Annotated Bibliography on Plant Resource Assessment Methods for Non-Timber Forest Products with a focus on Medicinal and Aromatic Plants

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Introduction

Main source for the references compiled in this paper is the Medicinal Plant Conservation Bibliography maintained by U. Schippmann which has a clear focus on medicinal and aromatic plants.

More literature has been collected in the preparation phase of the workshop on “Assessing the Sustainable Yield in Medicinal and Aromatic Plant Collection” (14-17 Sep 2006, International Academy for Nature Conservation, Isle of Vilm), with a specific emphasis on references with a methodological focus, including many case studies which do not deal with medicinal plants but with a wider range of non-timber forest products, too.

Many entries in this bibliography are accompanied by a short review summarizing the contents of the quoted reference. In a number of cases additional information on the reference was taken and quoted from Wong (2000): The biometrics of non-timber forest product resource assessment. A review of current methodology, with permission from the author.

Under an existing MoU with CABI-Publishing, Cambridge, it was possible to reproduce a number of reviews of articles contained in the Review of Aromatic and Medicinal Plants. These reviews are annotated as “CABI-RAMP”.

Explanation of entries


Descriptors: Resource Assessment General
Taxa: Durio spp., Eusideroxylon zwageri, Hevea brasiliensis, Shorea stenoptera
Plant Group: Palms
Countries: Indonesia
Plant Part: Fruits, Seeds

[7854 !!]

The standard bibliographic information is followed by a maximum of four descriptor types: Plant parts focussed on, keywords, country references and taxa/plant group references.

A four digit code number used in the compiler’s database is given in “[ ]” brackets. If a publication in this bibliography is present at the compiler’s office, this is designated by a “!!” after the four digit code number. All other references are cited on the basis of secondary sources.

1 "Review of Aromatic and Medicinal Plants (RAMP) is a fully searchable abstract database of internationally published research on cultivated and wild species of culinary herb, spice, essential oil and medicinal plants. Developed from CAB Abstracts, the original applied life sciences database, coverage includes the botany, cultivation, biological activity and use of these plants. Review of Aromatic and Medicinal Plants includes a fully searchable backfile to 1990. Over 50,000 research summaries bring a wealth of current and seminal research on aromatic and medicinal plants to your fingertips! Over 6,000 records are added to the database each year (www.cabi-publishing.org)."
Signs and abbreviations

The following signs and abbreviations are used in the references and reviews:

!! Publication present at the compiler’s office as original, reprint or photocopy
!

Publication seen by the compiler

§ Data element missing in literature reference (e.g.: no place of publication)

schp Uwe Schippmann
1. List of References


  Descriptors: Participation & Traditional Knowledge, Resource Assessment


  Descriptors: Resource Assessment, Sampling Techniques

  Plant Group: Trees

  Countries: Nepal


  The authors examined the effects of fire on the demography of Phyllanthus emblica, an important NTFP in the deciduous forests of Biligiri Rangan Hills in S India. P. emblica (Indian gooseberry; Euphorbiaceae) is a medium-sized tree (max. height 7 m); its berry fruits are harvested by the Soligas people as one of the most heavily harvested NTFP species in the region. Current fruit harvesting techniques range from beating of branches and collection of fruits from the ground to cutting of branches or occasionally cutting of the entire tree. At the population level, the Soligas harvest an average of 65% of the total fruit production. The revenue generated from this species together with the similar P. indofischeri may be as high as 12% of the cash income in a typical Soligas household.

  The authors assessed demographic responses to the combined effects of fire and the current fruit harvesting patterns using matrix population models. 7,372 individual trees were tagged and measured. Parameters measured were survival and growth rates and fecundity, i.e. the contribution of adults to the seedling stage. Frequent fires increased time to maturity by altering growth and survival rates, thereby causing a demographic shift from growth to regressions or negative growth. Extinction probabilities under the current fire regimes (every 2-3 years) suggest that populations will decline to lower densities. (schp, 10.8.2006).

  Descriptors: Case Study, Demography & Population Structure, Harvest Impact, Resource Assessment

  Taxa: Phyllanthus emblica

  Countries: India

  Part Used: Fruit


  Descriptors: Resource Assessment, Sampling Techniques

  Plant Group: Trees


  Descriptors: Resource Assessment, Sampling Techniques

  Plant Group: Trees


  Descriptors: Resource Assessment

  Plant Group: Medicinal and aromatic plants


  Interdisciplinary in scope, this book addresses the biological, ecological and anthropological aspects of ethnobotanical research through basic concepts and techniques. Eleven chapters are included, along with 3 appendices, in sections on: development and implementation of ethnobotanical research programmes; methods in collecting culture-based data, including specific recommendations for conducting interviews and gathering medicinal and other plant-use knowledge; anthropological methods used to observe and record interactions between people and plants; field techniques for

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assessing the ecological impact of ethnobotanical interactions; collecting plant specimens for the herbarium and bulk specimens for phytochemical analysis; methods used in quantitative and hypothesis-testing approaches; and resources for information, training and equipment for development of skills and research programmes. A subject index is supplied. (CABI-RAMP, 1996). Descriptors: Ethnobotany, Resource Assessment


Arvind Bhatt, Rawal, R.S. & Uppeandra Dhar (2006): Ecological features of a critically rare medicinal plant, Swertia chirayita, in Himalaya. - Plant Species Biology 21 (1): 49-52. Retrieved from http://www.blackwell-synergy.com/doi/full/10.1111/j.1442-1984.2006.00150.x, viewed: 18.10.2006. An experiment was conducted during May and June 2001 in Kanchula (KN), Kalaseer (KL) and Duggalbitha (DG) in Uttaranchal, India, and Pullag (PL) and Dora (DR) in Himachal Pradesh, to provide quantitative details of Swertia chirayita [Swertia chirata] through: (i) assessment of the distribution patterns and quantum of availability; and (ii) analysis of variations in biomass among natural populations. Almost all populations of Swertia chirayita examined grew under the canopy of Acer and Quercus mixed forests, mostly on a southeast aspect. Anaphalis triplinervis, Anemone obtusiloba, Stachys sericea [Stachys emodi] and Polygonum amplexicaule were the common associates of Swertia chirayita. The density of Swertia chirayita was low in all populations and ranged between 1.65 and 2.35 individuals per m2. The frequency of occurrence was high (90-95%) in all populations and either matched or exceeded the frequency of the other dormant species in the plot. Patterns of abundance:frequency ratio revealed random distributions in KN, PL and DR populations and regular distributions in DG and KL populations. The maximum value of aboveground biomass was observed in the flowering stage when comparing biomass during the different stages. There was significantly higher aboveground biomass observed in the KN population. The maximum value of below ground biomass was, however, obtained in the senescence stage. The variation in mean below ground biomass of the flowering and senescence stages was significant in all populations. In all cases (except DR), total biomass was greater at the flowering stage. However, total biomass of the flowering and senescence stages did not show significant variation except in the KN population. (CABI RAMP, 2006).


"Discusses the market aspects of trade and household economies involved in rattan (Calamus spp.) collection in southeast Asia. Local populations involved in gathering rattan and labor arrangements are described. The authors also describe中间人，such as small traders, shopkeepers, trade boat operators, and the networks, that supply rattan. Market structure and the generation of local economic value at the rural level also are characterized. Decentralization of the industry is widespread with production of goods often occurring inside homes and with simple technology; neither one requires much in the way of capital inputs. Production is seasonal, occurring when agricultural crops require less labor. Rattan weaving is a part-time activity, often done at night. Value-added processing at the local level is generally of three types: rudimentary processing of raw products before export, manufacture of products for local markets, and production of high-quality products for sale outside local markets. Products originally intended for private use have found markets in urban areas and among tourists.

Factors affecting the economy of nontimber forest products in Southeast Asia include widespread deforestation and degradation. Agricultural and export cash crops in an increasingly commercialized rural economy compete with nontimber forest products for land and labor. Government policies, particularly in Indonesia, aimed at resettling people fundamentally change land tenure arrangements and hasten the decline of traditional management systems. When supplies of nontimber forest products decline, people may allot more time to collecting (with decreased unit returns to labor), allot more time to alternate activities such as farming, wage labor, and so forth, evolve new management systems, shift activity to less depleted areas, or abandon nontimber forest product collecting altogether.

Value of nontimber forest products is often unstable because uses for products fall out of favor, knowledge about their collection is disappearing, synthetic substitutes are increasingly preferred, and changes in dietary preferences develop. Individual households change their economic uses of nontimber forest products and allocation of labor in response to changes in a variety of environmental, commercial, cultural, and personal factors. Impacts of changes on rural welfare also are discussed.

The authors advocate improvements in forest resource management that include increased attention to managing nontimber forest products; improved methods of harvest, storage, transport, and processing; increased processing and manufacturing near the forest source; improved marketing; diversification of products; integrating forest species into agricultural and agroforestry systems; greater attention to conservation and restoration of nontimber forest products; improved accounting of production, consumption, and trade; and increased investment in research and extension." (from Hagen & al. 1996, 27.1.2007).


