results from a previous interview sur-

Table 5. Quantities of *Prunus africana* bark harvested by, or sold to Plantecam Medicam by special permit holders during 1991/1992 (Divisional Section of Forestry, 1992)

Company	Bark mass (t)
Tedongeh	363
Essama	44
Plantecam Medicam	350
Emana	38
Erimon	237
Scao	39
Mokom	170
Effa	37
Mbah	113
Penandjo	37
Tchiaze	112
Mama	36
Nguenang	97
Acome	29
Tioveh	93
ITTC	27
Lutah	86
Amougou	22
Ngoko	86
ECIC	18
Mballa	81
Jahoung	11
Tedongho	71
I K Ndi	68
Le Bien	60

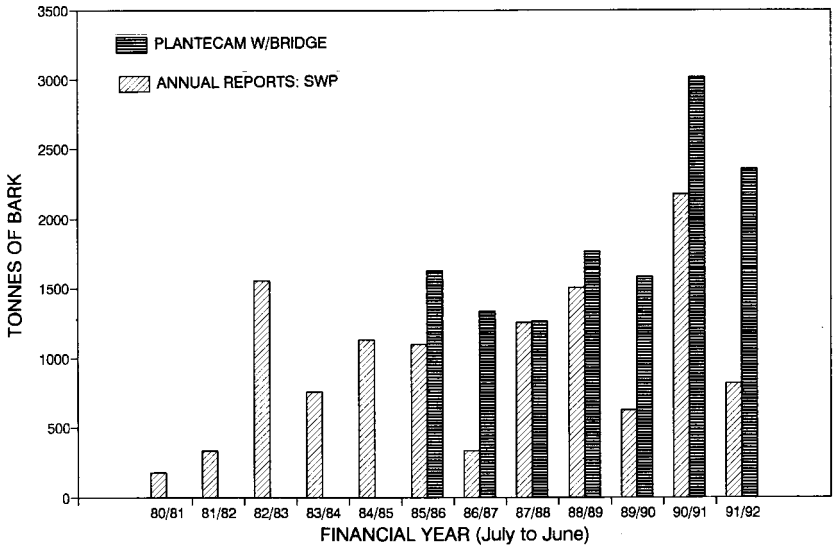


Figure 3. Mass of *Prunus africana* bark sold to, or harvested by Plantecam Medicam (1980/81 to 1991/92) (Ministry of Agriculture 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992; unpublished weighbridge data).

vey carried out to assess forest use, agricultural practices and villagers perceptions of the forest near Etinde Forest Reserve. These results were not provided to villagers. For this reason, people were justifiably reluctant to participate in this survey; (iii) political tensions in Cameroon after the presidential election.

Despite this, discussions and individual interviews were completed with a limited number of local people who had been involved in bark harvesting. Despite the small sample size, these interviews and earlier discussions with traditional leaders provide useful insights into local perceptions of *Prunus africana* bark harvesting. The results of the interview survey are summarized in Table 6.

Concern about the killing of *Prunus africana* trees was expressed by all traditional leaders we spoke to (Chiefs Evakise, Ewome Linelo and S. K. Liwonjo, pers. comm., 1992). There was also widespread concern about the preferential employment of outsiders to harvest bark, and the need to improve the terms of employment for temporary workers. The permanently employed bark harvesters who were outsiders to the community, were said to be starting fires and robbing beehives in the forest.

Bark harvesting was generally considered to be very hard work most suitable for strong young men due to the difficulty of climbing *Prunus trees* and carrying 50-70 kg loads of bark through the mountain forest. No women are involved in bark harvesting. All respondents were aware of the requirement that bark should only be removed from opposing quarters of the trunk, starting a "cutlass length" above the ground, and that 4-5 years should elapse before the trees are debarked again. Although no respondents were cultivating *Prunus africana*, all expressed an interest in this, but required support with materials (implements, fencing) and information on planting methods.

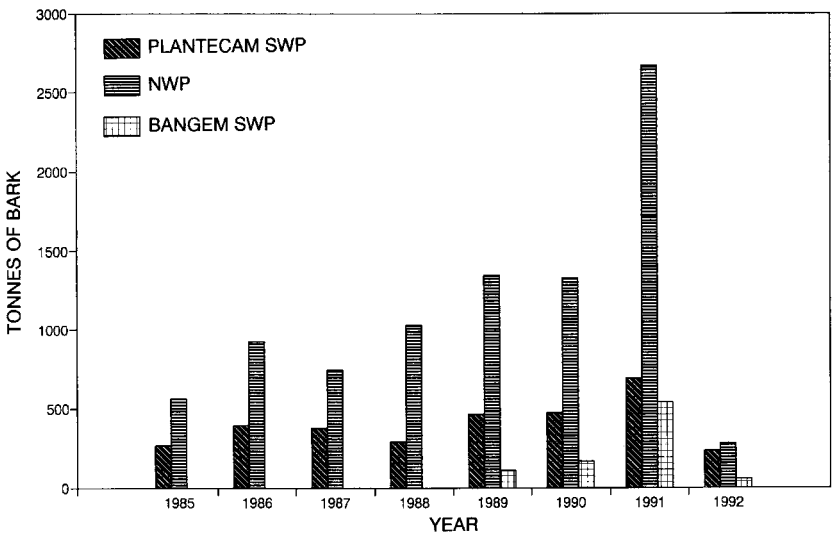


Figure 4. Quantity of *Prunus africana* bark harvested from different parts of Cameroon (1985 - 1992), showing the large quantity exploited from Afromontane forest in NW Province. Data for 1992 are incomplete. This represents a total of 11 537 tons of bark sold during the period 1986-1991 or an average of 1923 tons of bark year^{-1}.

Table 6. Views of bark harvesters about *Prunus africana* bark harvesting issues and attitudes to Prunus cultivation

Questions	Responses	n=7
Number of years collecting bark	1 year	1
	2 years	4
	13 years	1
Time of year of collecting bark	wet season	0
	dry season	2
	both seasons	5
Number of headloads per week	6-7	5
	7	
Number of headloads per day	1	7
Collecting limited to locals only?	no	7
Do outsiders collect in your area?	yes	7
Number of years before returning to the same tree to collect bark	4-5 years	1
	5 years	6
Problems collecting bark	poor climbing skills	7
	locals employed only temporarily	1
	no accident insurance	2
	no social benefits	5
	poor feeding of temporary workers	6
	low payment	1
	distance to resource	2
	bad roads	1
	poor carrying skills	1
	felling of trees	1
	locals not employed in factory	1
	loads abandoned	1
Solutions to the problems of bark collecting	teach climbing skills	1
	adequately feed the workers	4
	permanent work for local people	2
	social benefits for workers	2
	accident insurance for workers	2
	employ good strong climbers	1
	increase payment	1
Trees which give the best bark	medium aged trees	4
	female trees	1
	moist trees	1
Amount of bark removed from the trunk	1/2 of the bark	7
Price per kg	25 CFA	7
Do you cultiv ate trees?	no	7
Would you cultivate trees?	yes	7
Problems with cultivating trees	materials	5
	planting methods	2
	paying workers	1
	planting in the wet season	1

Forest conservation and bark harvesting from the wild

Sustainable or not? Theory and practice of forest harvest

Although it is commonly believed that most tree species completely regenerate their bark after it has been damaged, this is the exception, rather than a common response to serious bark damage (>10% of trunk bark removed below head height). Trees in the Proteaceae family, for example, are thick-barked and withstand fire damage, but are very vulnerable to fungal or borer attack once their bark is removed. The fact that *Prunus africana* was the target species for bark removal was extremely lucky. *Prunus africana*, together with *Warburgia salutaris* (Canellaceae) and some latex producing Ficus species (such as *Ficus natalensis*; Moraceae) are among the few African tree species that exhibit complete bark regrowth and are even able to withstand complete bark removal (Cunningham, 1991; unpublished records). The ability to withstand bark damage offered the potential for sustainable harvesting of *Prunus africana* bark. What is possible in theory, however, is difficult to implement in practice.

