Case Study CS8: Evaluation of the Harvest of *Prunus africana* Bark on Bioko (Equatorial Guinea): Guidelines for a management plan.

International Expert Workshop on CITES Non-Detriment Findings

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Outline

Context

Vegetation study

Pygeum forests

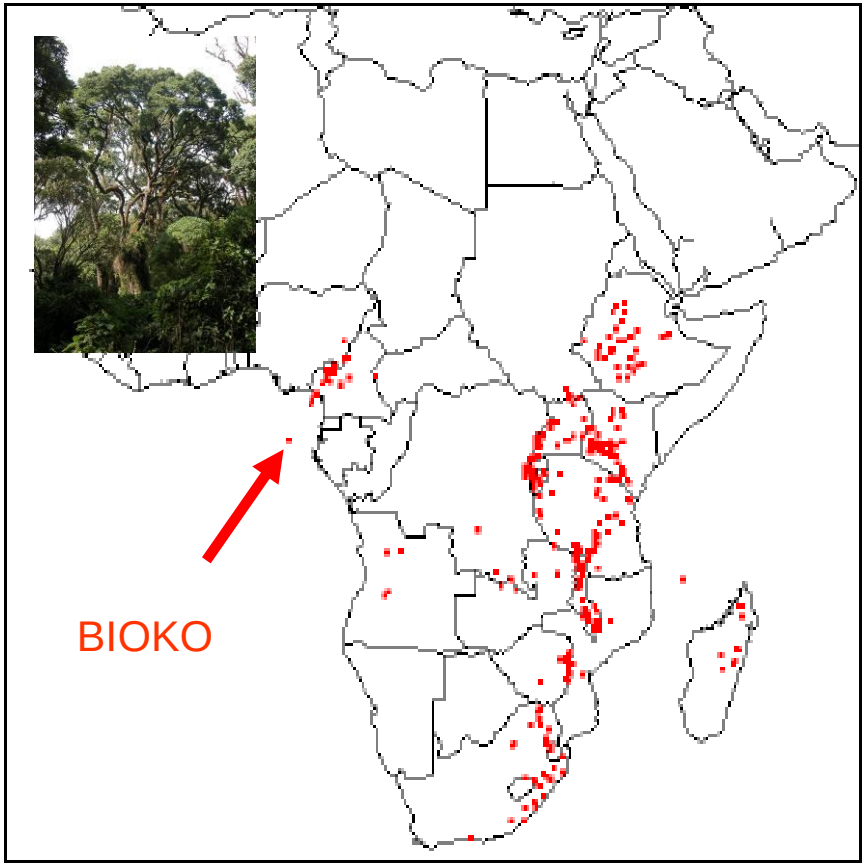
Bark yield

Management plan

Global distribution of *Prunus africana*

- **Pan-african distribution**: Kenya, Tanzania, Malawi, Uganda, República del Congo, Camerún, Sudáfrica, Zimbabwe, Islas de Madagascar, Gran Comora, Santo Tomé e Isla de Bioko.

- Natural populations grow in afromontane forests with high risk of deforestation.



***Prunus africana* (Hook. f.) Walkman**

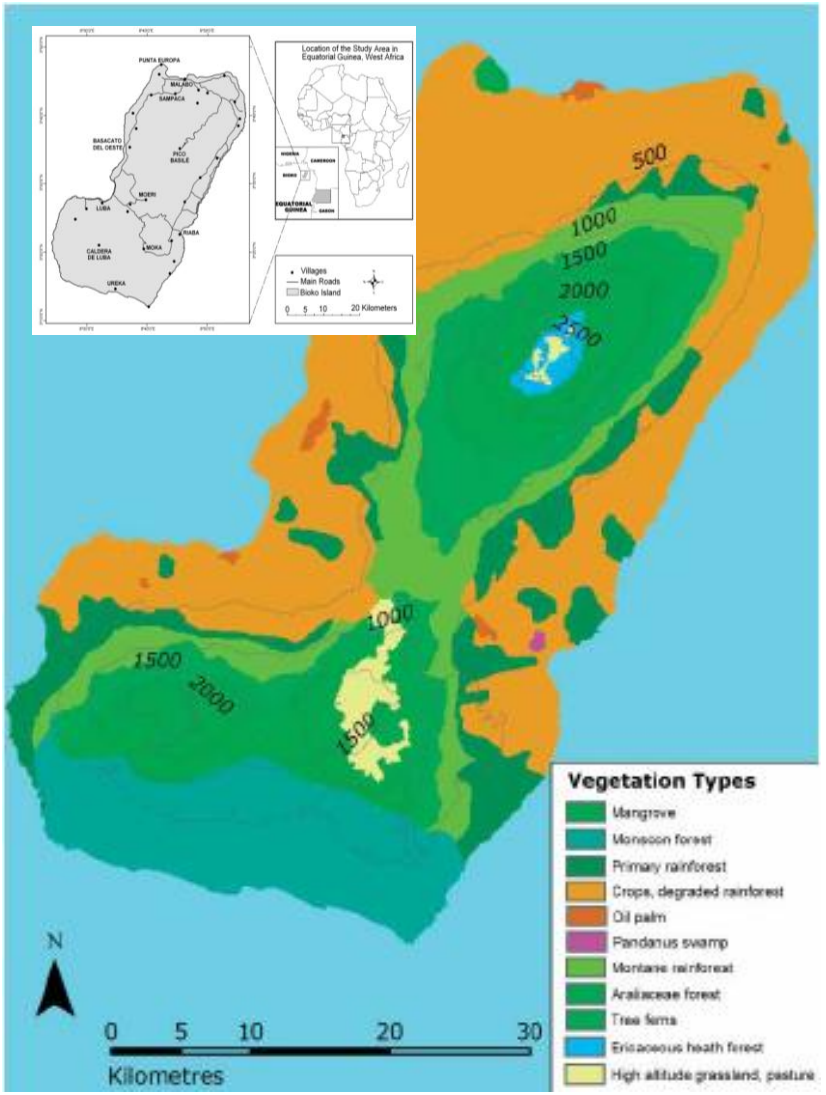
Context

Distribution of *Prunus africana* on Bioko

The Republic of Equatorial Guinea comprises three territories: Rio Muni (26,017 km^2), and the islands of Bioko (2,017 km^2) and Annobon (17 km^2).

Natural populations grow in afromontane forests in the mountains of Bioko Island

Altitude range	Ocaña, 1960	White, 1983	Summary review of potential vegetation types
0-20 m	Coastal drapery of greenery; coconut palms; mangroves	Guineo-Congolian rainforest; mangroves	Coastal Guineo-Congolian rainforest; mangroves
20-(600) 800 m	Equatorial forest; crops; monsoon forest	Guineo-Congolian rainforest	Guineo-Congolian rainforest; crops; monsoon forest
(600) 800 (1000) / 1400-1500 m	Montane rainforest; monsoon forest	Afromontane forest	Lowland afromontane forest: monsoon forest
1400 / 1500-2500 m	Araliaceous forest		Highland afromontane forest (Araliaceae)
2500-2700 m	Ericaceous area	Afromontane shrub area	Afromontane heath forest (Ericaceae)
2700-3000 m	Highland herbaceous prairies	Afromontane herbaceous area	Afromontane herbaceous area



Context

Bark explotation of *Prunus africana* in Bioko

- Use of *Prunus africana* is governed by Equatorial Guinea's Forestry Law of 1995 (EQG/96/002), under an appendix of 1997 that regulates sustainable use of non-timber forest products and harvest of *Prunus africana*.