    Descriptors: Resource Assessment, Sustainable Yield Calculation
    Taxa: Myrica esculenta
    Countries: India
    Part Used: Fruit


    Descriptors: Abundance & Rarity, Case Study, Resource Assessment
    Taxa: Skimmia laureola
    Plant Group: Medicinal and aromatic plants
    Countries: Nepal
    Part Used: Leaf


    Descriptors: Resource Assessment
    Plant Group: Medicinal and aromatic plants


    Descriptors: Resource Assessment
    Plant Group: Medicinal and aromatic plants


    Descriptors: Resource Assessment, Sampling Techniques


    This paper evaluate some extraction systems for Brazil Nut (Bertholletia excelsa) and Mahogany (Swietenia macrophylla) and discusses what approaches are currently available for assessing the sustainability of these systems and the impact extraction has on the forest ecosystem. The authors focus on three questions: (1.) Is the use sustainable for the harvested population? (2.) What is the impact of the use on the structure and function of the ecosystem? The authors emphasize that these two criteria – sustainability and impact – are treated separately when evaluating extraction plans. (3.) An economic analysis of the harvest intensities between zero and maximum sustainable yield should be conducted, with the goal of identifying the minimum economically viable harvest within the sustainability limits.

    The authors contradict the view among ecologists that a use cannot be considered sustainable if it results in a noticeable change in the forest. They argue: "For forest products to compete economically with other forms of land use, we must become more flexible in what we will accept in the composition of managed forests. Perhaps all that we should require of extraction systems is that they result in no loss of species from the forest, and no irreversible changes in ecosystems processes." (schp, 12.8.2006).

    Descriptors: Case Study, Resource Assessment
    Taxa: Bertholletia excelsa, Swietenia macrophylla
    Countries: Bolivia
    Part Used: Fruit


    Descriptors: Resource Assessment
    Plant Group: Medicinal and aromatic plants

Descriptors: Resource Assessment
Plant Group: Medicinal and aromatic plants


Descriptors: Resource Assessment
Plant Group: Medicinal and aromatic plants


Descriptors: Participation & Traditional Knowledge, Resource Assessment, Sustainable Yield Calculation
Countries: Nepal

[7694]

Additional descriptors from Wong (2000):
Characteristics: Natural forest in joint forest management (JFM) scheme.
Objectives: Provision of quantitative information on forest resource for comparison with similar data to be collected in 5 years time.
Type of study: Baseline study. Monitoring
Scale: Regional - 4 Koshi Hills districts
Participants: Team of 4: 2 project staff, project assistant and locally em
Protocol: Selection of 2 groups of up to 4 forests representing different forest types and condition in each District. Selected forests stratified into blocks corresponding with the management plan. 6 blocks selected for assessment within each group of forests. Block enumeration; selection of fixed reference point and selection of random bearing for transect into block. 6 plots laid out at 50 m intervals along transect. Plot is 5x10m and laid out perpendicular and on alternate sides of the transect. Trees are > 3m tall - local name and d recorded. Shrubs are 0.5-3m tall - name and number recorded. Plants < 0.5 m tall and of tree or shrub sp. are classed as regeneration (if abundance count on half the plot). Canopy cover %, shrub crown diameter and crown separation, litter layer, evidence of recent damage, evidence of recent management or harvesting. List of seed trees. Tally number of species per block into plant growth form categories (trees, tall shrub, lichens, ferns etc.).
Analysis: Creation of plot and block summaries to obtain figures of stocking, basal area, crown cover, regeneration of useful trees and total regeneration.


Descriptors: Resource Assessment, Sampling Techniques

[7767]


Descriptors: Resource Assessment, Statistics
Countries: Ghana

[7665 !!]


After giving some illustrative examples the authors explain the conceptual context of the terms utility, protected good, risk, hazard and damage. They discuss what has to be considered as an ecological damage from an anthropocentric perspective. They illustrate that use and damage of ecological goods are connected across a variety of integration and organisation levels. They argue that there is a convergence of anthropocentric and ecocentric perspectives on ecological damage. This wide overlap especially exists with regard to the precautionary principle as the basis for dealing with uncertainties. (from summary, 10.9.2006).

Descriptors: Ecological Damage, Resource Assessment

[7942 !!]


Descriptors: Non-wood forest products, Resource Assessment

- 12 -
Countries: Bolivia, Colombia, Ecuador

Additional descriptors from Wong (2000):
Characteristics: Plants and animals of natural forest.
Objectives: Which products have significant economic value & how can they contribute to socio-economic development? How can ecological sustainability be measured and what information is available?
Type of study: Valuation
Scale: Supra-national
Participants: Researchers
Protocol: Secondary data, interviews with experts, site visits and extensive fieldwork in Bolivia. Data: non-market values; net present value of NTFPs; export statistics.
Analysis: Description and discussion of issues.

Descriptors: Resource Assessment

Descriptors: Resource Assessment, Sampling Techniques

Descriptors: Abundance & Rarity, Resource Assessment

Descriptors: Abundance & Rarity, Resource Assessment

Descriptors: Resource Assessment, Sampling Techniques

Descriptors: Abundance & Rarity, Resource Assessment, Sampling Techniques

Descriptors: Resource Assessment
Countries: Zimbabwe

Descriptors: Resource Assessment

Descriptors: Non-wood forest products, Resource Assessment
Countries: Belize

This study documents the abundance, distribution and knowledge of medicinal plant species in a Ransa Dayak village and adjoining forest in West Kalimantan, Indonesia. Over 250 medicinal plant species from 165 genera and 75 families are utilized by the local healer. Late successional, primary and river bench forests contained the highest diversity of locally-used medicinal species and the greatest number of species restricted to a single forest type for which alternative species or remedies were unavailable. Epiphytes and trees restricted to primary forests are particularly important sources for plants used to treat unusual ailments. A 100% survey of village residents 15 years of age and older (n = 32) revealed that people older than 25 years of age, and older females in particular, possessed greater knowledge of medicinal plants and their uses than younger people and males. All residents, except the male healer, were more knowledgeable about medicinal plants found in early successional forests than those of primary forests. Commercial logging and the loss of traditional knowledge through acculturation pose twin challenges to the persistence of traditional medicinal plant use in this Ransa village and throughout much of Kalimantan. (CABI-RAMP, 19980311803).

Descriptors: Abundance & Rarity, Ethnobotany, Life history, Participation & Traditional Knowledge, Resource Assessment, Taxa

Plant Group: Medicinal and aromatic plants
Countries: Indonesia


Descriptors: Case Study, Demography & Population Structure, Endemism, Habitat, Population dynamics, Resource Assessment

Taxa: Beaucarnea gracilis
Plant Group: Succulents
Countries: Mexico


Descriptors: Resource Assessment, Statistics
Countries: Australia


Descriptors: Case Study, Regeneration, Reproduction, Resource Assessment

This analysis focuses on the status of non-timber forest products in management plans of the national forests in eastern Unites States. Of the 31 national forest plans, examined for coverage of non-timber forest products, only 7 plans addressed the management of these resources. A review of national legislation that affects national forests revealed that non-timber forest products are not recognized as a management objective. (from summary, 27.8.2006).


Descriptors: Abundance & Rarity, Case Study, Resource Assessment
Plant Group: Medicinal and aromatic plants
Countries: Costa Rica


A classification scheme in the USSR is proposed for vegetation, including wild fruits and mushrooms, honey plants, medicinals and wildlife. Important nectar-producing plants are Rubus idaeus, Epilobium spp., Salix spp., Viburnum spp., and Sorbus spp. Epilobium may yield up to 350 kg/ha of honey while willows can yield up to 150 kg/ha. The author analyzes the economic value of selected nontimber products, providing volume and some monetary value estimates for edible plants, mushrooms, honey, forage for livestock, and game animals. He concludes that nontimber values make up about 50% of the total economic value in commercial forests and 93% of the total value in a protected forest. (from Hagen & al. 1996, 7.9.2006).

Descriptors: Non-wood forest products, Resource Assessment
Countries: Russian Federation


Descriptors: Biomass Production & Yields, Resource Assessment
Countries: Russian Federation
Part Used: Fruit


Descriptors: Resource Assessment, Sampling Techniques


Descriptors: Resource Assessment
Plant Group: Medicinal and aromatic plants
Countries: Russian Federation


Descriptors: Non-wood forest products, Resource Assessment, Resource Management Policies
Countries: Congo, The Democratic Republic of the, Cameroon, Gabon, Equatorial Guinea


Descriptors: Case Study, Reproduction, Resource Assessment
Taxa: Stenocereus eruca
Plant Group: Succulents
Countries: Mexico


Descriptors: Harvest Impact, Resource Assessment
Plant Group: Palms
Countries: Brazil
[7899]


The pilot project surveys the current status of Prunus africana on Bioko after recent years' harvest (1996-2004). The general goal of the project was to determine the potential and current range on Bioko. Based on this range data, stocks could be assessed, bark harvest evaluated, and proposals made with necessary recommendations to consider in drawing up a management plan for sustainable use of the species. The following specific objectives were established to achieve the general goal: (a) survey of the distribution of dominant types of vegetation by means of a Landsat 7 ETM+ image; (b) characterisation of the forests where Prunus africana occurs in current and potential harvest areas, in terms of their structure, composition of the vegetation, wealth and diversity of tree species; (c) estimate of bark yield, and (d) establishment of silvicultural criteria for sustainable use of Prunus africana forests.