It is to the credit of Plantecam Medicam that a real effort has been made to ensure that all of the bark harvesters they have employed are shown the collecting procedure of removing bark "quarters" from opposing sides of the tree trunk, starting the bark removal above ground level and not debarking above the level of the first branch (Photo 1). Workers also know that if they are caught removing all bark from the trees, they face dismissal. All bark harvesters encountered during this survey were aware of these conditions.

Despite these commendable efforts, there are many cases where these guidelines are not followed and harvesting is not sustainable, particularly in NW Province. This is due to both the loss of monopoly control by Plantecam Medicam, with a resultant opportunistic scramble for wild stocks in NW Province by licensed entrepreneurs and also the felling and/or complete stripping of *Prunus africana* trees by some bark harvesters.

Photo 1. Stripping of *Prunus africana* bark from one of two opposing quarters of the trunk.

Prunus africana recruitment on Mount Cameroon

In 1991, Plantecam Medicam funded the Forestry Department to carry out a survey to determine the availability and distribution of *Prunus africana* on Mount Cameroon (Eben Ebai *et al*, 1992). Trees within 25 x 500 m sample plots at six sites around Mount Cameroon were measured, covering a total sample area of 45 ha. The number of seedlings m^{-2} was counted in three 2 x 2 m sub-samples in each plot, to get an estimate of regeneration rate, and a visual assessment was made of the extent of bark removal. The study showed that *Prunus africana* was most abundant in disturbed sites, with 63% of *Prunus africana* trees found along forest margins on the upper slopes of Mount Cameroon. Average density of trees >20cm DBH was only 5.5 trees ha^{-1}. Seedlings were most abundant where there was good light penetration into the forest and undergrowth was sparse, with seedling density usually 5 seedlings m^{-2}, but with patches of up to 50 seedlings m^{-2} (Eben Ebai *et al*., 1992). Both of these observations are as expected from a light-demanding, secondary forest species such as *Prunus africana*.

The Eben Ebai *et al*. (1992) study highlighted the relatively low density of *Prunus africana* trees and the high proportion (83%) of trees >20cm DBH (n = 130 020) within all sample plots. It should be noted here that sampling was not random, but was based on the guidance of knowledgeable local people to sites where *Prunus africana* occurred. Thus, it is reasonable to expect an even lower natural population density if sampling were to be random. Second, the study showed a low level of recruitment of *Prunus africana* trees at four of the six sample sites (Figure 5). In all six sample sites, size class distributions are unusual, showing low or sporadic recruitment. Whether this is due to episodic events, limited forest disturbance, 20 years of bark harvesting on Mount Cameroon or a combination of these factors is unknown and needs further investigation.

These data clearly show the destructive effects of felling or killing large *Prunus africana* trees in a situation where there is both a low density and low recruitment of large trees. They also suggest the need for bark harvesting to be excluded from Etinde Forest Reserve so that it can be maintained as a control area for comparison with other sites on Mount Cameroon where commercial bark removal is taking place. Although Eben Ebai *et al*. (1992) recorded some trees killed by debarking, the majority of debarked trees had survived. From field observations it would appear that a far higher mortality rate due to debarking and felling has occurred in forest in NW Province than on Mount Cameroon.

Photo 2. Limited bark regeneration and subsequent borer attack in a dry site (Mount Oku).

How many wild *Prunus africana* trees are debarked ?

To appreciate the extent of damage to wild *Prunus africana* populations, and the scale of cultivation required to replace harvesting of wild stocks, we need to know how many trees are debarked currently. Estimates of the number of *Prunus africana* trees that would have to be planted to ensure sustainable rotation to meet current demand can be obtained from estimates based on bark production by wild populations on Mount Oku (Table 7).

Mean bark yield was 55 kg tree^{-1}, with variation in yields of 38-73.8 kg tree^{-1} with the exception of April 1985 when mean bark yields are suspiciously high (128.2 kg tree^{-1}), either due to taking too much bark from each tree or underenumerating the trees harvested. The annual quantity of *Prunus africana* bark harvested (1923 metric tons), would represent almost 35 000 trees year-1 assuming that regulations were followed and bark on opposing quarters of the trunk only was removed. From field experience and the observations of others (Besong *et al*., 1991; Macleod and Parrott, 1990) we can confidently assert that these regulations are not always observed today.

Figure 5. *Prunus africana* diameter size class distributions from sample plots surveyed by Eben Ebai et al (1992) on Mt Cameroon. Unfortunately, data for trees less than 20cm DBH are lumped together. Histograms nevertheless show poor recruitment at four sites (Munyenge, Ekona Lelu, Bokwango and Mapanja) and unusual size class distributions at all sites.

Conservation issues: bark exploitation

Habitat destruction and change

Field observation suggests that bark gatherers selectively harvest bark from the largest trees available. Where over-exploitation of large trees occurs, there is a shift to trees with a smaller and smaller diameter at breast height (DBH). Although *Prunus africana* shows remarkable bark regrowth in moist sites, this is not always the case and trees are attacked by wood-borers (Photo 2) and exhibit crown die-back. Forests are dynamic systems with 4-10% in canopy-gap phase at any one time, and a turnover rate of approximately 100 years (Brokaw, 1985). As a secondary forest, light demanding species, *Prunus africana* recruitment would normally be favoured by disturbance. This is not the case, however, when species selective over-exploitation is taking place. *Prunus africana* die-off or a shorter lifespan of trees attacked by fungi and wood-borer after poor bark regrowth will result in changes in species com-

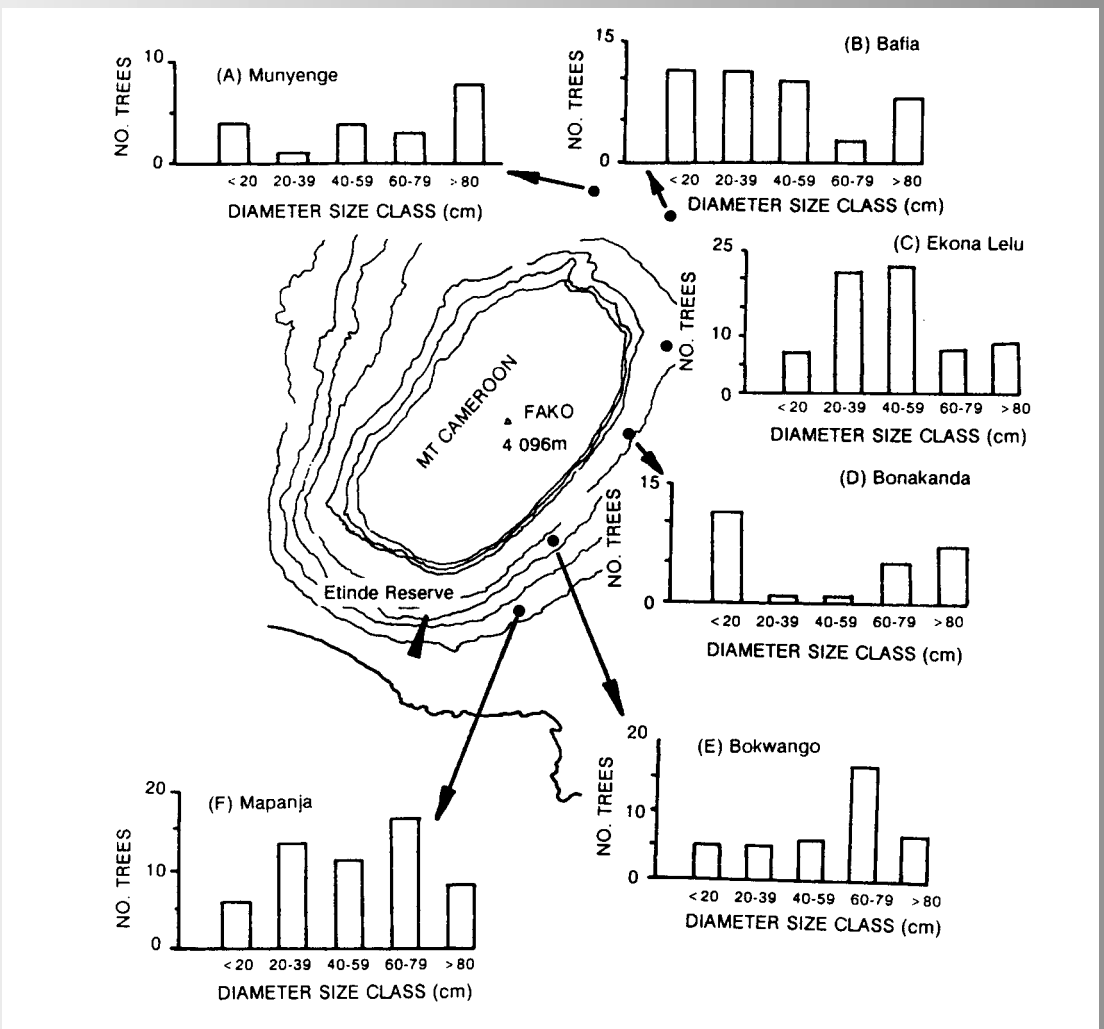


Table 7. **Total mass of bark harvested from *Prunus africana* in Afromontane forest at Mt Oku and total number of trees harvested in 1984/85 (Forestry Department data, Bui Division in Macleod, 1987) used as a source of mean bark yield. Note that no data are available for the period July-September 1985, which is the rainy season when harvesting conditions are difficult.**