- In 1999, the Forestry Department of Equatorial Guinea set an annual export quota for *Prunus* bark of 500 tonnes, upon consultation with the CITES Authorities in Malabo (Sunderland and Tako, 1999).

- Commercial harvesting is conducting to overexploited throughout its range and decline of *Prunus africana* forest ecosystems.

Bark of *Prunus africana*

Context

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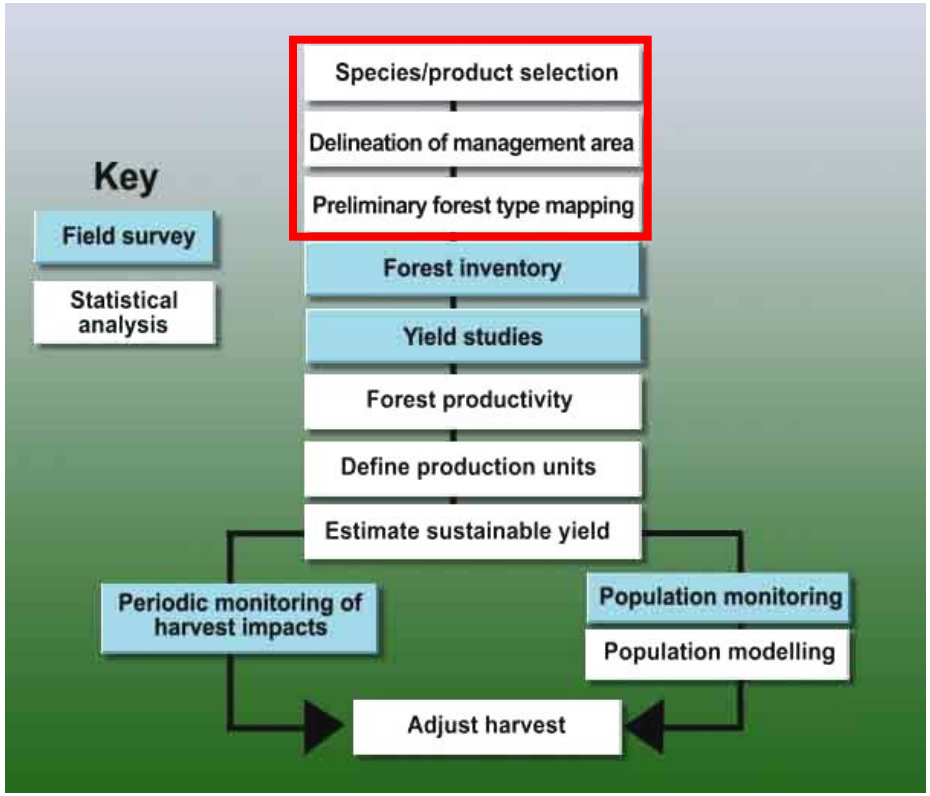
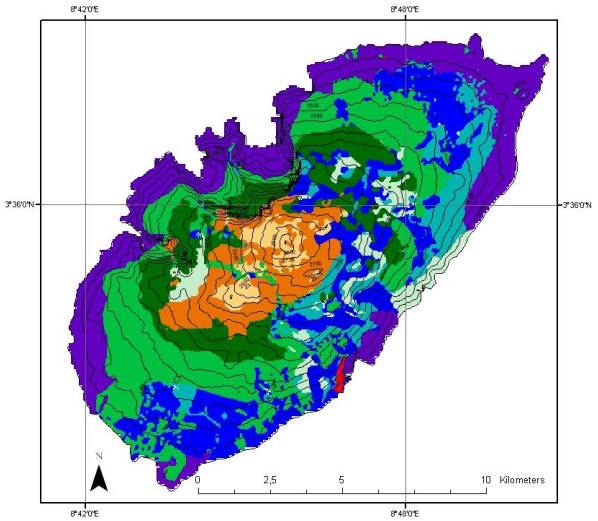




Wong, J L G, Thornber, K and N Baker. 2001. Resource assessment of non-wood forest products: experience and biometric principles. FAO, Rome

Afromountain forests (potential area of *Prunus africana*)

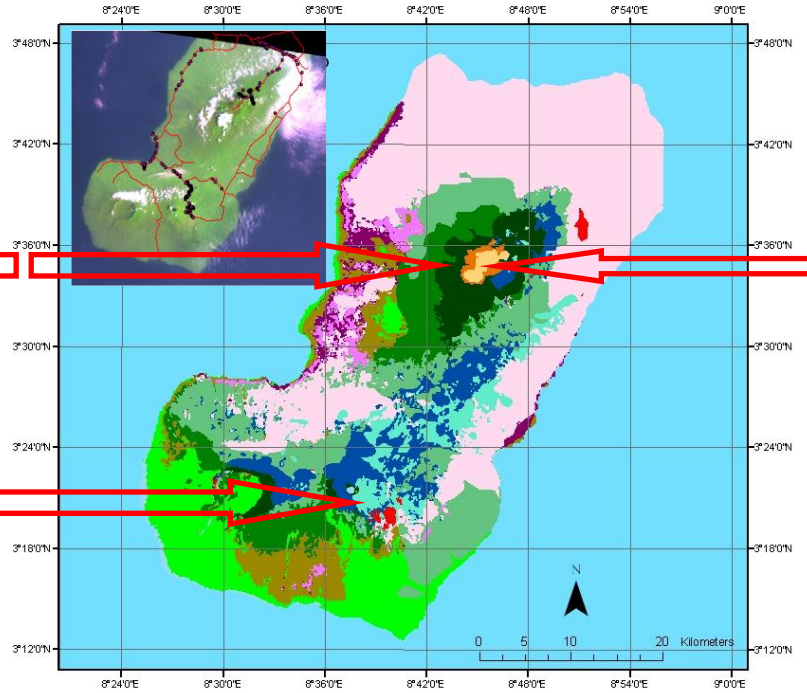
Supervised classification of Bioko Island

Vegetation types

Afromontane forests (*Araliaceae*)

Grassland (Degraded Afromontane forests)

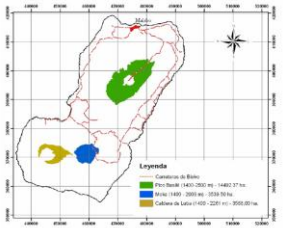
Afromontane shrub lands (*Ericaceae*)