The guidelines provided are the culmination of a series of stages in work oriented towards evaluating Prunus africana specimens and their current status following bark-harvesting activities. For this purpose, remote sensing techniques (a 2003 Landsat 7 ETM+ image) were used along with inventory of a representative area of Bioko Prunus africana forests and evaluation of the status of individual trees according to use patterns. The project offers a methodology (new technologies and forest inventories adapted to the evaluation of Non-Timber Forest Resources) that can be readily applied to establish guidelines for sustainable international trade in Prunus africana in other regions. (schp, 29.1.2007).

Descriptors: Resource Assessment, Sustainable Yield Calculation
Taxa: Prunus africana
Plant Group: Medicinal and aromatic plants
Countries: Equatorial Guinea
Part Used: Bark
[8037 !!]


Descriptors: Participation & Traditional Knowledge, Resource Assessment
Countries: Turks and Caicos Islands
[7434 !!]


Descriptors: Method Manual, Resource Assessment, Sampling Techniques
[7814]


Descriptors: Participation & Traditional Knowledge, Resource Assessment
[7833]


This book, intended as an introduction to ethnobotany, is aimed primarily at undergraduates, but also at researchers in anthropology and botany wanting introductions to the subjects of botany and anthropology, respectively. Traditional methods of plant management and plant use, the history of interactions between plants and peoples, and the concepts, methodology and future of ethno botany are discussed in 12 chapters: (1) Introduction to ethnobotany; (2) Plant structures, functions and applications; (3) Traditional botanical knowledge; (4) Methods in ethno botanical study; (5) Traditional botanical knowledge and subsistence: wild plant resources; (6) Traditional botanical knowledge and subsistence: domesticated plants and traditional agriculture; (7) Plants in material culture; (8) Traditional phytochemistry; (9) Understanding traditional plant use and management: indigenous perceptions of the natural world; (10) The history of
List of References

plant-human interaction: palaeoethnobotanical evidence; (11) Applied ethnobotany: commercialisation and conservation; and (12) Applying ethnobotany in sustainable development: practical considerations. In addition to a bibliography and a brief postscript about the Pilgrim Fathers, there is a subject index. (CABI-RAMP, 19960309613).

Descriptors: Ethnobotany, Method Manual, Resource Assessment

[4923]


Descriptors: Genetic Variability, Resource Assessment
Taxa: Panax quinquefolius
Plant Group: Medicinal and aromatic plants
Countries: United States
Part Used: Root


Descriptors: Case Study, Regeneration, Resource Assessment
Taxa: Hyphaene coriacea
Plant Group: Palms
Countries: South Africa
Part Used: Leaf


Descriptors: Harvest Impact, Resource Assessment
Taxa: Hyphaene coriacea, Phoenix reclinata
Plant Group: Palms
Countries: South Africa
Part Used: Exudate


The complexity and the cost of managing sustainable use of wild populations increase markedly with an increasing number of uses and resource users. The author suggests that if the primary objective of core conservation areas is accepted to be the maintenance of habitat and species diversity, then the limited money and manpower available for management limits sustainable harvesting use of plant resources to low diversity, low conservation priority vegetation types or encroaching species. For high diversity, high conservation priority sites such as afro-montane or coastal
evergreen forest, the emphasis must be on providing alternative sources of supply to resource users outside of core areas. The author argues that, in theory, sustainable harvesting of habitat specific, slow reproducing plant species from wild populations is possible, but in practice this it is not. What is often glossed over is that high conservation priority habitats with a high species diversity and vulnerability to over-exploitation require a level and intensity of management that is not possible with the economic constraints that are a feature of many conservation departments. For practical purposes these plant plant species are a non-renewable resource. For those species or vegetation types it is imperative that to concentrate on providing alternative sources of supply outside core conservation sites. (schp, 21.8.2006).

Descriptors:  Critical Analysis, Economics, Resource Assessment, Susceptibility, Threat


This detailed manual on wild plant resources sets out the approaches and field methods involved in participatory work between conservationists, researchers and the primary resource users. Supported by 97 excellent illustrations, 16 tables and 22 text boxes, it explains how local people can learn to assess the pressures on plant resources and what steps to take to ensure their continued availability. This guide is invaluable for all those involved in resource management decisions regarding plants and diversity, and in particular those studying or working in conservation, rural development and park management. (from summary, 21.5.2001).

Descriptors:  Ethnobotany, Method Manual, Resource Assessment, Sampling Techniques, Susceptibility


Descriptors:  Case Study, Participation & Traditional Knowledge, Resource Assessment

Taxa:  Berchemia discolor

Countries:  Zimbabwe

Part Used:  Bark, Fruit

Additional descriptors from Wong (2000):

Characteristics:  Deciduous woodland tree.

Objectives:  Field test of appropriate monitoring systems for indigenous plant use which involve local people.

Type of study:  Monitoring

Scale:  Field test -Kariyangwe area, Binga district (CAMPFIRE)

Participants:  Local people under supervision of researchers

Protocol:  Condition scoring for tree health, bark damage and cutting developed with basketmakers. Size class of tree measured using rulers. Icons used to represent scores to facilitate recording by illiterates. CyberTracker software on palm-top computers used for data collection. Plots discarded due to difficulties of plot location, unfamiliarity of techniques for plot establishment etc. Trees in basketmakers own fields and adjacent areas monitored.

Analysis:  Histograms of scores and distribution maps produced from data downloaded onto base PC. System worked well.


Descriptors:  Method Manual, Resource Assessment, Sampling Techniques


To overcome the absence of agreed methodologies for ensuring cross-site comparability of data, this booklet describes sampling techniques established by Smithsonian Institution research teams for establishing and maintaining permanent inventory plots in tropical forests, basically aiming at the tree composition. It gives detailed description of the recommended procedures for field work and data management, a.o. sampling and plot design, surveying the plot, slope correction, tagging trees, standards for dbh measurements, tree conditions, mapping software (as of 1992). All elements are amply illustrated. The authors propose user guides and field guides to be made available to reserve managers, students and researchers which contain information on site ecology, methodology and data already gathered at the plot, including a mini-herbarium of photocopied voucher specimens. (schp, 12.8.2006).

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Descriptors:  Resource Assessment, Sampling Techniques


Descriptors:  Participation & Traditional Knowledge, Resource Assessment
List of References


Descriptors: Participation & Traditional Knowledge, Resource Assessment


Ecological and ethnobotanical descriptions of 2 permanent, 1-ha plots located in the Amazonian forest near 2 Tacana communities situated north and west of the Madidi National Park in the Iturralde Province, Department of La Paz of northwestern Bolivia, are presented. Interviews were conducted with 13 Tacana men and women to identify and enumerate uses of all of the trees, palms, and lianas more than or equal to 10 cm dbh in these plots. Of the 185 species found in both plots, 115 species are used by the Tacana: 59 species for construction, 9 as sources of fibre, 33 for technology and crafts, 66 as firewood, 32 for food or water, 40 for medicine, 8 for hunting or fishing, 9 for commercial purposes, and 11 for miscellaneous uses. Sixty-four percent of useful species had multiple uses. This utilization of the forest corresponds with that of other Amazonian indigenous groups and shows a high reliance on the forest for plant materials, especially for medicine, technology and crafts, and construction. (CABI-RAMP, 19990613543).

Descriptors: Ethnobotany, Resource Assessment
Countries: Bolivia


Descriptors: Non-wood forest products, Resource Assessment
Countries: Cameroon


Descriptors: Resource Assessment
Countries: Cameroon


Descriptors: Non-wood forest products, Resource Assessment


Descriptors: Non-wood forest products, Resource Assessment

Countries: Colombia, Ecuador, Peru


Descriptors: Participation & Traditional Knowledge, Resource Assessment

Plant Group: Trees


Descriptors: Resource Assessment

Plant Group: Mushrooms


The long-term exploitation of V. vitis-idaea in a spruce cowberry forest in Kirov, Bulgaria was investigated. Complete thicket recovery was not possible when 75% of peripheral shoots was cut, even when row material stocking takes place once in 4 years. During this period, the projecting cover, shoot height and overground phytomass productivity did not recover. Results indicate that V. vitis-idaea coenopopulation recovery after stocking will occur not earlier than 5 years. Such an interval between stockings will ensure the maximum yield of medicinal raw material from an area without thicket degradation. (CABI-RAMP, 20053105309).