Month	Bark dry mass (kg)	Number of trees	Mean yield of bark tree^{-1} (kg)
Dec. 1984	30 704	575	53.4
Jan. 1985	57 163	993	57.6
Feb. 1985	39 909	726	55.0
Mar. 1985	55 752	435	128.2
Apr. 1985	29 830	473	63.1
May 1985	54 060	1319	41.0
June 1985	37 795	793	49.5
Oct 1985	26 053	353	73.8
Nov 1985	54 628	1043	52.4
Dec 1985	38 152	1007	37.9
Total	**424 046 kg**	**7717 trees**	

* figures derived from Macleod (1987)

position in Afromontane forest where *Prunus africana* was formerly a dominant tree.

Reduction in bird and primate carrying capacities

Selective felling or girdling and die-off of the larger trees in a population results in lower seed production for the next generation of trees (Connell *et al*., 1984). It also represents lower production of food for frugivorous birds and mammals. This has important implications for bird and probably primate populations in Afromontane forest islands where over-exploitation of *Prunus africana* is taking place.

Afromontane forests of Cameroon contain some of the most important habitat in Africa for bird conservation, with a high number of endemic bird species (Collar and Stuart, 1988). Examples are the endangered Bannerman's Turaco (*Tauraco bannermani*) and the near-threatened Cameroon Mountain Greenbul (*Andropagus montanus*). These birds and the near-threatened primate Preuss's Guenon (*Cercopithecus preussii*) are all endemic to the Bamenda Highlands. All feed on *Prunus africana* fruits in addition to the fruits of other trees (Fotso and Parrott, 1991; S. Tame, pers. comm.). *Prunus africana* fruits are probably an important dietary component which would be lost with *Prunus africana* over-exploitation.

From studies in Malaysia, it is known that selective removal of tropical forest trees reduces its carrying capacity for hornbills (Johns, 1987). It is likely that this is also true for Bannerman's Turaco in Oku forest, which only has 0.08-0.12 pairs ha^{-1} (an estimated 800-1000 pairs) and is the major locality for this spectacular endemic bird (Fotso and Parrott, 1991). At an average *Prunus africana* density of 5.5 trees ha^{-1} (Eben Ebai *et al*., 1992) and a bark yield of 55 kg tree^{-1}, the commercial harvesting of 1923 tons of bark each year would affect over 6300 ha of Afromontane forest annually.

Commercial harvesting of *Prunus africana* bark has been taking place in all of Cameroon's three most important forests for bird conservation - (Mount Oku, Mount Cameroon and Mount Kupe; Collar and Stuart, 1988). For these reasons alone, it is important that *Prunus africana* cultivation becomes an alternative to exploiting wild stocks.

Genetic erosion ?

Two issues are of particular concern for species conservation. First, the apparently heavy exploitation of *Prunus crassifolia*, which is currently recognized as a separate species endemic to Kivu, Zaire. Kalkman (1965) stressed that more material was required to be sure. With

commercial exploitation of *Prunus* bark from the wild in Kivu, Zaire, further taxonomic study is now an urgent requirement.

Second, the removal of large, reproductively mature *Prunus* trees reduces seed dispersal and genetic flow between already isolated montane "islands", further increasing their isolation. A project aimed at determining genetic variation in and between *Prunus africana* populations on montane islands using DNA fingerprinting (RAPD) techniques is curently in progress. If genetic erosion is taking place, then *ex-situ* field gene banks need to be established.

Environmental and cultural accounting

The Global Biodiversity Strategy (WRI, 1992) points out that national governments currently consider forest and wetland ecosystems as "free goods", where their degradation does not count as depreciation on a nation's basic capital stock in calculations of Gross National Product. *Prunus africana* is a good example of this: quotas were given for bark exploitation without adequate knowledge of the quantities or consequences involved. The result has been the "mining" of natural resource capital rather than managed use. The quantity of bark harvested has increased annually (Figure 4), and from field observation and other reports (Macleod and Parrott, 1990; Besong *et al*., 1991) it is clear that this increase has been at the expense of wild *Prunus africana* stocks.

Although environmental accounting is in its infancy, it would be useful to make a study comparing the economic benefits of *Prunus africana* bark harvesting with the real costs involved. Local people and traditional leaders are aware of many of these costs: the waste of *Prunus* timber from felled or girdled trees that have been debarked, leaving the trees to die and timber to rot; reduced access to *Prunus africana* for traditional medicine, and the contribution that heavy vehicles transporting the bark make to degradation of country roads. It would also appear that benefits from the 2% regeneration tax are insufficient to cover even the direct costs of replanting *Prunus africana* trees. Macleod and Parrott (1991) observe that the permits issued to four contractors to exploit 600 tons of *Prunus africana* bark from Kilum forest could represent the death of 75 000 trees at an average bark yield of 8 kg tree^{-1}. The cost to the Cameroon government of replanting these trees would be an estimated 11.5 million CFA (US $ 43 000), compared to "Regeneration tax" benefits of only 1.7 million CFA (US $ 6300). It would be at least 15-20 years before replanted trees could be harvested. Bark yields tree^{-1} may be higher than estimated (see Table 7), but it would still be extremely informative to carry out a detailed cost-benefit analysis with the estimates already available.

The problem needs to be seen from a cultural as well as an environmental perspective. According to the Fon of Banso, debarking and die-off of *Prunus africana* trees has even occurred within a sacred forest which is the burial site of 17 previous Fons (traditional leaders). The Fon also considered that commercial harvesting of *Prunus africana* bark had stimulated forest clearing, by changing local perceptions of the forest from being a community asset to being a resource to be exploited for personal gain (A. Hamilton, pers. comm., 1991). This was given as a major reason for the surge in forest destruction after 1985. It is difficult to evaluate whether this is correct or not. There is no doubt, however, that massive forest clearing took place after 1985 when coffee prices collapsed and farmers expanded their fields to grow alternative crops such as beans and potatoes.

Alternatives to bark harvesting from wild populations

Under their current special licence, it is specified that Plantecam Medicam should plant 5 ha of *Prunus africana* per year for the next 5 years. At most, the Forestry nursery at Buea only holds 1000 seedlings on behalf of Plantecam Medicam. This is only enough to plant 1 ha. Only 2 ha have been planted at Buea, at the excessively wide spacing of trees 5 m apart with 5 m between rows. There is little doubt that the requirement to plant 5 ha of *Prunus africana* per year has not been fulfilled. It is also clear that even if this were achieved, it would not be sufficient to replace the wild harvested trees. The question is: how many trees need to be planted if bark production is to be sustainable?

Two approaches can be taken to answering this question given that no data exist on bark production yields from cultivated *Prunus africana* trees. First, we can estimate planting requirements for the well-documented *Acacia mearnsii* (Mimosaceae; Black wattle), an Australian tree cultivated worldwide for its tannin producing bark. This can then be linked to *Prunus africana* bark production data from wild collections in the Mount Oku forests, NW Cameroon, during a period when records were kept of total bark yields and the number of trees from which bark was harvested.