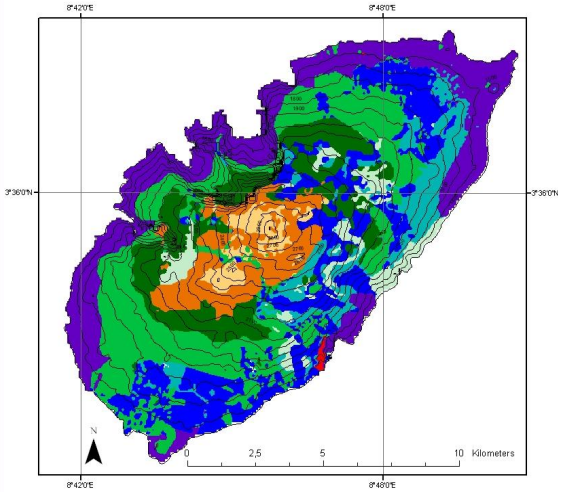


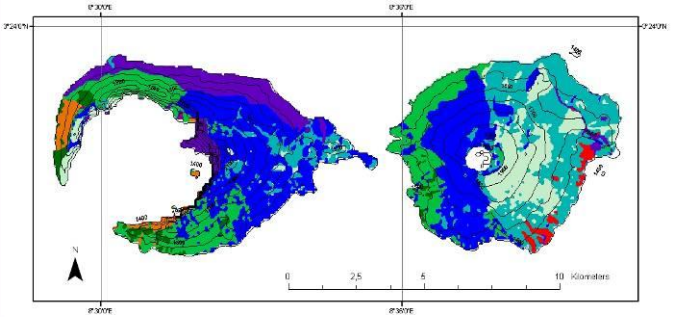
Accuracy 72% (k 0.69)

Altitude range	Ocaña, 1960	White, 1983	Summary review of potential vegetation types
(600) 800 (1000) / 1400-1500 m	Montane rainforest; monsoon forest	Afromontane forest	Lowland afromontane forest: monsoon forest
1400 / 1500-2500 m	Araliaceous forest		Highland afromontane forest (Araliaceae)
2500-2700 m	Ericaceous area	Afromontane shrub area	Afromontane heath forest (Ericaceae)
2700-3000 m	Highland herbaceous prairies	Afromontane herbaceous area	Afromontane herbaceous area

Supervised classification of afromontane forests of Bioko







Vegetation type	Supervised classification (Landsat ETM+ 2003)	
	Pico de Basilé (ha)	Moca and Gran Caldera de Luba (ha)
Guineo-Congolian rainforest mixed with afromontane elements	1568	390
Low afromontane forest	2030	435
Afromontane herbaceous prairies	793	0.5
Afromontane heath shrubbery (Ericaceae)	1131.37	20.25
Grasslands	17	76
Secondary afromontane forest	1735	3443
Herbaceous prairies (degraded afromontane forest)	175	1370
Highland afromontane forest (Araliaceae)	7043	1393
Degraded Guineo-Congolian rainforest	1.5	14
Young Guineo-Congolian rainforest mixed with crops	115	35
Old secondary Guineo-Congolian rainforest	0	0.5
Primary Guineo-Congolian rainforest	0.36	0
Total	14,609.23	7177.25

Accuracy 80% (k 0.81)

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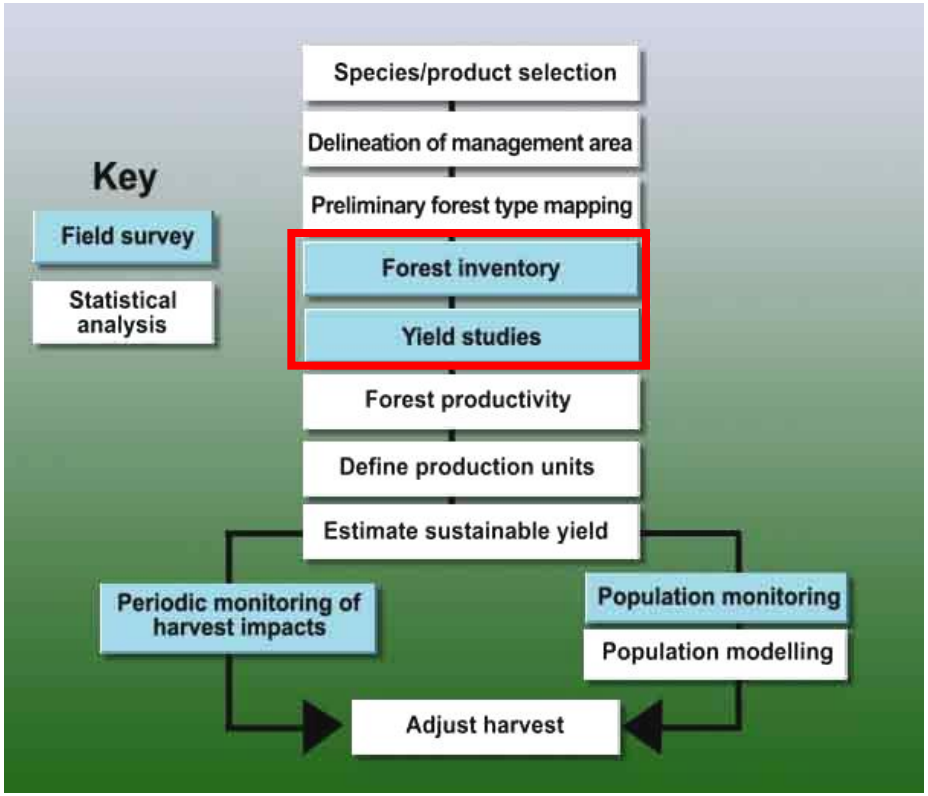
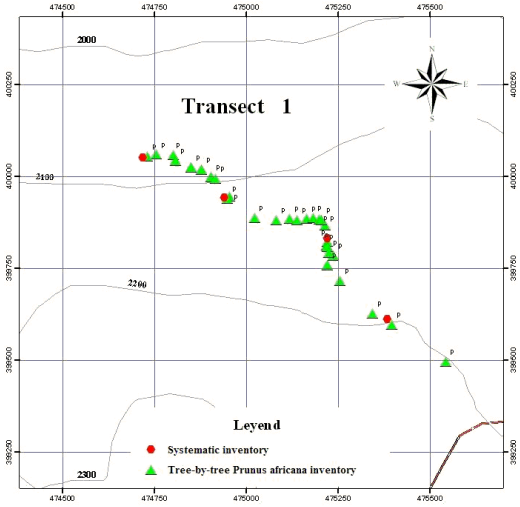
Steps of NDF Plan