Descriptors: Regeneration, Resource Assessment
Taxa: Vaccinium vitis-idaea
Plant Group: Medicinal and aromatic plants
Countries: Bulgaria


Descriptors: Participation & Traditional Knowledge, Resource Assessment


Natural resource managers can evaluate the effects of management procedures only by examining whether the responses of species and communities are consistent with conservation objectives. Monitoring provides a measurement of these responses through status and trend analysis. We present a three-level, hierarchical approach of increasing intensity for monitoring rare plant species and suggest appropriate sampling and analysis methods for each level. Level 1 focuses on species occurrence by mapping distributions of species and identifying the presence/absence or spatial extent of each population. Level 2 involves a quantitative assessment of abundance or condition, often in terms of density, percent cover, or frequency. Level 2 monitoring allows the analysis of population trends and hypothesizing about demographic mechanisms. Level 3 involves demographic monitoring of marked individuals, thereby permitting quantitative assessment of demographic parameters, such as survivorship, growth, and fecundity. These data can be used for modeling and population viability analysis. Level 3 monitoring provides the most thorough and rigorous analysis of demographic mechanisms underlying population trends. The three levels can be efficiently nested, so that, for example, a few populations of a species receive intensive Level 3 monitoring while all populations receive a lower intensity of monitoring. Monitoring programs involving these three levels are being used on 13 rare plant species at Tiger Creek Preserve, Florida, owned by The Nature Conservancy. Intensity levels for particular species were chosen based on global and local rarity, logistical constraints, and prior data availability. Examples are given of results for two species with different life histories. Monitoring at three levels for Nolina brittoniana is inconclusive (Level 1), suggests expanding populations (Level 2), and highlights both the need for only minor recruitment to maintain population growth and the uncertainty regarding actual recruitment (Level 3). Level 2 monitoring for Warea carteri clearly shows that fire promotes aboveground population appearance and expansion, although the mechanisms causing this population behavior can only be hypothesized based on available data. (from website, 15.8.2006).

Descriptors: Method Manual, Resource Assessment


Descriptors: Resource Assessment, Sustainable Yield Calculation
Taxa: Sclerocarya birrea
Plant Group: Palms
Countries: South Africa
Part Used: Fruit

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Descriptors: Resource Assessment
Countries: Kenya


Descriptors: Resource Assessment
Plant Group: Palms


Descriptors: Case Study, Harvest Impact, Regeneration, Resource Assessment
Taxa: Chamaedorea radicalis
Plant Group: Palms
Countries: Mexico
Part Used: Leaf


Descriptors: Demography & Population Structure, Resource Assessment
Taxa: Desmoncus orthacanthos
Plant Group: Palms
Countries: Mexico


The paper determines the optimal survey design for an inventory of the commercially important rattan Calamus poilanei in Laos. It aims at finding out how much time an optimally designed survey would require. Based on a 7-day pilot study, a model was developed to determine the optimal survey design which minimises survey time for a given survey precision. For the study the stems of this single-stemmed palm species were only counted in the plots, no length measurements were taken.

The study revealed that a density estimate with the relatively low precision of 20% is predicted to require 30 days of work in the forest for a team of 4-5 people to survey 10km2, and 229 days for an area of 100 km2. It is most unlikely that individual Lao villages will be able to invest this much time in a single resource. Economising the survey efforts, however, could reduce the precision of the results to such a degree that the data cease to be meaningful.

On the aspect of sensitivity of the survey design regarding population declines, the study finds that a series of two surveys one year apart, each with precision of 20%, could only reliably be expected to detect an annual decline in 45% or more. Such a decline would wipe out the population in less than three years. Sensitivity this poor would have very limited value in monitoring programmes.

Compared to other studies with less provocative findings, the authors assume that Calamus poilanei may be a particularly difficult one to monitor. However, they also state that existing studies with optimized study design so far rarely stated the survey time required to carry it out on a larger scale or in regular intervals. (schp, 24.7.2006).

Descriptors: Critical Analysis, Non-wood forest products, Resource Assessment, Statistics
Taxa: Calamus poilanei
Plant Group: Palms
Countries: Lao People's Democratic Republic
Characteristics: Single-stemmed understorey climbing palm in evergreen and semi-evergreen forest.

Objectives: Determination of an optimal survey design for inventory of a commercially important rattan.

Type of study: Inventory methodology

Scale: Pilot study -Ban Naphong, Bolikhamxay Province.

Participants: Student

Protocol: Survey line 600 m long running perpendicular from a major stream. Line divided into 100 m sections. A single 20 x 100 m plot laid out perpendicular to the line and centred on it at a randomly selected points in each 100 m section. Each plot subdivided into 40 sub-plots of 5 x 10 m. In all sub-plots all stems of C. poilanei with > 1 m between the ground and the base of the petiole of the last fully expanded leaf were counted. The time taken to lay out and enumerate each plot was recorded. Survey team consisted of 5 people, 2 to lay out plot and 3 to enumerate. Total area enumerated was 12 ha sampled at 10% SI.

Analysis: Alternative designs were simulated using the data from the sub-plots. Each plot was divided into an appropriate number of alternative plot sizes and shapes i.e. 2 20x50 or 4 10x50 m. 12 different plot configurations were tested. One of the smaller plots was randomly selected for each large plot and used to estimate the mean and SD for rattan density. The simulation process was repeated 11 times for each alternative plot size except the two largest for which only 1 calculation was possible. Data from the 11 estimates were averaged and used to calculate the coefficient of determination CV for the alternative plot size and shapes. Regression analysis was undertaken to determine an empirical relationship between plot size, shape and CV. Power analysis undertaken to determine the minimum rate of population decline that can be detected by a specific sampling design.

Additional descriptors from Wong (2000):

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<th>Descriptors: Resource Assessment</th>
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<td>Plant Group: Medicinal and aromatic plants</td>
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<td>Countries: Bulgaria</td>
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The authors have prepared and present standardized medicinal plant inventories for various sites within the Central Balkan National Park and they give recommendations for improved management of the investigated areas. For each site the medicinal plants with economic importance have been assessed regarding the quantity of the resource in kg for the given area. (schp, 15.2.2003).

<table>
<thead>
<tr>
<th>Descriptors: Biomass Production &amp; Yields, Case Study, Population status, Resource Assessment</th>
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<tr>
<td>Plant Group: Medicinal and aromatic plants</td>
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<td>Countries: Bulgaria</td>
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The authors have investigated the tree-less, high-altitude regions of the Central Balkan National Park. Field work was carried out in 1996. 105 medicinal plant species were found are assessed and grouped under six major categories which are, however, not clearly defined (Appendix 3). Unfortunately, in Appendix 2, a different grouping is given which appears to be more consistent but which is not reflected in the text. The main part of the text consists of very useful short species accounts. The major information given herein is an estimate of the plant biomass in kg found in the National Park of each species. The method used to arrive at these quantitative estimates is not described in the paper. (schp, 16.2.2003).

<table>
<thead>
<tr>
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<tr>
<td>Taxa: Alchemilla vulgaris, Arctostaphylos uva-ursi, Betonica officinalis, Cetraria islandica, Primula elatior, Primula veris</td>
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<td>Plant Group: Medicinal and aromatic plants</td>
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Descriptors: Market analysis, Non-wood forest products, Resource Assessment
Countries: Ghana
[7783]

Descriptors: Non-wood forest products, Resource Assessment
[7792]

Prunus africana (Hook.f.) Kalkm. is a secondary forest canopy tree species that has been declining over much of its geographical range in sub-Saharan Africa during recent decades due to unsustainable harvesting of its bark for the international medicinal plant trade. One of the locations where the species is experiencing rapid mortality is Isecheno study site in the Kakamega Forest, Kenya where this study was conducted. Between 1997 and 2003, 21% of the P. africana (more than or equal to 10 cm DBH) at Isecheno died and an additional 9% experienced more than or equal to 50% canopy dieback. However, scars from bark harvesting on P. africana were relatively small and scarred trees were not more likely to be dead or dying than unscarred trees, suggesting that bark exploitation is not causing P. africana mortality at Isecheno. Other possible causes that require further evaluation include disease, insect attack, nutrient deficiency, and/or climatic fluctuation. The poor regeneration of P. africana at Isecheno can likely be explained by the relative lack of recent disturbance coupled with the thick undergrowth layer at this site. P. africana mortality is of concern not only because the species is listed as Vulnerable by IUCN, but also because black and white colobus monkeys [Colobus guereza (Rüppell, 1835)] at Isecheno exploit it as their top food species and are particularly reliant on its leaves during times of preferred Moraceae fruit scarcity. The anticipated continued decline of P. africana may have adverse effects on C. guereza feeding habits, intergroup relations, and population density at Isecheno. Conservation of P. africana offers a formidable challenge since the species appears to require disturbance for regeneration, yet at sites where disturbance is occurring, P. africana is often a target of bark harvesters engaging in unsustainable levels of exploitation. (CABI-RAMP, 20053050273).
Descriptors: Demography & Population Structure, Regeneration, Resource Assessment
Taxa: Prunus africana
Plant Group: Medicinal and aromatic plants
Countries: Kenya
[7655 !!]