Bark yields: extrapolations from *Acacia mearnsii* cultivation

Black wattle (*Acacia mearnsii*) bark production from 12 year old stands with a mean density of 1363 trees ha^{-1} is 28.1 tons ha^{-1} (Schonau, 1973; 1974). Unlike the recommended *Prunus africana* bark harvesting methods, *Acacia mearnsii* bark production is from successive plantings of trees felled and totally stripped of their bark. Timber is then sold as fuelwood. Mean bark thickness at breast height in these *Acacia mearnsii* trees was 5.46 mm, with a mean DBH of 14.4 cm and a mean height of 16.4 m at 12 years old (Schonau, 1973; 1974).

Field observation suggests a similar bark thickness in *Prunus africana*. Probably due to site differences, the diameters of *Prunus africana* in the enrichment planting at Ntingue varied considerably (7.9 - 42.3 cm DBH), with trees up to 17 m high. This short initial survey of this 15 yr old planting gave mean DBH of 15.8 cm (n = 49 trees). These preliminary data suggest that comparisons between *Prunus africana* and *Acacia mearnsii* bark production are reasonable.

The mean quantity of *Prunus africana* bark processed annually from 1986-1991 by Plantecam Medicam was 1923 metric tons $year^{-1}$ (see above). Assuming that bark production and growth rates in *Acacia mearnsii* plantations would be the same as those for *Prunus africana*, this quantity of bark would be produced by 68.4 ha of trees felled and totally stripped of bark each year. These would be 12 year old stands with 1363 trees ha^{-1}. Current annual demand would thus represent 93 229 trees each year. A 12 year rotation would therefore require 820.8 ha of trees. Even if the planting of 5 ha of *Prunus africana* trees each year for 5 years was being carried out by Plantecam Medicam as stipulated in their current licence agreement, this would be totally inadequate to supply the existing demand for bark. In brief, current efforts to cultivate *Prunus africana* are totally inadequate and can not be expected to take the harvesting pressure off wild stocks.

Market forces and *Prunus* cultivation

The commercial value of the bark is well known to small farmers in Cameroon. Farmers are also aware of the damage to wild *Prunus africana* populations that has occurred in some areas, and the resultant scarcity of bark. This has encouraged farmers in NW Cameroon to cultivate Prunus africana from seed on a much larger scale than Plantecam Medicam. Ideally, cultivation by Plantecam Medicam and Special Permit holders could be supplemented with production from farmers in montane Cameroon. As a fast growing indigenous tree, *Prunus*

Photo 3. Mass propagation of forest trees from cuttings, Mbalmayo.

africana also has great potential for reafforestation and tree-based permaculture systems on steep slopes where current maize and bean production is unsustainable due to high rates of soil loss.

If small farmers are to become involved in *Prunus africana* cultivation, however, there needs to be a guaranteed market for the bark they produce at a price that makes production profitable. Plantecam Medicam can offer a market for *Prunus africana* bark for the next 5 years, but are unable to give any guarantee beyond that (E. Legendre, pers. comm., 1992). The 15 year old enrichment planting near Dschang gives us the opportunity to calculate annual bark yields ha^{-1}, and what profits could be reasonably be expected, based on standard forestry input costs in Cameroon. Another possibility (A. Hamilton, pers. comm. 1991) would be for farmers to cultivate only young *Prunus africana* trees (2-3 years old) for processing. This would give farmers a shorter rotation crop to cultivate, but feasibility depends on the level of active ingredient in young trees. Samples of 30 young (2-3 yr old) trees, and a 1 kg sample of bark from two 15 year-old cultivated trees were supplied to Plantecam Medicam in December 1992 as part of this study for testing.

The size of the market for "Tadenan" and "Pygenil", produced from *Prunus africana* bark, is uncertain. Continued demand for these herbal preparations will depend on competition from new treatments for benign prostatic hyperplasia (BPH), such as anti-androgens, 5-alpha reductase inhibitors and hyperthermia using urethral probes. A recent patent was taken out for a synthetic compound which acts as a testosterone 5-alpha-reductase inhibitor (Rasmusson *et al*., 1988). Trials with new medicines containing 5-alpha reductase inhibitors show a reduction in prostatic mass, improved urine flow and reduction in symptoms in about a third of patients with BPH (Anon., 1992). The effect of these new drugs on phytotherapy and the market for treatments based on *Prunus africana* extracts is difficult to estimate. On one hand, there is a resurgence in popularity for herbal treatments, but on the other, *Prunus africana* based products have been on the market for 20 years, and may lose ground to newer treatments. This question should be resolved as far as possible before small farmers are encouraged to spend time and money producing a long-term crop for which they may not have a market. Small farmers have much to lose. Market failure could result in many disappointed and justifiably angry farmers, and might damage the credibility of the conservation and rural development organizations involved.

Cultivation

Techniques

Cultivation of *Prunus africana* is easier than other forest trees with slower grow rates and more specific habitat requirements. *Prunus africana* seed appears to be recalcitrant. Fresh seed germinates readily, however (Table 8). It is a light tolerant, secondary forest species that makes an ideal tree for reafforestation, boundary markers or plantations, and has been used

by the ICBP Mount Kilum project to mark the forest boundary around Mount Oku (over 15 000 trees were planted on the forest boundary in 1990-1991).

Prunus africana has also been propagated from cuttings in Cameroon, with a root-strike of 10% of cuttings after 3 weeks (G. Bockett, pers. comm., 1992). This was done in sand, without the use of rooting hormone. A much greater percentage of rooted cuttings could be expected with the use of commercially available auxin-based rooting hormones. Leakey (1987) has emphasized the opportunities that clonal forestry can offer for enhancing yield and quality of forest products and the opportunities for implementing this in the tropics. Although this has mainly been applied to indigenous timber and fruit trees in West and Central Africa (Leakey et al., 1990), there is potential to develop faster growing, high active-ingredient yielding varieties of *Prunus africana*. This expertise already exists in Cameroon, where timber trees are being mass produced in low-technology propagators (Photo 3).

Lessons from *Cinchona* bark production in West Cameroon

In the late 1970s, in an effort to reduce dependency on imported anti-malarial drugs, considerable effort and expense were put into establishing *Cinchona* plantations in the Menoue Division, W Cameroon with an accompanying factory at Dschang. The aim was to establish a 200 ha plantation at Bansoa, initially through involvement of the Ministry of Agriculture, with the project then handed over to UCCAO (Union de Coopérative de Cacao et de Café de l'Ouest) (United Republic of Cameroon, 1981). From an initial 10 ha planting in the first year, expansion was planned to 20 ha by 1982/83 and 30 ha year^{-1} in the following years (United Republic of Cameroon, 1976). From 1983, it was also planned to cultivate 30 ha of smallholdings in W and NW Cameroon. Bark production was projected to be 300 kg ha^{-1} after 5 years.

A fully equipped factory was built at Dschang with support funding from the international community, accompanied by staff housing and imported equipment for processing of *Cinchona* bark right through to the production of quinine. In many ways, this factory symbolized an ideal often expressed in Africa: to reduce dependency on expensive imported pharmaceuticals and produce effective drugs for common and often fatal tropical diseases (in this case malaria). In addition, as *Cinchona* is an exotic species, production had to be based on cultivated stocks rather than exploitation from the wild.

Despite the infrastructure and ideals, the project failed entirely after a few years. Today, the factory and its processing equipment are derelict. The *Cinchona* plantation has been felled for housing and bean fields. Only a single, debarked *Cinchona* tree remains. If cultivation is to provide a viable alternative to harvesting of wild *Prunus africana* stocks, the incredible waste of energy and expenditure on the *Cinchona* project must not be repeated. Bark yields from cultivated stocks must not be underestimated and cultivation has to be an economic proposition, with fair prices for bark produced so that small farmers are involved. Plantecam Medicam needs to ensure that large scale production takes place on land with secure tenure in a similar way to oil palm and rubber plantations. At present, *Prunus africana* trees in the trial plot at Buea are already being felled to make space for beans that farmers are growing underneath them. While there is nothing wrong with an agroforestry approach, uncertainty over tenure appears to have been a major factor in *Cinchona* plantations being replaced by beans and cocoyams. The same could happen with *Prunus africana* plantations if these mistakes are repeated.