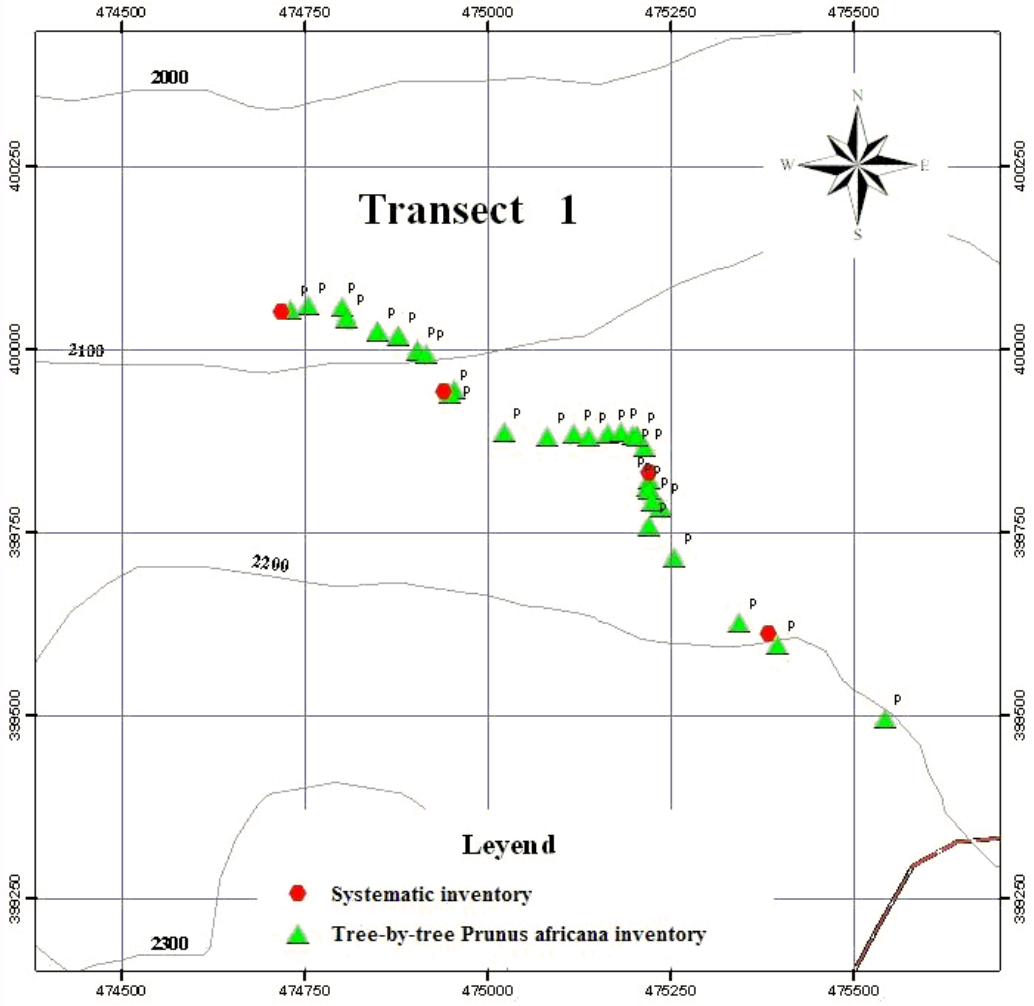




Harvest Area	Yield of the average tree (kg tree^{-1})	Density (stems ha^{-1})	Average dry bark yield by diameter class (kg ha^{-1})*
Pico de Basilé – high area	107.11	15.38	1647.35
Pico de Basilé – low area	115.92	2.65	307.19
Moca – low area	39.68	9.95	394.82
Moca – Monguibus	30.87	5.68	175.34
Moca – Biaó	35.04	6.37	223.21

Forest inventory and population structure of *Prunus africana* forests

Field survey methodology

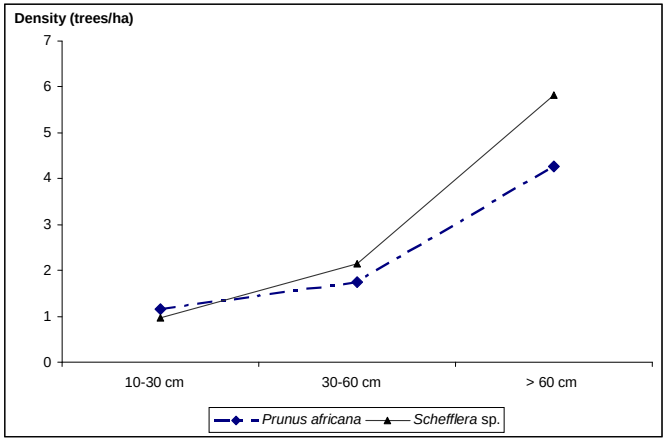


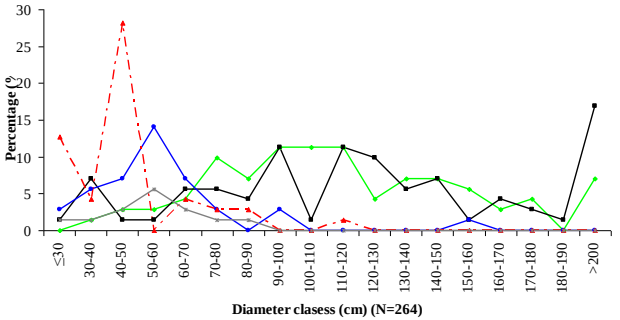
Systematic and tree survey

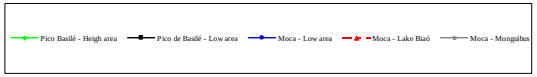
1. Number of plots 41
2. Number of trees 264 (Basile, 168; Moka, 96)
3. Parameters sampled: height (m), DBH (cm) and vertical stand structure.
4. Harvesting sampled: bark thickness, bark height, number of harvest.
5. Condition of *Prunus africana* trees in defoliation classes proposed by Sunderland and Tako (1999)

Structural attributes of the vegetation in *Prunus africana* forests by species, showing absolute values for density and basal area (BA)

Taxa	Place	Density (trees/ha)	BA (m^2/ha)
Bersama abyssinica	Moca	4.46	1.43
Crassocephalum mannii	Basilé and Moca	0.39	0.31
Ficus chlamydocarpa var. chlamydocarpa	Moca	1.55	0.46
Ficus sp.	Basilé and Moca	2.72	1.04
Ficus sp.	Basilé	0.39	0.31
Homalium sp.	Moca	0.58	0.26
Hypericum lanceolatum	Basilé and Moca	0.39	0.31
Macaranga spinosa	Basilé	0.58	0.26
Maesa lanceolata	Moca	4.08	1.21
Neboutonia macrocalix	Basilé	6.60	1.91
Nuxia congesta	Basilé and Moca	4.27	1.29
Oxyanthus spp.	Moca	3.49	1.94
Polyscias fulva	Basilé and Moca	2.33	0.51
Prunus africana	Basilé and Moca	7.18	0.94
Psycotria peduncularis	Moca	0.78	0.37
Psycotria sp.	Moca	0.19	0.16
Schefflera spp. (*S. barteri, S. mannii*)	Basilé and Moca	8.93	1.65
Trema orientalis.	Basilé and Moca	0.97	0.40
Trichilia prieureana	Basilé	5.05	1.62
Uragoga sp.	Basilé and Moca	0.39	0.22
Xymalos monospora	Moca	2.33	0.87
Zanthoxylun sp.	Moca	0.39	0.22
Other unidentified species (Bubi names)	Basilé and Moca	11.05	5.64
Total Figures		**69.29**	**23.51**







Prunus africana density

Population structure

Site	Total tree density (trees/ha)	*P. africana* density (trees/ha)	Average stand height (m)	Total tree CCF (%)	*Prunus africana* CCF (%)
Pico de Basilé and Moca	69.29	7.18	24	77.16	14.7