Descriptors: Harvest Impact, Resource Assessment
Taxa: Geonoma deversa
Plant Group: Palms
Countries: Peru
Part Used: Leaf
[7990 !!]

Descriptors: Resource Assessment
Taxa: Nypa fruticans
Plant Group: Cycads
Countries: Malaysia


A. korupensis is a recently described liana from Cameroon whose leaves yield the alkaloid michellamine B, which shows in vitro activity against HIV. The only known population is limited to approx equal to 15000 ha within Korup National Park and its immediate surroundings. Ecological data from 457 individuals at 7 sites indicate that the population is dominated by canopy-climbing individuals. Population densities are low with values ranging from 2.5 to 12.9 plants/ha.

Reproductive data suggests limited seed dispersal, episodic fruiting and no vegetative reproduction. Starch gel electrophoresis of 11 enzymes indicated low genetic diversity with only 7.1% of the 14 loci polymorphic. Mean observed (Hobs) and expected (Hc) heterozygosity were 0.022 and 0.041, respectively. Wright's F statistic analysis suggests that A. korupensis is highly inbred (FIS = 0.46) with moderate levels of subpopulation differentiation (FST = 0.12). Michellamine B content differed significantly across leaf types and was higher in mature leaves. There was also a significant relation between Michellamine B content and stage class. Occurrence of rare, unique alleles in samples from most sites, low overall population size and density, and low availability of individuals for recruitment into the adult stage class are important considerations for the rational management of A. korupensis. It is concluded that efforts should be made to protect all the sites and prevent loss of genetic variation (rare alleles) by fragmentation of habitats and subsequent genetic drift. (CABI-RAMP, 19971611185).

Descriptors: Case Study, Demography & Population Structure, Ecology, Genetic Variability, Habitat, Medicinal property, Population status, Resource Assessment
Taxa: Ancistrocladus korupensis
Plant Group: Medicinal and aromatic plants
Countries: Cameroon
Part Used: Leaf


Descriptors: Resource Assessment, Statistics


Descriptors: Harvest Impact, Resource Assessment
Plant Group: Palms


The major part of this report describes a two-tiered wild ginseng population monitoring program, and relevant field protocols, which should provide most of the answers needed to manage the ginseng resource for conservation, and perhaps continued harvesting. The monitoring program will yield population dynamics information from the high intensity monitoring of a smaller number of populations, and general population trends from the low intensity monitoring of a larger number of populations. (from summary, 29.11.2002).

Descriptors: Case Study, Population status, Resource Assessment, Sampling Techniques
Taxa: Panax quinquefolius
Plant Group: Medicinal and aromatic plants
Countries: United States
Part Used: Root

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List of References

Additional descriptors from Wong (2000):
Characteristics: Slow-growing perennial herb in temperate forest.
Objectives: Develop protocol for a monitoring programme which will provide data of wild population dynamics and vulnerability to harvests.
Type of study: Monitoring protocol
Scale: National
Participants: Local forestry and conservation staff
Protocol: Extensive, low intensity population trend monitoring programme of 10-20 populations per State. Intensive, high intensive population dynamics monitoring programme of 5-10 populations per State. Study population selection criteria: (1) a minimum number of 100 individual plants [which is the estimated minimum viable population size], (2) no evidence of harvesting, (3) remote location, (4) similar and typical habitat, (5) no evidence of recent natural disturbance. At each site: soil collected for analysis and % cover in vegetation strata e.g. tree, shrubs etc. recorded. Patches of plants mapped in detail in 1 m² square micro-plots marked into 20x20 cm grid and sequentially numbered. In subsequent years, recruits should be numbered and the parent plant identified. Measurement for each plant: sequential number, ht in cm to lowest leaf, maximum width in cm of all leaves, % of leaf area browsed and the number of fruit segments which are assumed to contain seed. Germination: 50 seeds collected from non-study plants and sown under wire cages at each study population. 25 seeds taken of germination at research station in standard conditions. Measurements taken in July (fruiting season) every year.
Analysis: Plants grouped into cohorts according to size and demographics of each group determined as averages of all plants in the cohort. Rates of mortality, growth, flower production, seed production, vegetative offshoots are required. Data used in size classified transition matrix to determine the overall growth rate of the population for each year of the study. Not used for projection as environmental conditions will not be stable. Advocates the use of at minimum of 4 annual matrices in random order to perform stochastic population projections. Projections of a stochastic series of 100 years can be used to estimate the minimum viable population size (maximum size of population which gives 5% extinction of populations) and to predict the effects on population survival of harvesting.

The major part of this report describes a two-tiered goldenseal population monitoring program, and relevant field protocols, which should provide most of the answers needed to manage the goldenseal resource for conservation, and perhaps continued harvesting. The monitoring program will yield population dynamics information from the high intensity monitoring of a smaller number of populations, and general population trends from the low intensity monitoring of a larger number of populations. (from summary, 29.11.2002).
Descriptors: Case Study, Population status, Resource Assessment, Sampling Techniques
Taxa: Hydrastis canadensis
Plant Group: Medicinal and aromatic plants
Countries: United States
Part Used: Root

Additional descriptors from Wong (2000):
Objectives: To acquire, direct, empirical evidence of the sustainability or otherwise of wild American ginseng harvesting.
Characteristics: Long-lived, slow growing temperate forest understorey herb.
Type of study: Demographic monitoring
Scale: National
Participants: Local park staff and researchers
Protocol: Two level monitoring programme of large undisturbed wild populations (same protocols as in Gagnon 1999): 1) High intensity monitoring of > 100 identified individuals (tagged or micro-plot mapped) from 5-10 populations per State spread over the species range. 2) Low intensity monitoring of 10-20 populations per State across species range. These populations to be monitored for size class structure i.e. numbers in each size class tallied as well as fruit or seed production for the whole mapped population. 3) Measurement of harvested roots in trade.
Analysis: Suggested analyses are: 1) Determination of minimum viable population size, and population growth. These data can be used to generate region-specific annual transition matrices that can be used in stochastic modelling and elasticity matrices to determine critical life stages and transitions for populations growth. 2) Detect population trends. 3) Indication of resource depletion i.e. are roots in trade becoming smaller with fewer sourced from the wild.

Descriptors: Reproduction, Resource Assessment
Countries: India

Descriptors: Harvest Impact, Resource Assessment
Plant Group: Palms
Countries: Brazil
Part Used: Seed

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Descriptors: Abundance & Rarity, Resource Assessment


Descriptors: Case Study, Harvest Impact, Resource Assessment
Taxa: Ocotea bullata
Plant Group: Medicinal and aromatic plants
Countries: South Africa
Part Used: Bark


Descriptors: Participation & Traditional Knowledge, Resource Assessment, Resource Management Procedures & Approaches
Taxa: Ocotea bullata
Plant Group: Medicinal and aromatic plants
Countries: South Africa
Part Used: Bark


“Studies the effect of various harvest intensities under controlled conditions on the size of fronds from Rumohra adiantiformis used for floral greenery. A management experiment was begun in 1982 to allow harvesting of fern fronds from state lands. Only mature, hardened (nonwilting), unblemished fronds have value for the florist trade. Frond size, color, and form are crucial to quality. Demographic and phenological studies of fern populations showed that populations were sensitive to moisture levels and should not be harvested during months of bud initiation and frond maturation. Cycles of total harvest of mature fern fronds had marked effects on the population structure and size of mature fronds when compared to control plots. Deficiencies of potassium and phosphorus may be the cause of loss of productivity in harvested fern plots. Limiting harvests to only 50 percent of mature ferns may allow for nutrient recycling. Recommendations are made for policies on issuing permits and contract terms, length of harvest season, establishment of permanent reference plots, conditions for site closure to harvest, monitoring and future research, and efforts to develop nursery techniques for domestication. A brief description of the land area, labor force, and infrastructure also are included. This article exemplifies adaptive management strategies using scientific method and statistical analysis for ecosystem conservation of viable populations of commercially valuable species used in the floral greenery trade.” (from Hagen & al. 1996, 27.1.2007).