Prunus africana planting by rural farmers in NW Cameroon

The commercial importance of *Prunus africana* in NW Province has been an important stimulus to rural farmers to start growing this tree from seed. Although some farmers in the Oku area started planting *Prunus* as early as 1977,

Table 8. Results of a germination experiment with *Prunus africana* in southern Africa (Geldenhuys, 1981)

Treatment	Percentage germination	Time to 80% germination (weeks)
Control: pericarp not removed	52.0	5.6
Pericarp removed:		
Cold water, 7 days	90.0	3.1
Cold water, 1 day	92.5	2.9
HCl, pH 3, 1 day	92.0	2.5
HCl, pH 1, 1 day	94.0	3.3

Table 9. Locations, farmers names and number of *Prunus africana* seedlings being cultivated by farmers in the Oku area, NW Province, Cameroon

Location	Farmer	Number of trees
Bamti	Fabian Baba	2000
Bamti	V N Mbenkum	900
Mengu Vekovi	Charles Shey	100*
Feking	G S Feking	100
Mbam	G S Mbam	100
Total		3300

* trees planted in 1977

most *Prunus* cultivation has taken place since 1990 with encouragement from the Kilum Mountain Forest Project (KMFP) of ICBP and the "Trees for the Future" project. KMFP has assisted around 70 nurseries in the Oku area, all of which propagate *Prunus africana*. Several thousand trees have been planted in small plantations (Table 9) and around compounds and on farmland. These figures are probably an underestimate - *Prunus africana* fruited heavily in 1991 and planting figures for 1992 should be much higher (J. Parrott, pers. comm., 1993).

More trees are under cultivation by rural farmers in either Oku (Table 9) or Nso (Table 10) than in the Plantecam Medicam supported nursery at Buea, which in December 1992 only contained about 1000 seedlings. Among other advantages, cultivation may reduce the efforts entailed in bark transport (Photo 4).

Medicinal tree cultivation by Cameroon government departments

Over the past 17 years, ONADEF (Office National de Devéloppement des Forets) has applied its experience of indigenous (e.g. *Terminalia superba*) and exotic timber species (e.g. *Pinus*, *Eucalyptus*) to four tree species with medicinal value: three species cultivated for bark production (*Prunus africana* and two exotic *Cinchona* species) and *Voacanga africana* cultivated for its seed. The foresight of ONADEF in implementing medicinal tree cultivation in plantations and through enrichment planting is exceptional in Africa, and is a source of valuable information applicable not only in Cameroon, but in other African countries as well.

Prunus africana trees have been planted in two main areas of Cameroon. There is a small (2 ha) *Prunus africana* plantation at Buea and a *Voacanga africana* plantation of 100 ha (E. Legendre, pers. comm., 1992) on PAMOL land in the Fako division, SW Cameroon. A large-scale (c. 60 ha) enrichment planting has been

Table 10. Names of groups, farmers and number of *Prunus africana* trees planted and in nurseries in Nso area, NW Province, Cameroon (C. Dig, pers. comm., 1992)

Group/Farmer	Trees planted	Trees in nursery	Total
F. Motakima	2500	200	2500
C. Levla	1000	150	1150
Wainkar Womens Group		574	574
Bui Beans, Corn and Forestry Enterprise	1900	2000	3900
Sob village	1000		1000
CECUVIV: A. Koutoupit	2000	1500	3500
Vekovi Tree Production Centre		4195	4195
Ndzembo Traditional Trees	475		475
Total			17,494

undertaken in Menoua Division, W Cameroon. In 1974/75, two years after Plantecam Medicam started commercial harvesting of *Prunus africana* bark, Fond Forestière established a nursery at Ntingue near Santchou in Menoue Division, W Cameroon. At this early stage, the Government of Cameroon had recognized the need for cultivation of medicinal plants and allocated 75 million CFA francs to inventory, harvesting and marketing and 25 million CFA francs to experiments and regeneration as part of a 5 year plan (1976-1981) (United Republic of Cameroon, 1976). Review of past experience from the 60 ha *Prunus africana* enrichment planting and the failure of the *Cinchona* bark production and its associated quinine production project is essential in order to avoid the mistakes, and benefit from the successes of the past.

Photo 4. Bark harvester with 50 - 60 kg load of *Prunus africana* bark.

Policies for achieving sustainable *Prunus africana* harvesting

Several previous studies have resulted in recommendations for measures to bring wild *Prunus* bark harvesting to a sustainable level and to implement cultivation.

Ministry of Economic Affairs and Planning, Cameroon

In 1976, the government of Cameroon noted that "There also exist in Cameroon a number of foreign companies (Plantecam, Hollando, Sodex, Sodexpharm, Continaf, etc.) which export medicinal plants such as *Voacanga*, *Strophanthus gratus*, *Yohimbe* [*Pausinstylia johimbe*], *Rauwolfia vomitoria*, *Vinca rosea*, *Funtumia elastica*, *Pygeum* and aromatic plants.

The result of this disorderly exploitation is a gradual reduction of the potential supply of medicinal plants. For example, 800 tons of *Voacanga* and 50 tons of *Pygeum* are traded each year (United Republic of Cameroon, 1976)".

To resolve this problem, the government recommended that a para-statal corporation should be set up "to control the production and marketing of medicinal plants, and to absorb the companies and private individuals now engaged in those activities". In addition, 100 million CFA francs were set aside for inventory, organization of harvesting, marketing and regeneration. The enrichment planting near Dschang was implemented as part of this five-year plan and is a useful source of information on yields and economics of *Prunus africana* cultivation. The quantity of *Prunus africana* bark extracted from the wild annually has increased, however, from 50 tons (United Republic of Cameroon, 1976) to an average of 1923 tons.

International Council for Bird Preservation (ICBP)

Detailed resource management recommendations were made by Macleod and Parrott (1990) as the problem worsened and affected important conservation areas in NW Province. Their report stressed the need for prompt action and:

(1) a complete ban, pending further study;
(2) an inventory to determine the status of *Prunus* throughout Cameroon's forests;

Photo 5. *Prunus africana* felled for total bark removal, Mount Oku forest reserve (photo : G Bockett).

(3) an independent study should be made to determine the best harvesting techniques and intervals for sustainable harvesting of *Prunus* bark;
(4) on the basis of points (2) and (3), annual harvesting quotas should be calculated for each forest area and each Division; and
(5) on the basis of points (2), (3) and (4), permits should be issued against a licence fee and a deposit. The deposit would be returned when the Forestry Department was satisfied that the contractor had complied with recommended harvesting procedures.

Forestry Department

In January 1991, three senior members of the Forestry Department visited areas of SW, W and NW Cameroon where *Prunus africana* harvesting had taken place, meeting with harvesters, conservation NGO's and representatives of Plantecam Medicam (Besong *et al*., 1991). Their report highlights the risk that had been taken by permitting the exploitation of *Prunus africana* bark when the extent or productivity of the resource was unknown. Besong *et al*. (1991) also record the insufficient control of bark exploitation, lack of respect for quotas or forestry regulations and consequent resource degradation (Photo 5). A major reason identified for this is that people did not feel responsible for the forest resource, resulting in opportunsitic over-exploitation. Key recommendations were :

(1) To reduce quotas and limit the number of permits given out.
(2) To restrict the activities of permit holders to the forest zones allocated to them. Inventories should be done in these areas by the permit holders, and their accuracy certified by the local Conservator of Forests.
(3) To hold permit holders responsible for the damage caused to the trees. Bark harvesting techniques should be respected (i.e. bark removal from opposing quarters of the trunk up to the first branch). Killing of trees is forbidden in forestry legislation. This gives adequate power to Conservators to control this situation.
(4) To increase minimum exploitable diameter to 40 cm DBH.
(5) To limit the total volume of bark harvested annually to 1500 tons year^{-1}.
(6) To introduce reafforestation.
(7) To raise forest regeneration taxes and link them to this exploitation in order to finance a silviculture programme.
(8) To encourage Plantecam Medicam to create its own plantations, following the example of private oil palm and rubber companies such as HEVECAM and SOCOPALM in Cameroon.
(9) To start an education campaign to raise awareness of the importance of trees and their value as a source of revenue.
(10) To organize a meeting with all interested parties (government, Plantecam Medicam, permit holders, etc.) to discuss the problems of production, allocation of permits, pricing and the role of each permit holder.