Area	Altitude range (m)	Total density (stems/ha)	*P. africana* density (stems/ha)	Total CCF (%)	*Prunus africana* CCF (%)	Average stand height (m)
Moca	**1429-1997**	**75.79**	**6.82***	**88**	**12**	**23**
Pico Biaó	1833-1997	54.91	6.37	78	13	23
Monguibus	1723-1829	103.45	5.68	96	8	24
Low area	1429-1556	79.58	9.95	100	19	21

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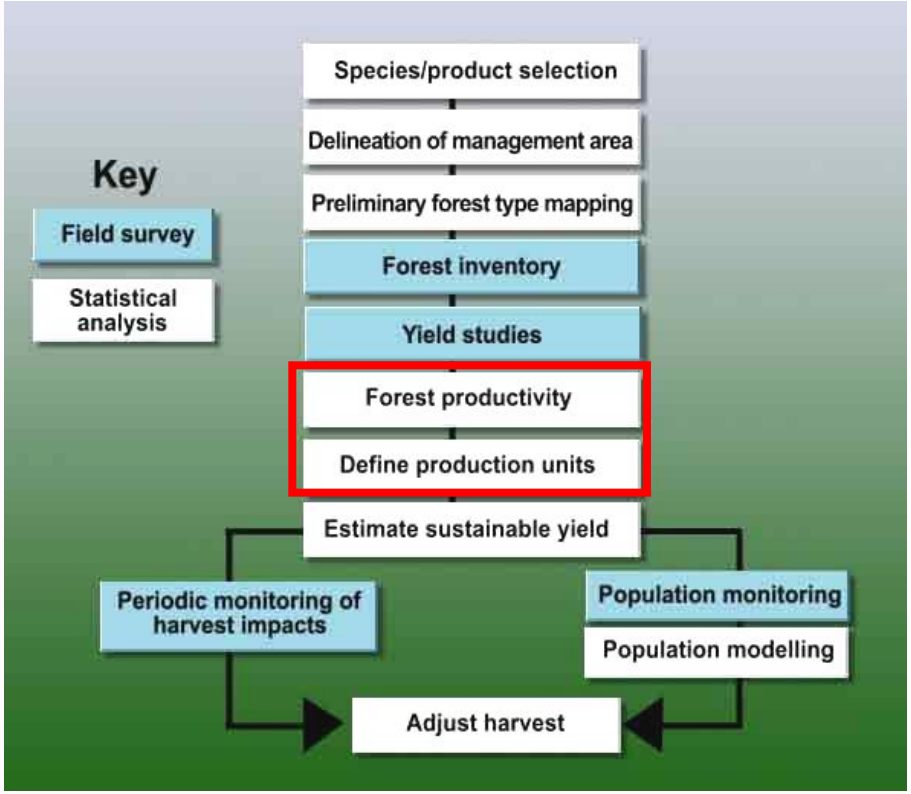
Non detrimental harvesting



Harvest area	Estimated potential bark yield (t year^{-1}) in unharvested condition, depending on F (nº of years between harvests)		Recommended quota (t year^{-1}) for 2006 following analysis of status in current and new harvest areas	
	F = 10 yrs	F = 8 yrs	F = 10 yrs	F = 8 yrs
Current areas	Current areas	Current areas	Current areas	Current areas
Pico de Basilé highlands	192.38	240.48	0 (bark regeneration period)	0 (bark regeneration period)
Pico de Basilé lowlands	24.4	30.93	0 (bark regeneration period)	0 (bark regeneration period)
Moca lowlands	8.16	10.2	4.8 (2nd harvest)	5.1 (2nd harvest)
Moca Monguibus	1.30	1.62	1.30 (unharvested)	1.62 (unharvested)
Moca Lake Biaó	1.15	1.44	0.58 (2nd harvest)	0.72 (2nd harvest)
Total current areas	**227.73**	**284.49**	**5.96**	**7.35**
New areas	**New areas**	**New areas**	**New areas**	**New areas**
Pico de Basilé (south)	**91.03 (estimated)**	**113.79 (estimated)**	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé (east)	**60.69 (estimated)**	**75.86 (estimated)**	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas	**379.45**	**474.14**	**157.68**	**197**

Production units and estimated yield

Average yield of dry *Prunus africana* bark (kg ha^{-1}) in the different harvest areas

(Hall *et al.*, 2000)	55 Kg. tree^{-1}
(Ndam *et al.*, 2000)	85 Kg. Tree^{-1}
(Walter y Rakotonirina, 1995)	50-200 Kg. Tree^{-1}

Harvest Area	Yield of the average tree (kg tree^{-1})	Density (stems ha^{-1})	Average dry bark yield by diameter class (kg ha^{-1})*
Pico de Basilé – high area	107.11	15.38	1647.35
Pico de Basilé – low area	115.92	2.65	307.19
Moca – low area	39.68	9.95	394.82
Moca – Monguibus	30.87	5.68	175.34
Moca – Biaó	35.04	6.37	223.21

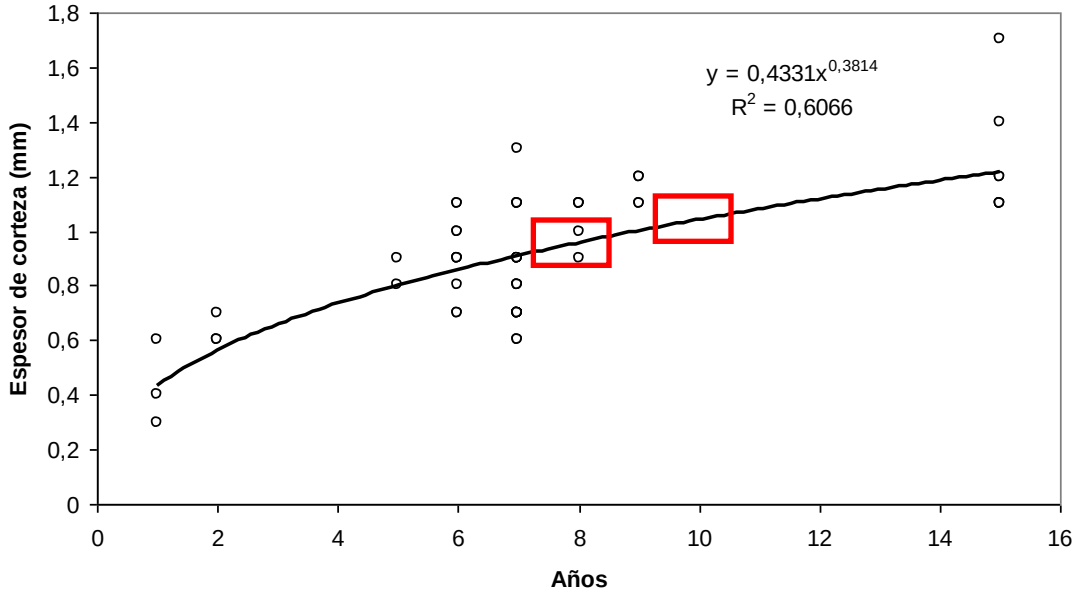
*conversion factor fresh bark/dry bark 0.5

Bark regeneration and extraction

Bark yield

Tabla 16.- Espesores de la corteza (media ± error estándar) de *Prunus africana* obtenidos en función del DAP comparados con los mencionados por Tonye *et al* (2000).