Descriptors: Case Study, Demography & Population Structure, Regeneration, Resource Assessment
Taxa: Rumohra adiantiformis
Plant Group: Ferns
Countries: South Africa
Part Used: Leaf

Additional descriptors from Wong (2000):
Characteristics: Polymorphic terrestrial fern in semi-dense moist forest.
Objectives: Information required to advise managers concerning controlled exploitation of fronds. 3 research questions: (1) understanding of population demographics, (2) determining optimal harvesting strategies, (3) extensive monitoring of exploitation.
Type of study: Demographic & harvesting impacts
Scale: Research - Groenkop Forest, southern Cape province.
Participants: Researchers
Protocol: Population structure - 3 parallel transects orientated parallel transects orientated east-west. On each transect circular plots of 0.5 m radius located 5 m apart (39, 43 and 32 plots in each transect). In each plot the number of fronds in each of 5 developmental stages were counted. Six months later, in 10 plots per transect; counted fronds and measured stalk length and width, length and surface area of each lamina in each developmental stage. Growth rates - every month for a year a new line transect was marked at random through the fern stands. 20-30 new buds touching the line were tagged. Every fortnight the following was recorded: frond stage, stalk length, length, width and area of lamina. Frond growth rate calculated as the average length of time a frond remained in a particular developmental stage.
Treatment plots -8 blocks selected to represent a gradient from dense to sparse stands. Each block divided into 3 plots of 3x3 m
List of References


Descriptors: Resource Assessment
Plant Group: Medicinal and aromatic plants
[2473]


Himalayan medicinal plants are threatened by large scale exploitation for trade. Research applicable to their sustainable use is largely lacking. We analyze the effects of different harvesting patterns on the population ecology of two highly threatened Himalayan medicinal plants, Nardostachys grandiflora (Valerianaceae) and Neopicrorhiza scrophulariiflora (Scrophulariaceae), in Shey-Phoksundo National Park and in its buffer zone in northwestern Nepal. We first documented local harvesting approaches of two major user groups, amchi (traditional doctors trained in Tibetan medicine), who harvest plants in a selective manner for local health care purposes, and commercial collectors, who harvest unselectively and at much higher intensity for trade. We then applied the selective harvesting approach of amchi in an experiment to test the effects of different harvesting levels on the population ecology of these two species. These experiments revealed a positive effect of low harvesting levels on plant density, but recruitment and survival rates decreased with increasing harvesting levels. We also analysed the effect of high harvesting pressure for trade on the population ecology of N. grandiflora. Recruitment and survival rates were higher in N. scrophulariiflora than in N. grandiflora; the latter species is more vulnerable to harvesting than the former. The difference between them in sustainability of harvest is related to differences in their strategies of vegetative reproduction and in harvesting practices associated with these strategies. Management of Himalayan medicinal plants can be improved by taking harvesting patterns, plant life forms and growth patterns into consideration. (CABI-RAMP, 20053189842).

Descriptors: Harvest Impact, Regeneration, Reproduction, Resource Assessment
Taxa: Nardostachys grandiflora, Neopicrorhiza scrophulariiflora
Plant Group: Medicinal and aromatic plants
Countries: Nepal
Part Used: Root
[7676 !!]


Descriptors: Resource Assessment, Sustainability
[6862 !!]

Gill, G.J. (1993): OK, the data's lousy but its all we've got (being a critique of conventional methods). - IIED, London (Gatekeeper Series 38. Sustainable Agriculture Programme).

Descriptors: Critical Analysis, Resource Assessment
[7699]


Descriptors: Resource Assessment, Sampling Techniques
Countries: Australia
[7594 !!]


Descriptors: Resource Assessment
Countries: Lao People's Democratic Republic
[7770]

Descriptors: Method Manual, Resource Assessment

[4326 !!]


This paper from the early 1990s dates from the early years of increasing research efforts regarding no-timber products from forests. The authors refer to the recent studies and review paper which tried to give estimates of the economic value of these products, esp. in comparison with the value of classical timber value. They argue that many of these studies rely a set of untested assumptions which are largely rejected by the authors and replaced by a series of six hypotheses which need to be tested in future research. This and other articles from the same issue of Economic Botany represent the outcome of a workshop held in 1992 in Bangkok. The authors cite three prominent early studies on the sustainable harvest and economic values of wild plants and animals from forests: Panayotou & Ashton (1992), de Beer & McDermott (1989) and Peters, Gentry & Mendelsohn (1989).

Untested assumptions: (1) 'Extraction of plants and animals from forests by rural populations helps conservation because foraging does not disturb the forest as much as logging'. The authors hold against that there is evidence that even indigenous people far from markets can deplete forest goods. (2) 'Extraction of plants and animals from the forest can be a useful way to raise rural income because the benefits go directly to the extractors.' Here, the authors counter that foraging may rather be an inferior occupation, a job done only until people find ways to switch to more profitable occupations. (3) 'Tropical forests should be preserved because it contains great economic value owing to the many plants and animals used by local people'. This is contrasted by empirical work suggesting that the overall economic value of goods culled from the forests may not be as high as initially hoped for. Instead of 400 US$ estimated by Peters, Gentry & Mendelsohn (1989), the authors arrive only at a value of about 50 US$ per hectare. (schp, 26.8.2006).

Descriptors: Critical Analysis, Economics, Resource Assessment

[4503 !!]


Countries: Guatemala
Part Used: Bark, Wood
[7596 !!]


Descriptors: Reproduction, Resource Assessment
Plant Group: Trees
Part Used: Seed
[7448 !!]


This short editorial paper gives an historical overview of the application of biometrical survey methods in forestry. (schp, 31.8.2006).

Descriptors: Resource Assessment, Sampling Techniques
[7925 !!]


Descriptors: Resource Assessment, Sampling Techniques
Plant Group: Trees
Part Used: Leaf
[7597 !!]


Descriptors: Resource Assessment
Taxa: Bombax ceiba
Plant Group: Trees
Countries: Australia
[7992 !!]

Descriptors: Participation & Traditional Knowledge, Resource Assessment
Countries: Ghana


The aim of this publication is to outline approaches suitable for use by developing countries to assess, with reference to socio-economic factors, the status and sustainability of national biodiversity. In an annex a comparative overview of the major biodiversity assessment techniques is given. (from summary, 5.5.1997).

Descriptors: Resource Assessment


Garcinia lucida Vesque (Clusiaceae) is a highly valued non-timber forest tree. The bark and the seeds are exploited and commercialised for medicinal purposes and palm wine processing in Cameroon, Gabon and Equatorial Guinea. The bark is often removed over almost the entire circumference of the stem, leading to high mortality. To identify the processes or the life stages that influence the population dynamics and to forecast the potential effects of harvesting, a demography study was carried and a matrix model was constructed to characterise the population dynamics of G. lucida in the South Cameroonian Atlantic humid forests. The study revealed that height and diameter growth values were very low and may constitute biological disadvantages for the dynamics of the species. The flowering and fruiting model, the absence of seed dormancy, and the high germination and seedling survival rates constituted advantages for the population dynamics, which is characterised by effective regeneration strategies. Rates of growth, survival and fecundity allowed calculations of transition probabilities of the matrix model. The value of the dominant eigenvalue ($\lambda$) was 1.063, slightly higher than the value expected for stable populations. The sensitivities of $\lambda$ to changes showed that the population growth was most sensitive to changes in tree growth, particularly in the seedling stage. Elasticity analysis showed that growth and fecundity elements had much lower contributions to $\lambda$, indicating that the harvesting of seeds may have a low impact on population growth. However, the population growth was highly sensitive to changes in survival probability, particularly among trees of 5-10 cm, diameter at breast height (dbh). The last stages, containing the large reproductive individuals over 10 cm dbh, which are interesting for the bark extraction, accounted for lowest elasticity, indicating that the extraction of bark may have at least a low impact on population growth. Thus, there may be a good scope for sustainable extraction of G. lucida bark in these stages. The size-class 5-10 cm dbh proved by loop analysis to be the most important reproductive stage for population maintenance. However, individuals in this size-class are also exploited by forest gatherers, and increased exploitation pressure on trees in this size-class is likely to have a considerable impact on the population growth and to compromise the scope for sustainable exploitation of this resource.

Descriptors: Demography & Population Structure, Population dynamics, Population status, Resource Assessment
Taxa: Garcinia lucida
Plant Group: Medicinal and aromatic plants
Countries: Cameroon


Descriptors: Participation & Traditional Knowledge, Resource Assessment


Descriptors: Cultivation, Non-wood forest products, Resource Assessment
Countries: Sri Lanka


Descriptors: Case Study, Demography & Population Structure, Population dynamics, Resource Assessment, Threat
Taxa: Magnolia dealbata
List of References


- Descriptors: Ecology, Resource Assessment, Resource management
- Taxa: Harpagophytum procumbens
- Plant Group: Medicinal and aromatic plants
- Countries: Namibia, South Africa
- Part Used: Root


- Descriptors: Bibliography, Non-wood forest products, Resource Assessment
- Plant Group: Medicinal and aromatic plants


The paper outlines and briefly describes methods that may be used to assess the impact of harvest on population processes of NTFP species under harvest. It presents sampling protocols for rapid or short-term assessment as well as long term monitoring of populations.

The authors define sustainability with respect to both the target species and its ecosystem: “Extraction is considered sustainable if the harvest has no long term deleterious effect on the reproduction and regeneration of populations being harvested in comparison to equivalent non-harvested natural populations. Furthermore, sustainable harvest should have no discernable adverse effect on other species in the community, or on ecosystem structure and function.”