In addition to the above recommendations, Eben Ebai *et al*. (1992) recommended enrichment planting with wild grown *Prunus africana* seedlings in order to avoid the costs of nursery establishment, and argued against the felling *Prunus africana* trees.

Conclusion

The market for "Tadenan" in France has generated a massive commercial demand for *Prunus africana* bark in Cameroon. In contrast to companies producing palm oil and rubber, which are both produced from large commercial plantations or small-holder production, *Prunus africana* continues to be taken from the wild. Plantecam Medicam deserves credit for attempting sustainable bark harvesting by removing opposing quarters of trunk bark rather than girdling the trees. However, quotas have been awarded by the Forestry Department without adequate forest inventories, and with limited resources to control exploitation. Overexploitation of *Prunus africana* in NW Cameroon has worsened since bark harvesting permits were awarded to 50 entrepreneurs and Plantecam Medicam lost its monopoly over bark harvesting. As the sole exporter of bark and bark extract, however,Plantecam Medicam must bear a large degree of responsibility for the over-exploitation taking place and needs to take steps to remedy this situation.

Despite the assurances of Laboratoires Debat that measures for conservation and sustainable use *Prunus africana* have been taken by its subsidiary Plantecam Medicam, this has not applied to the entrepreneurs who are its main suppliers. Plantecam Medicam buys bark from Special Permit holders regardless of how the bark was harvested. Plantecam Medicam has also not fulfilled afforestation requirements for cultivation of 5 ha each year under its current licence agreement. The Forestry Department has limited money and manpower, which has restricted forest inventory and control of bark exploitation. These factors are worsened by corruption and the poor economic situation in Cameroon. This situation casts serious doubt on managed, sustainable harvesting from wild populations and probably enrichment plantings. The 1991 "ban" on bark harvesting is a good example of this. Despite the ban, in 1991, double the usual quantity of bark was sold to Plantecam Medicam. The elaborate system of controls devised to ensure legal harvesting proved totally ineffectual (J. Parrott, pers. comm. 1993). What are the future options under these circumstances ? There are four main alternatives to the destructive harvesting of *Prunus africana* bark. First, managed sustainable use of wild populations after stock assessments and preparation of management plans. This could only take place if the management capacity of the Forestry Department was strengthened. Second, a complete ban on bark harvesting from wild populations, rather than the unsuccessful partial ban instituted in 1991. Third, phasing out harvesting of wild stocks in favour of cultivation. Fourth, promotion of other medical treatments to *Prunus africana* phytotherapy to treat prostate gland hypertrophy.

Recommendations

National and regional capacities to manage core conservation areas need to be strengthened together with pro-active rural development and resource managment options in buffer zones around these core areas. The Kilum Mountain Forest project (ICBP) is a good example of this. The general requirements for this institution building, including international funding for equipment, infrastructure and training are well known to conservation agencies. Long-term commitment to address the rapid growth in human needs and numbers that is the driving force behind forest clearing and habitat destruction in Africa is also essential (see Cunningham, 1990).

Managed sustainable harvesting of *Prunus africana* is theoretically possible thanks to the remarkable bark recovery of a high proportion of debarked trees. In practice, however, the high inputs of Forestry Department money and manpower required are not available and are unlikely to become available with the current economic situation in Cameroon. Provided there continues to be a market for *Prunus africana* bark, cultivation is the major long term alternative to rather than "mining" Cameroon's natural resource capital.

Conservation by cultivation

Objective: Local production of *Prunus africana* to provide an alternative to the destructive harvesting of wild stocks

(1) Plantecam Medicam and other Special Permit holders should take responsibility for establishment of large enough *Prunus africana* populations to replace harvesting of wild stocks, following the example of rubber and palm oil plantations such as PALMOIL, SOCOPALM, HEVECAM. Plantecam Medicam or Laboratoires Debat should acquire land to cultivate *Prunus africana*, rather than expecting land to be provided by the Forestry Department. *Prunus africana* grows well at low altitudes, and active ingredient yields could be increased through clonal selection. This should be done in addition to enrichment planting, and should be the main focus of bark production for future needs (see Besong *et al*., 1991).

(2) The commercial viability of converting some of the oilpalm plantations around Mount Cameroon to *Prunus africana* and tropical timber agroforestry systems needs to be investigated. At present the economic viability of palm oil production appears to be seriously affected by higher yielding oilpalm estates in south-east Asia.

(3) Research needs to be unertaken on the selection of fast growing, high active-ingredient yielding *Prunus africana* cultivars. This could be done through joint work between the Forestry Department, ONADEF, the Cameroon Centre for the Study of Medicinal Plants (CEPM) and the U.K. Institute of Terrestrial Ecology and University of Edinburgh, following the Mbalmayo example.

(4) If it is economically viable, small-holder farmers should play a greater role in *Prunus africana* cultivation, including agroforestry/permaculture systems and using *Prunus africana* trees as hedges in tea plantations.

(5) *Prunus africana* cultivation using selected high active-ingredient yielding varieties (rather than from wild collected seed/cuttings) should only take place if this poses no threat to the genetic integrity of wild populations in core conservation sites.

(6) Nurseries and extension support should be established to assist small-holder farmers, following the Kilum Mountain Forest (ICBP) example (Besong et al, 1991)

In-situ conservation of representative viable populations

Objective : Maintenance of representative viable populations of *Prunus africana* in Afromontane forests

(1) Core conservation areas should be recognized as control sites for comparison with forests where bark exploitation on wild

populations continues to take place. Disturbed sites should be used to monitor forest recovery and *Prunus africana* regeneration. It is recommended that no *Prunus africana* harvesting should take place within the areas set aside for Afromontane forest conservation (see Gartlan, 1989). There should be an immediate withdrawal of bark harvesters working within these high conservation priority sites.

(2) Community forests should be recognized and more established, as ICBP are doing. This could include the support from local community leaders and traditional healers for forest conservation.

(3) Good fertile material of *Prunus crassifolia* needs to be collected in Kivu, Zaire to confirm Kalkmans' (1965) identification of this as a separate species. The effects of the international bark trade on *Prunus* populations in Zaire and Madagascar need to be investigated. The Kenyan situation is considered to be a lower priority due to the low volume of the trade, which is reportedly based on bark harvested from deproclaimed forests, pipelines and new tea plantations where the forest would be destroyed anyway (J Leakey, pers. comm., 1992).

Ex-situ conservation

Objective : To establish field gene banks for *ex-situ* conservation of this species which has an apparently recalcitrant seed.

Provenance collections in secure field banks should be established for *Prunus africana* genotypes. The same should apply to provenance collections for *Prunus africana* and *Prunus crassifolia* from other sites, particularly where commercial bark harvesting is taking place. Where these field banks occur outside the countries of origin of the material, they should be accompanied by legal agreements that cover control and compensation for the use of the material.

Bark harvesting from wild populations

Objective : To set sustainable limits and manage bark harvesting over a set period until *Prunus africana* plantations and enrichment plantings are established.

(1) Current Special Permits should be revoked and reissued after comprehensive inventories have been established prior to further bark exploitation from the wild. It is suggested that prospective Special Permit holders should fund these inventories, which should be carried out independently.

(2) Strong support should be given to the following recommendations made by Besong *et al*. (1991):
   (i) to reduce quotas and limit the number of permits given out;
   (ii) to restrict the activities of permit holders to the forest zones allocated to them;
   (iii) that permit holders should be held responsible for the damage caused to the trees; bark harvesting techniques need to be respected;
   (iv) the minimum exploitable diameter should be increased to 40 cm DBH;
   (v) forest regeneration taxes need to be raised and linked to this exploitation in order to finance a silviculture programme.

(3) The volume of bark harvested annually will depend on the results of the forest inventories. Besong *et al*. (1991) suggested that this should not exceed 1500 tons year^{-1}. From this study, annual report data over the six year period (1985/86-1990/91) showed that this was the recorded annual average (1551 tons year^{-1}), with more accurate weighbridge data giving a figure only slightly higher than this (1923 t year^{-1}). If bark harvesting were excluded from core conservation areas, and given that overexploitation has depleted wild stocks in the major supply area (NW Cameroon), we suggest that a limit of 1500 tons year^{-1} is too high and should be greatly reduced following inventory work (see Macleod and Parrott, 1990).