DAP	N	Espesor de corteza (cm.)	Espesor de corteza (cm.) (Tonye *et al.*, 2000)
≤30	4	0,8 (0,05)	
30-40	11	0,96 (0,07)	1,1
40-50	14	1,06 (0,06)	1,2
50-60	9	1,08 (0,07)	1,3
60-70	5	1,22 (0,14)	1,4
70-80	6	1,29 (0,08)	1,5
80-90	-	-	1,5
90-100	3	1,39 (0,06)	1,5
≥100	20	1,59 (0,10)	1,5-1,7



Bark regeneration and extraction

Maximum potential dry bark yield in harvest areas by total surface area, and average dry bark yield

Harvest area	Surface area (ha)	Average dry bark yield by diameter class * (kg ha^{-1})	Maximum potential dry bark yield (t)
Pico de Basilé – high area	1622	1647.35	2672.00
Pico de Basilé – low area	1119	307.19	343.75
Moca – low area	282	394.82	111.34
Moca – Monguibus	103	175.34	18.06
Moca – Biaó	72	223.21	16.07

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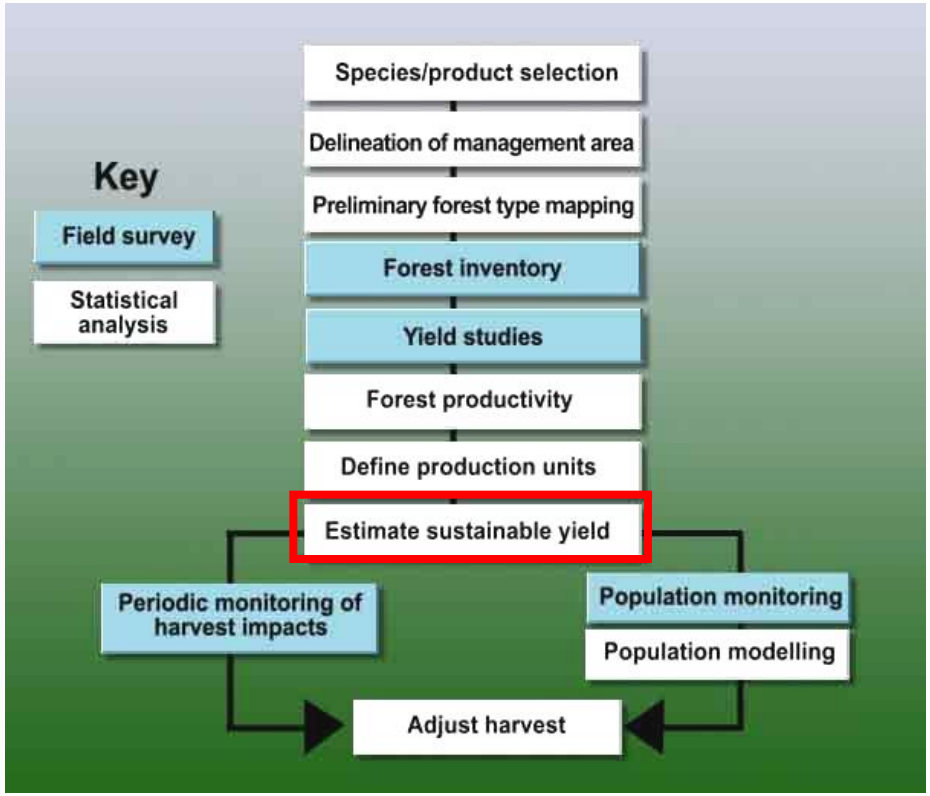

Non detrimental harvesting

Potential annual dry bark yield in current and new proposed harvest areas for return times of F = 10 years and F = 8 years

$$Q = [A \times P \times RME \times Y \times V] F^{-1}$$

where: Q = annual quota per management unit (kg of dry material) A = harvest area (ha) P = proportion of area exploited (%) RME = minimum estimated density of *Prunus africana* in the harvest unit (trees ha^{-1}) Y = estimated yield per tree per harvest (kg of dry material per tree) V = proportion of exploitable trees (%) (alive and not over-exploited) F = return times (years)

Working area	**A Surface area harvested (ha)**	**P Proportion of area exploited (%)**	**RME *Prunus africana* density (stems ha^{-1})**	**Y Estimated yield per tree (kg $tree^{-1}$)**	**RME x Y Estimated dry bark yield[1] (kg ha^{-1})**	**V Proportion of exploitable trees (%)**	**Estimated potential bark yield[2] (t $year^{-1}$) in unharvested condition, depending on F (Nº of years between harvests)**	
							F = 10 years	F = 8 years
Current areas							Current areas	Current areas
Pico de Basilé – high area	1622	80	15.38	107.11	1647.35	90	192.38	240.48
Pico de Basilé – low area	1119	80	2.65	115.92	307.19	90	24.74	30.93
Moca – low area	282	80	9.95	39.68	394.82	90	8.16	10.02
Moca – Monguibus	103	80	5.68	30.87	175.34	90	1.30	1.62
Moca – Lake Biaó	72	80	6.37	35.04	223.21	90	1.15	1.44
Total current areas[3]							227.73	284.49
New areas							**New areas**	**New areas**
Pico de Basilé – south area	1500 (estimated)	80	7.56 (estimated)	111.5 (estimated)	842.94 (estimated)	90	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé – east area	1000 (estimated)	80	7.56 (estimated)	111.5 (estimated)	842.94 (estimated)	90	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas[4]							**379.45**	**474.14**

Current annual dry bark yield in current and new proposed harvest areas for return times of F = 10 years and F = 8 years

Non detrimental harvesting

Harvest area	Estimated potential bark yield (t year^{-1}) in unharvested condition, depending on F (nº of years between harvests)		Recommended quota (t year^{-1}) for 2006 following analysis of status in current and new harvest areas	
	F = 10 yrs	F = 8 yrs	F = 10 yrs	F = 8 yrs
Current areas	Current areas	Current areas	Current areas	Current areas
Pico de Basilé highlands	192.38	240.48	0 (bark regeneration period)	0 (bark regeneration period)
Pico de Basilé lowlands	24.4	30.93	0 (bark regeneration period)	0 (bark regeneration period)
Moca lowlands	8.16	10.2	4.8 (2nd harvest)	5.1 (2nd harvest)
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Moca Lake Biaó	1.15	1.44	0.58 (2nd harvest)	0.72 (2nd harvest)
Total current areas	**227.73**	**284.49**	**5.96**	**7.35**
New areas	**New areas**	**New areas**	**New areas**	**New areas**
Pico de Basilé (south)	**91.03 (estimated)**	**113.79 (estimated)**	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé (east)	**60.69 (estimated)**	**75.86 (estimated)**	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas	**379.45**	**474.14**	**157.68**	**197**