In order to assess sustainability of harvesting a NTFP, knowledge of distribution, abundance, population structure (i.e. density, age/size distribution, number of reproductive adults), population dynamics (i.e. mortality, recruitment) is required and the effect of harvesting on these parameters.

The authors repeatedly focus on the need to include a natural area which is not subject to human-induced disturbance into the field assessments, otherwise there will be no baseline data for determining the effects of harvest. Only direct comparison between natural and harvested populations yields sufficient information to assess sustainability. (schp, 8.8.2006).

- Descriptors: Resource Assessment, Sampling Techniques


- Descriptors: Resource Assessment, Sampling Techniques
- Plant Group: Grasses, incl. bamboo


- Descriptors: Ecological Damage, Resource Assessment


- Descriptors: Participation & Traditional Knowledge, Resource Assessment


- Descriptors: Rapid Assessment, Resource Assessment

Hedge, S.G. & Ellstrand, N.C. (1999): Life history differences between rare and common flowering plant species of...

This paper from the late 1980s marks the era where population biology of plant was just beginning to develop and where demographic approaches were being transferred from human and animal research to plants. The purpose of this short conference paper is to draw attention to some of the more salient differences between plant and animal populations in terms of their structure and function.

Mobility: Higher plants are non-mobile and dependent on the elements or animals for dispersal of propagules. Clumped distribution often results in some members being under stress by density. Lif cycle strategies: For plant conservation purposes, five phases can be divided; (i) pre-dispersal, (ii) dispersal, (iii) germination and establishment, (iv) adult stage, (v) flowering and fertilization. Modular structure: A plant is an assemblage of parts that are born and die at different times. The units of construction like leaves, flowers or seeds are sometimes more relevant for population dynamics that the whole plant. Reproduction: Vegetative reproduction plays an important role. Seed dormancy and seed banks have no parallel in animal populations. Asexual reproduction like agamospermy may substitute sexual reproduction by seed. Polyploidy: Polyploidy affects population biology, structure and evolution in many ways. There is no parallel to this in the animal kingdom. (schp, 18.8.2006).


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<th>Type</th>
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<tbody>
<tr>
<td></td>
<td>Tree Group: Mushrooms</td>
<td>Forest Service Pacific Northwest Research Station.</td>
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<td></td>
<td>Countries: Nepal</td>
<td>Recent approaches to participatory forest resource assessment. pp. 135-169, ODI, London (Rural development forestry study</td>
</tr>
</tbody>
</table>

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Descriptors: Resource Assessment
Plant Group: Medicinal and aromatic plants


Descriptors: Resource Assessment
Taxa: Sabal uresana
Plant Group: Palms
Countries: Mexico


Descriptors: Non-wood forest products, Resource Assessment
Taxa: Frangula alnus, Vaccinium myrtillus
Countries: Poland
Part Used: Fruit


Descriptors: Collection volume, Distribution, Map, Population status, Resource Assessment
Taxa: Panax quinquefolius
Plant Group: Medicinal and aromatic plants
Countries: United States


Descriptors: Rapid Assessment, Resource Assessment, Species Richness
Countries: Canada


Descriptors: Resource Assessment, Sampling Techniques
Plant Group: Grasses, incl. bamboo
Countries: Malaysia
Part Used: Seed
### List of References

**Additional descriptors from Wong (2000):**

- Characteristics: Understorey clumping, woody grass in logged over forest.
- Objectives: Investigation of usefulness of satellite imagery for mapping bamboo areas in tropical logged forest.
- Type of study: Mapping
- Scale: Reserve -Chebar Forest Reserve, Nami, Kedah.
- Participants: Researchers
- Protocol: Used digital image process and visual interpretation of hardcopy (TM 453). Used hardcopy for ground truthing. Field inventory: sample points randomly chosen in mapped units containing bamboo. Plots were 100x100m (1 ha). Stems tallied into diameter classes. Numbers of culm and clumps in plot counted.
- Analysis: Visual interpretation of bamboo-dominated forest was possible in colour composite images. Field data used to determine bamboo densities and permitted the discrimination of two bamboo density classes in each of the 2 bamboo forest types.


- Descriptors: Abundance & Rarity, Diversity, Resource Assessment
- Plant Group: Medicinal and aromatic plants


The paper summarizes the findings of a EU and FAO funded programme in several African countries and of the subsequent expert meetings. For several NTFPs field testing of inventory protocols was carried out and evaluated. Six case studies were implemented. For each, a draft inventory protocol was designed and tested in the field, using a.o. systematic vs. random sampling, multiple species (MSI) vs. single species (SSI) inventory methods, and adaptive cluster sampling (ACS): (1) Inventory of populations and quantification of the production of quinquéliba leaves (Combretum micranthum) in Benin. (2) Testing techniques for the quantification of Pausinystalia johimbe bark in Cameroon. (3) Testing of techniques for assessment of wild fruit yields of baobab (Adansonia digitata) in Kenya. (4) Utilization of local knowledge to assess harvesting yield of wild mushrooms in Malawi. (5) Using ACS for the quantification of leaves of the liana species Gnetum buchholzianum in the Central African Republic. (6) Testing inventory technique approaches through a comparison of inventory of single species to multiple-species in Zambia. (schp, 9.8.2006).

- Descriptors: Case Study, Resource Assessment, Sampling Techniques
- Taxa: Adansonia digitata, Combretum micranthum, Gnetum buchholzianum, Pausinystalia johimbe
- Countries: Benin, Central African Republic, Cameroon, Kenya, Malawi, Zambia


The authors have designed and tested a methodology in India to enable communities to monitor medicinal plant populations in a rigorous way and to experiment with alternative management systems. With an aim to recognise local conditions and knowledge and to provide reliable information, the method is trying to link standard scientific methods with the growing experience of participatory research. The main part of the paper lays out the objectives and community oriented approaches taken (local participation, implementation, capacity building, participatory tools, dissemination and integration). Only little information is given on the field inventory and assessment methods themselves that have been indentified as being both culturally acceptable and scientifically rigorous. (schp, 12.8.2006).

- Descriptors: Participation & Traditional Knowledge, Resource Assessment
- Countries: India


- Descriptors: Resource Assessment
- Countries: Nepal
List of References

Characteristics: Low growing, non-woody plants in hill forest.
Objectives: Trial of protocol for integrating NWFP resources into conventional forest inventory.
Type of study: Methodological development
Scale: Local - Dhading & Nuwakot Districts
Participants: Forestry staff
Protocol: 0.1 ha (100x10m or 200x5m) strip for NWFPs laid between 18m radius tree plots. N=20 clusters. Team of NWFP specialists (2xbotanists, field assistant and local helper) accompanied forest inventory team. Useful parts of 5 specimens of each species weighed and mean used to estimate weight per unit area.
Analysis: Plot size too small, need 5-10% enumeration because of clumped nature of species.

Additional descriptors from Wong (2000):


Descriptors: Abundance & Rarity, Resource Assessment
Countries: Germany


Descriptors: Harvest Impact, Resource Assessment
Taxa: Hyphaene petersiana
Plant Group: Palms
Countries: Namibia
Part Used: Leaf


Descriptors: Biomass Production & Yields, Resource Assessment
Countries: Finland
Part Used: Fruit


Descriptors: Regeneration, Reproduction, Resource Assessment
Plant Group: Trees
Countries: South Africa


Descriptors: Biomass Production & Yields, Resource Assessment
Taxa: Vaccinium myrtillus, Vaccinium vitis-idaea
Countries: Russian Federation
Part Used: Fruit

Additional descriptors from Wong (2000):

Characteristics: Understorey shrubs of boreal forest.
Objectives: Understanding of berry productivity
Type of study: PSP & long-term monitoring
Scale: Regional - Karelia
Participants: Researchers
Protocol: Annual monitoring of permanent sample plots began in 1974. a) Sample plots of 0.3-0.4 ha located in different forest types. Complete description of ground cover and assessment of forest canopy made for each plot. In each plot berry yield assessed in 40 systematically laid out quadrats of 1 m² and 3-5 replicate samples of 100 berries picked an weighted to give yield per hectare. b) 'random' routes across different taxation portions. Main phytocenosic and topographic factors influencing productivity recorded and berries counted in temporary quadrats of 0.5-1 m². 30-100 plots measured depending on the size and character of the stands.
Analysis: Design gives a 15-20% precision which is deemed acceptable for industrial and scientific purposes. Data from 1974-1983 analysed for phenology and to determine the conditions required for heavy fruiting which was found to be meteorological conditions in both the current and previous year, forest type and within a type on tree canopy closure. Yield fluctuates significantly


This study explores the impact of three different collection methods on the regeneration of this frequently collected and traded plant species which is listed in CITES Appendix II. The collected product is the plant rhizome from which essential oil is extracted. An experiment with 209 2x2m plots on both north- and south-facing slopes of a valley in Gorkha District was conducted over two years. Harvesting 100% of the plants in plots followed by replanting of upper plant parts and 2cm of the rhizome provided the fastest regeneration and rhizome biomass growth. (from summary, 25.1.2007).