(4) In conjunction with the reduced number of Special Permit holders and controls over harvesting recommended by Besong *et al*. (1991), and a drastic reduction in annual expected bark quotas following thorough inventories, the price paid for the bark should be increased to stimulate *Prunus africana* cultivation.

(5) Special emphasis should be placed on field assessment of bark damage (Cunningham, 1991) in addition to more detailed work on population structure of *Prunus africana* in Cameroon, following the work done by Eben Ebai *et al*. (1992).

Awareness campaign

Objective: To raise awareness of the value of forests, forest resources and the need for their rsponsible use. This could focus on *Prunus africana* as a multiple-use species with local and international value.

"Trees for Health" or "Forests are Wealth" campaigns that are designed to promote understanding of the importance of habitat and medicinal plant conservation and encourage the cultivation of medicinal plants should be instituted (see Besong *et al*., 1991) through WWF, WHO, UNESCO and national government Departments of Environment, Forestry and Health or local NGOs in countries where commercial harvesting of *Prunus africana* or other medicinal plant species is taking place

Monitoring

Objective : To monitor the effectiveness of these and other recommendations, as well as the status and recovery of *Prunus africana* populations.

(1) Permanent plots or transect lines need to be set up outside and within core conservation areas;
(2) A timetable needs to be set by the Forestry Department for the implementation of cultivation, and a register needs to be kept of the land area that this involves, with more practical spacings between trees than those implemented at Buea.

Acknowledgments

This survey could not have been produced without the assistance and hospitality of C. A. Asanga, J. B. Besong, G. Bockett, M. Bovey, C. Dig, S. Eben Ebai, S. Ekema, B. N. Ewusi, F. C. Foncham, S. Gartlan, E. Legendre, R. Ordot, N. Ndam, B. N. Nkongo, S. Tame and V. Tame. We would also like to acknowledge the help and advice of Chief S. K. Liwonjo (Mapanja), Chief Evakise (Bokwango) and Chief Ewome Linelo (Bwassa). Particular thanks go to A. Hamilton for his great interest and encouragement in this project, J. Gillet, for drawing our attention to the Austrian clinical trial conducted with *Prunus africana* extract, G. Bockett for photographs, Royal Botanic Gardens, Kew for the cover illustration, M. Cunningham for data processing and graphics. Thanks also to J. Parrott for his comments on earlier versions of this paper. Financial assistance for this study was provided by WWF, UNESCO and the Tropical Forest Programme (USDA Forest Service) (Grant no. 93-G-001). This study was carried out as part of the WWF-UNESCO-RBG, Kew "People and Plants" initiative, in collaboration with WWF-Cameroon and the Centre for the Study of Medicinal Plants, Yaoundé.

References

Anonymous. 1992. Urology: risk of benign prostatic hyperplasia (BPH) underestimated. *Hospital and Specialist Medicine*. October 1992, 58

Anonymous. 1993. Bushenyi trees ravaged. *The New Vision*, Friday 5 February.

Besong, J. B.; Abeng Abe Meka, P.; Ebamane-Nkoumba, S. 1991. *Etude sur l'exploitation du* Pygeum*: rapport de mission effectuée dans les provinces du Sud-Ouest, de l'Ouest et du Nord-Ouest*. 25 Janvier 1991. Cameroon, Direction des Fôrets, Ministère de l'Agriculture, United Republic of Cameroon.

Barlet, A.; Albrecht, J.; Aubert, A.; Fischer, M.; Grof, F.; Grothuesmann, H.G.; Masson, J.C.; Mazeman, F.; Mermon, R.; Reichelt, H.; Schonmetzler, F.; Suhler, A. 1990. Wirksamkeit eines Extraktes aus *Pygeum africanum* in der medikamentösen Therapie von Miktionsstörungen infolge einer beningen Prostathyperplasie: Bewertung objektiver und subjektiver Parameter. *Wiener Klinische Wochenschrift*, 102 (22), 667 - 673.

Brokaw, N. V. L. 1985. Treefalls, regrowth and community structure in tropical forests. In S. T. A. Pickett; P. S. White (eds) *The Ecology of Natural Disturbance and Patch Dynamics*, pp. 53-69. New York, Academic Press.

Catalano, S.; Ferretti, M.; Marsili, A.; Morelli, I. 1984. New constituents of *Prunus africana* bark extract. *Journal of Natural Products*, 47 (5), 910.

Collar, N. J.; Stuart, S.N. 1988. *Key Forests for Threatened Birds in Africa*.

International Council for Bird Preservation Monograph no. 3. Cambridge, IUCN/ICBP.
Connell, J. H.; Tracey, J.G.; Wells, L.J. 1984. Compensatory recruitment, growth and mortality as factors maintaining rainforest tree diversity. *Ecological Monographs*, 54, 141-164.
Cunningham, A. B. 1993. *African Medicinal Plants: Setting Priorities at the Interface Between Conservation and Primary Healthcare*. People and Plants working paper 1. Paris, UNESCO.
Cunningham, A. B. 1991. Development of a conservation policy on commercially exploited medicinal plants: a case study from southern Africa. In O. Akerele; V. Heywood; H. Synge (eds), Conservation of Medicinal Plants, pp. 337-358 . Cambridge, Cambridge University Press.
Cunningham, A. B. 1992. *Plants, People and Park: Multiple Use and Development Alternatives Around Bwindi-Impenetrable Forest, W. Uganda.* Report to CARE-International, Kampala.
Debat, J. 1966. *Br. App*., 25.893/66, June, 10.
Donkervoort, T.; Sterling, A.; van Ness, J.; Donker, P.J. 1977. A clinical and urodynamic study of tadenan in the treatment of benign prostatic hypertrophy. *European Urology* 3, 218.
Eben Ebai, S.; Ewusi, B. N.; Asanga, C. A.; Nkongo, J. B. N. 1992. An evaluation of the quantity and distribution of *Pygeum africanum* on the slopes of Mount Cameroon. Limbe, Cameroon. Divisional Service of Forestry.
Fako Divisional Service of Forestry, United Republic of Cameroon. 1988. Annual Report 1987/88. Limbe, Divisional Delegation of Agriculture, Ministry of Agriculture.
Fako Divisional Service of Forestry, United Republic of Cameroon. 1989. *Annual Report 1988/89*. Limbe, Divisional Delegation of Agriculture, Ministry of Agriculture.
Fako Divisional Service of Forestry. 1990. *Annual report 1989/90*. Limbe, Divisional delegation of Agriculture, Ministry of Agriculture.
Fako Divisional Service of Forestry. 1992. *Annual report 1991/92*. Limbe, Divisional delegation of Agriculture, Ministry of Agriculture.
Fotso, R. C.; Parrott, J. R.; 1991. Ecology and breeding biology of Bannerman's Turaco (*Turaco bannermani*). *Bird Conservation Internationa*l, 1.
Gartlan, S. 1989. *La conservation des écosystèmes forestiers du Cameroun*. IUCN Tropical Forest Programme report. Gland, IUCN.
Geldenhuys, C. J. 1981. *Prunus africana* in the Bloukrans River Gorge, southern Cape. *South African Forestry Journa*l, 118, 61-66.
Jeanrenaud, S. 1991. *The conservation - development interface: a study of forest use, agricultural practices, and perceptions of the rainforest. Etinde forest, South West Cameroon*. Report submitted to the Overseas Development Administration
Johns, A. D. 1987. The use of primary and selectively logged rain forest by Malaysian hornbills (Bucerotidae) and implications for their conservation. *Biological Conservation*, 179 - 190.
Kalkman, C. 1965. The Old World species of Prunus sub-genus *Laurocerasus. Blumea*, 13 (1), 33 - 35.
Kokwaro, J. O. 1976. *Medicinal Plants of East Africa*. Nairobi, General Printers Ltd.
Leakey, R. R. B. 1987. Clonal forestry in the tropics - a review of developments, strategies and opportunities. *Commonwealth Forestry Review*, 66, 61 - 75.
Leakey, R. R. B.; Mesen, J.F.; Tchoundjeu, Z.; Longman, K.A.; Dick, J. McP.; Newton, A.; Matin, A.; Grace, J.; Munro, R.C.; Muthoka, P.N. 1990. Low-technology techniques for the vegetative propagation of tropical trees. *Commonwealth Forestry Review*, 69, 247 - 257.
Longo, R.; Tira, S. 1981. Constituents of *Pygeum africanum* bark. *Planta Medica*, 42, 195 - 203.
Mabberley, D.J. (1987). *The Plant Book*. Cambridge, Cambridge University Press.
Macleod, H. L. 1987. *The Conservation of Oku Mountain Forest, Cameroon*. International Council for Bird Preservation Study Report no. 15. Cambridge., ICBP.
Macleod, H. L.; Parrott, J. 1991. Exploitation of *Pygeum* bark in the Kilum Mountain Forest Reserve. In litt. International Council for Bird Preservation.
Ministry of Agriculture. 1980. *Rapport Annuel 1979 - 1980*. Conservation des eaux et forêts et des chasses du Sud-Ouest. 8 Juillet, 1980. Buea.
Ministry of Agriculture. 1981. *Annual Report of Activities 1980 - 1981*. September 1981. Buea, Conservator of Forests, South-West Province.
Ministry of Agriculture. 1982. *Annual Report of Activities 1981 - 1982*. October 1982. Buea, Conservator of Forests, South-West Province.
Ministry of Agriculture. 1983. *Annual Report of Forestry Activities 1982 - 1983*. October 1983. Buea, Conservator of Forests, South-West Province.
Ministry of Agriculture. 1984. *Annual Report of Activities 1983 - 1984*. January 1985. Buea, Conservator of Forests, South-West Province.
Ministry of Agriculture. 1985. *Report of Activities 1984 - 1985*. August 1985. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.
Ministry of Agriculture. 1986. *Report of Activities 1985 - 1986*. August 1986. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.
Ministry of Agriculture. 1987. *Report of Activities 1986 - 1987*. August 1987. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.