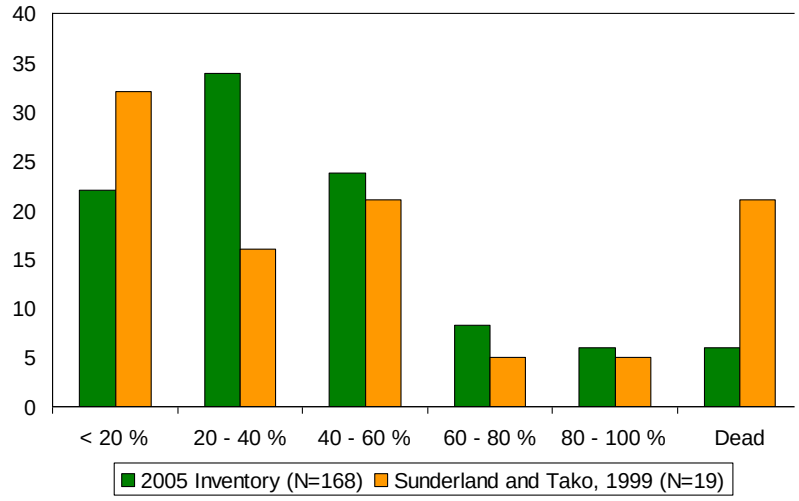
Non detrimental harvesting

Detected problems

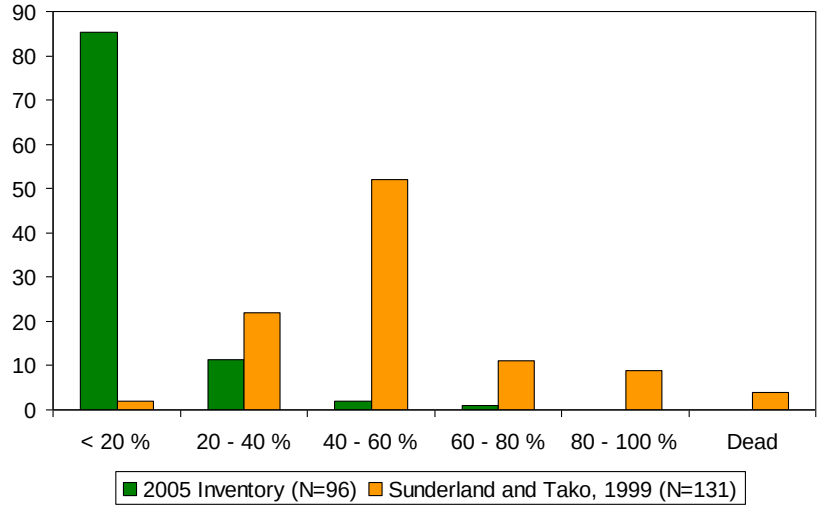
Over extraction
(Pico de Basilé)

Second and third
extractions (Pico de Basilé)

Damage Caused to Trees as a Result of the Harvest Process



Basile

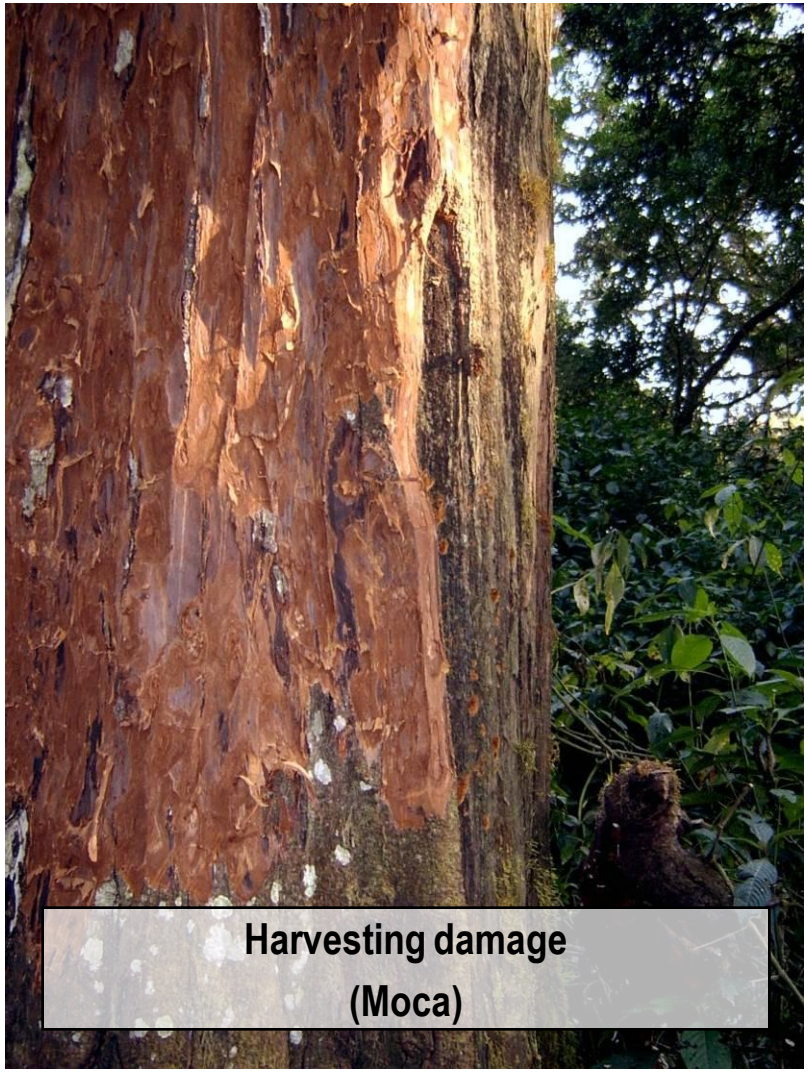


Moca

Damage Caused to Trees as a Result of the Harvest Process

Non detrimental harvesting

Dead tree of *Prunus africana*
(Pico de Basilé)



Harvesting damage
(Moca)

Harvesting techniques and bark regeneration

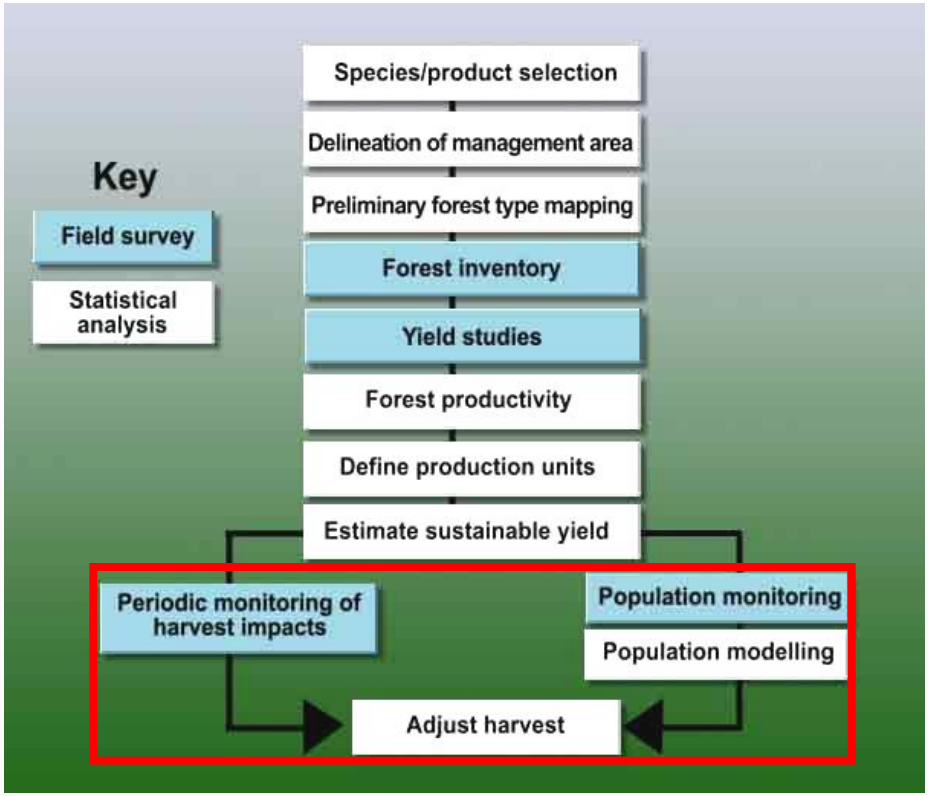
Non detrimental harvesting

Tools and techniques

Debarking (peeling) process

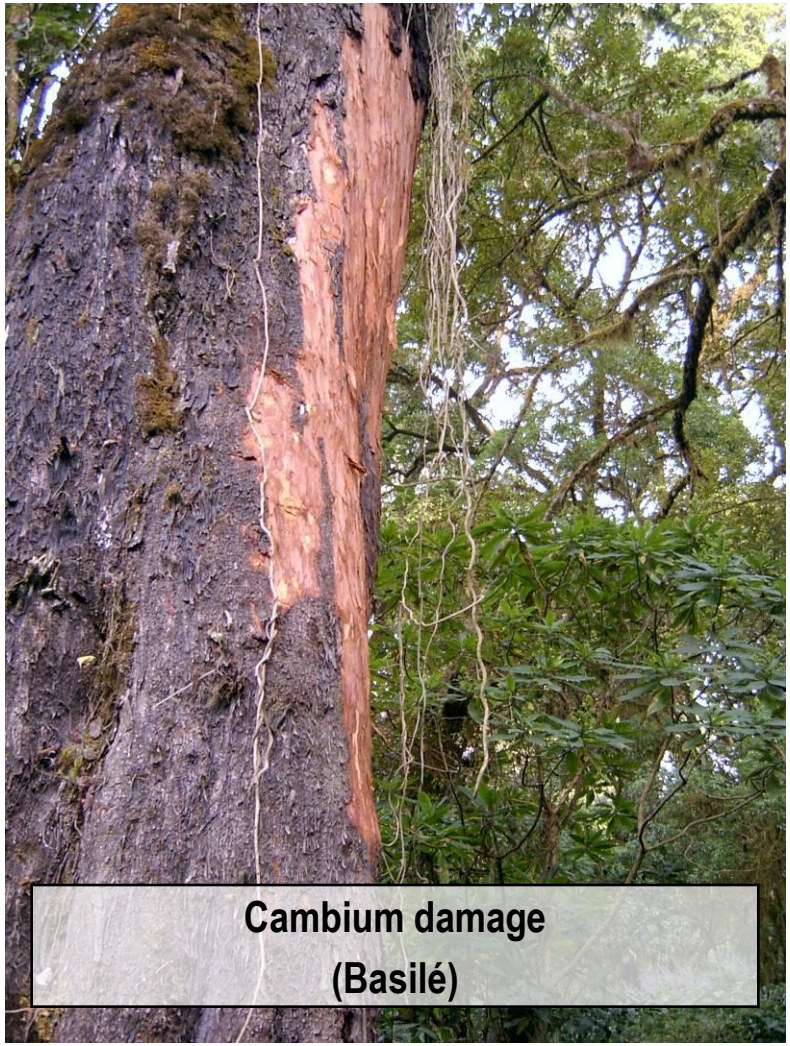

GHANA

Steps of NDF Plan



Monitoring system

Detected problems



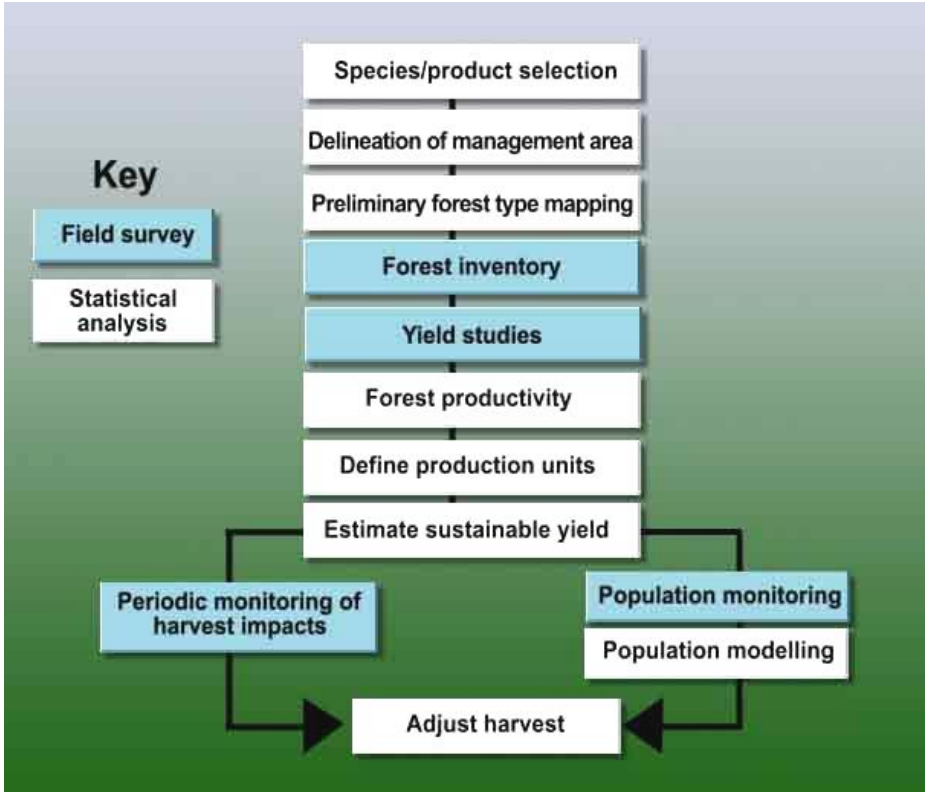
Cambium damage
(Basilé)

Extraction d<30 cm
(Moca)

Steps of NDF Plan

Germoplasm conservation and agroforestry systems of *Prunus africana*)

Steps of NDF Plan



Wong, J L G, Thornber, K and N Baker. 2001. Resource assessment of non-wood forest products: experience and biometric principles. FAO, Rome

Evaluation of the Harvest of *Prunus africana* Bark on Bioko (Equatorial Guinea)

- **Guidelines for a Management Plan –**

Thank you

Merci beaucoup

Gracias

UNIVERSIDAD D CÓRDOBA