Ministry of Agriculture. 1988. *Report of Activities 1987 - 1988*. August 1988. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.

Ministry of Agriculture. 1989. *Report of Activities 1988 - 1989*. August 1989. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.

Ministry of Agriculture. 1990. Conservation of Forestry. *Annual Report 1989 - 1990*. September, 1990. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.

Ministry of Agriculture. 1991. Conservation of Forests. *Annual Report 1990 - 1991*. September, 1991. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.

Ministry of Agriculture. 1991. *Portant suspension de l'exploitation du* Pygeum *et annulation des permis speciaux comprenant le* Pygeum. Yaoundé, 28 February, 1991. Arrete no. 11/A/MINAGRI/DF/SEF.

Ministry of Agriculture. 1992. Conservation of Forests. *Annual Report 1991 - 1992*. October, 1992. Buea, Ingénieur en Chef des Eaux et Fôrets et des Chasses, South-West Province.

Ministry of Agriculture. 1992. *Portant levée de la suspension de l'exploitation du* Pygeum. Yaounde, 14 February, 1992. Arrete no. 48/A/MINAGRI/DF/SEF.

Neba, S A. 1982. *Modern Geography of the United Republic of Cameroon*. New York, Hamilton Printing Company.

Nsom, C. L.; Dick, J. 1992. *An ethnobotanical tree survey of the Kom area*. Unpublished document. Ijim Mountain Forest Project.

Palmer, E.; Pitman, N. 1972. *Trees of Southern Africa*. Cape Town, A A Balkema.

Macleod, H.L.; Parrott, J.R. 1989. *The overexploitation of* Pygeum *in Cameroon*. Unpublished Report. International Council for Bird Preservation.

Pousset, J-L. 1992. *Plantes Médicinales Africaines. Tome II*. Paris, Agence de Coopération Culturelle et Technique.

Rasmusson, G. H.; Reynolds, G.F. 1988. 17-beta-N-Monosubstituted carbamoyl-4-AZA-5 alpha- androst-1-en-3-ones which are active as testosterone 5-alpha-reductase inhibitors. July 1988. United States Patent 4 760 071. 26

Rasoanaivo, P. 1990. Rainforests of Madagascar: sources of industrial and medicinal plants. *Ambio*, 19, 421 - 424.

Schönau, A. P. G. 1973. Metric bark mass tables for Black wattle, *Acacia mearnsii*. October 1973. Wattle Research Institute Report 1972 - 1973. Pietermaritzburg,Commercial Forestry Research Institute.

Schönau, A. P. G. 1974. Metric site index curves for Black wattle. October 1974. *Wattle Research Institute Report 1973 - 1974*. Pietermaritzburg, Commercial Forestry Research Institute.

Thieblot, L.; Berthelay, S.; Berthelay, J. 1971. Action preventive et curative d'un extrait d'écorce de plante africaine *Pygeum africanum* sur l'adenome prostatique expérimental chez le rat. *Therapie* , 26, 575 - 580 (cited by Pousset, 1992).

Thieblot, L.; Grizard, G.; Boucher, D. 1977. Etude du V 1326 : Principe actif d'un extrait d'ecorce de plante africaine *Pygeum africanum* sur l'axe hypophospho-genito surrenalien du rat. *Therapie* 32, 99 - 100 (cited by Pousset, 1992)

Uberti, E.; Martinelli, E.M.; Pfifferi, G.; Gagliardi, L. 1990. HPLC analysis of N-docosyl ferulate in *Pygeum africanum* extracts and pharmaceutical formulations. *Fitoterapia*, 61 (4), 342 - 347.

Vivien, J.; Faure, J.J.; 1985. *Arbres des forêts denses d'Afrique Centrale*. Paris, Agence de Coopération Culturelle et Technique.

United Republic of Cameroon. 1976. Fourth Five Year Economic, Social and Cultural Development Plan (1976 - 1981). Yaoundé, Ministry of Economic Affairs and Planning.

United Republic of Cameroon. 1981. The *Fifth Five Year Economic, Social and Cultural Development Plan (1981 - 1986)*.Yaoundé, Ministry of Economic Affairs and Planning.

Watt, J. M.; Beyer-Brandwijk, M. M. 1962. *Medicinal and Poisonous Plants of Eastern and Southern Africa*. London, E & S Livingstone Publishers.

World Resources Institute. 1992. *Global Biodiversity Strategy: Guidelines for Action to Save, Study, and Use Earth's Biotic Wealth Sustainably and Equitably*. Washington, WRI, IUCN and UNEP with FAO and UNESCO.

Already published in this series:

1. Cunningham, A.B. 1993. *African medicinal plants: setting priorities at the interface between conservation and primary healthcare*.

The People and Plants Initiative

was started in July 1992 by WWF, UNESCO and the Royal Botanic Gardens, Kew to promote the sustainable and equitable use of plant resources through providing support to ethnobotanists from developing countries.

The initiative stems from the recognition that people in rural communities often have detailed and profound knowledge of the properties and ecology of locally occurring plants, and rely on them for many of their foods, medicines, fuel, building materials and other products. However, much of this knowledge is being lost with the transformation of local ecosystems and local cultures. Over-harvesting of non cultivated plants is increasingly common, caused by loss of habitat, increase in local use and the growing demands of trade. Long-term conservation of plant resources and the knowledge associated with them is needed for the benefit of the local people and for their potential use to local communities in other places.

The diversity of traditional plant-resource management practices runs through a spectrum from "cultivation" through to gathering "wild" plants, all of which are included in the People and Plants approach.

Ethnobotanists can work together with local people to study and record the uses of plant resources, identify cases of over-harvesting of non-cultivated plants, find sustainable harvesting methods and investigate alternatives such as cultivation.

The People and Plants initiative is building support for ethnobotanists from developing countries who work with local people on issues related to the conservation of both plant resources and traditional ecological knowledge. Key participants organize participatory workshops, undertake discussion and advisory visits to field projects and provide literature on ethnobotany, traditional ecological knowledge and sustainable plant resource use. It is hoped that a network of ethnobotanists working on these issues in different countries and regions can be developed to exchange information, share experience and collaborate on field projects.

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