Lawrence, A. (): 'No personal motive?' Volunteers, biodiversity, and the false dichotomies of participation. - Ethics, Place and Environment 9 (3): 279-298.
List of References

and altruistic goals to some of the world's poorest people. This overview of the contributions to this special issue of IFR points to the more sophisticated understanding of NTFP potential that has been acquired since the early 1990s. Focus on differences among NTFPs has led to literature around more specific groupings, such as bushmeat, indigenous forest fruits, or medicinal plants, each providing a more useful lens for assessing ways in which such products lead to sustainable rural livelihoods and forest management. However, contemplation of NTFPs as a group reminds us that forestry is a complex multi-stakeholder management system, wherein a focus on any one subset of components cannot ignore the ecological and social systems of which they form part. The methodological developments portrayed here advocate a more systemic approach, combining biological and economic approaches with NTFP users' own perceptions and knowledge within adaptive forest management, thereby side-stepping the hazards of the NTFP category. (CABI-RAMP, 20033122724).

Descriptors: Non-wood forest products, Resource Assessment
Plant Group: Medicinal and aromatic plants


Descriptors: Participation & Traditional Knowledge, Resource Assessment
Plant Group: Trees
Countries: Mexico


Descriptors: Case Study, Participation & Traditional Knowledge, Resource Assessment
Countries: Peru


Descriptors: Abundance & Rarity, Case Study, Resource Assessment
Taxa: Durio spp., Eusideroxylon zwageri, Hevea brasiliensis, Shorea stenoptera
Countries: Indonesia
Part Used: Exudate, Fruit, Seed, Wood


Characteristics: Species appearing in Shorea robusta forest succession.
Objectives: Development of methodology to assess feasibility of community management of natural forest for policy and programme development.
Type of study: Rapid appraisal -2 days
Scale: State-wide -Southwest Bengal
Participants: Multi-disciplinary research team
Protocol: Study sites stratified according to length of time protected and matched for microclimate, floristics and soils. Single 100 m² plots at each site located > 50m from forest edge. Structural regeneration: frequency of all plant species in plot; measure 12 upper storey crowns and gaps (selected either randomly or systematically)-crown separation ratio=mean gap/mean crown; measure d and ht of 12 canopy trees; stand profiles drawn for each plot. NTFPs: ethnobotanical survey of all products used for home consumption or sale. Information collected included; harvesting seasons, volumes and parts utilised.
Analysis: 1) Description of Shorea robusta succession in West Bengal 2) Lists of plant products available in different ages of regenerating forest. 3) Relative availability of forest products as forest regenerates.

Additional descriptors from Wong (2000):
Characteristics: Species appearing in Shorea robusta forest succession.
Objectives: Development of methodology to assess feasibility of community management of natural forest for policy and programme development.
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Analysis: 1) Description of Shorea robusta succession in West Bengal 2) Lists of plant products available in different ages of regenerating forest. 3) Relative availability of forest products as forest regenerates.


Grasses, incl. bamboo
Plant Group: Regeneration
Descriptors: Resource Assessment
Countries: Philippines


Fruit
Part Used: Reproduction
Taxa: Vaccinium vitis-idaea
Countries: Estonia


Ethnobotany, Method Manual, Resource Assessment
Descriptors: Statistics


This book on ethnobotanical methodology is the first of a series forming a contribution to the People and Plants Initiative of the World Wide Fund for Nature, UNESCO and the Royal Botanic Gardens, Kew which aims to provide information that will assist botanists to undertake conservation work with local communities. Consisting of 8 chapters that describe the basic concepts, skills and techniques that guide collection of data in the field, the manual is for use in designing projects that yield information that can be applied to community development and biological conservation. The first chapter gives a basic description of data collection and hypothesis testing, whilst chapters 2 to 7 explore the contributions to ethnobotany from the diverse fields of botany, ethnopharmacology, anthropology, ecology, economics and linguistics. Chapter 8 discusses the link between ethnobotany, biodiversity conservation and community development. The manual is tailored for field workers including university students, cultural promoters and nature guides, who are beginning their first research project although it will be useful for seasoned ethnobotanists and researchers of related disciplines. (CABI-RAMP, 19941611066).

Additional descriptors from Marriott (1990)
Characteristics: Understorey shrub in boreal forest.
Objectives: Understanding of the production characteristics of berries in relation to soil and stand structure.
Type of study: Productivity, permanent sample plots
Scale: Regional -North-west and South-east Estonia
Participants: Researchers
Protocol: Measurement in 1978-84, 24 and 5 sub-plots containing 430 and 100 permanent 1 m² quadrats respectively from north-west and south-east Estonia. Stand, soil and co-dominant characteristics recorded and visual estimation of productivity/phenology for the V. vitis-idaea plants.
Analysis: Stepwise-linear regression used to determine the most significant variables that contribute to the variation in berry yield. ANOVA used to determine the significance of the relationships. Two factor hierarchical ANOVA used to test the degree of association between yields in a plot on successive years. Developed predictive (linear multiple-regression) equation for the productivity of the current year and for the next year in the autumn.


<table>
<thead>
<tr>
<th>Taxa</th>
<th>Demography &amp; Population Structure, Resource Assessment</th>
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<tbody>
<tr>
<td>Plant Group</td>
<td>Sabal yapa</td>
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<td>Countries</td>
<td>Mexico</td>
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<td>Part Used</td>
<td>Leaf</td>
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<tr>
<th>Taxa</th>
<th>Abundance &amp; Rarity, Distribution, Resource Assessment</th>
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<tbody>
<tr>
<td>Plant Group</td>
<td>Medicinal and aromatic plants</td>
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<tr>
<td>Countries</td>
<td>United States</td>
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As demand for goldenseal (Hydrastis canadensis) and ginseng (Panax quinquefolius) intensifies due to the herbal plant trade, basic information about distribution and abundance is needed to inform management strategies. We surveyed 16 sites focusing on West Virginia, but including nearby sites in Pennsylvania, Kentucky, Ohio, and Maryland, USA, to determine H. canadensis and P. quinquefolius presence and abundance. In total we surveyed 29.32 ha over two summers in a wide range of aspects, elevations, management regimes and forest cover types. So few patches of goldenseal were encountered that we were unable to detect statistically significant effects of elevation, aspect, land use or vegetation on either encounter probability or density. Ginseng was more frequently encountered than goldenseal. The probability of encountering ginseng increased with elevation. Overall, ginseng was not more frequent or abundant on north-facing ‘cove’ forests. A significant elevation xaspect interaction was found, whereby ginseng was most abundant on west-facing slopes at low elevation, but more abundant on east-facing slopes at middle elevations. Extrapolations of ginseng densities to the state of West Virginia suggest that the species is not rare in the typical sense. Instead, it is widespread, but scarce everywhere it is found. Harvest rates are estimated to be approx equal to 5% of the natural ginseng population annually. Understanding basic ecological relationships and management of these species is made difficult by the widespread, dispersed nature of individuals, patches and populations and the complex interaction with human harvesters. (CABI-RAMP, 20033138954).


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<tr>
<th>Taxa</th>
<th>Abundance &amp; Rarity, Distribution, Resource Assessment</th>
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<tbody>
<tr>
<td>Plant Group</td>
<td>Hydrastis canadensis, Panax quinquefolius</td>
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<th>Taxa</th>
<th>Resource Assessment, Sampling Techniques</th>
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<tr>
<td>Plant Group</td>
<td>Grasses, incl. bamboo</td>
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<tr>
<th>Taxa</th>
<th>Case Study, Demography &amp; Population Structure, Population Viability Analysis, Resource Assessment</th>
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<tr>
<td>Countries</td>
<td>United States</td>
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| Taxa               | Population Viability Analysis, Resource Assessment |


| Taxa               | Resource Assessment |

Mi Yoon Chung, Nason, J.D. & Myong Gi Chung (2004): Implications of clonal structure for effective population size and genetic drift in rare terrestrial orchid, Cremasra appendiculata. - .

Descriptors: Case Study, Genetic Variability, Resource Assessment
Taxa: Cremasra appendiculata
Plant Group: Orchids
Countries: Korea, Republic of


Arnica montana occurs in Nardus stricta grasslands on siliceous soils in mountain areas. This habitat type (Code 6230) is listed in the EU-FFH-directive (92/43) and the species Arnica montana is listed in Annex V (92/43). The maintenance of Arnica populations is closely bound to traditional farming systems. The habitats are threatened by conversion to more intensive agriculture. To stop this, the farmer needs to be compensated to maintain these habitats. The sustainable use of Arnica flower heads can contribute to this. Productivity and biodiversity of its habitats were determined by carrying out an inventory of the meadows from a conservation and economic perspective. The habitats are diverse, but production is low. There is a wide range of productivity, biodiversity, Arnica cover and species composition within the habitats. Biodiversity and productivity are positively correlated, but biodiversity and cover are negatively correlated. To maintain the high biodiversity of the grassland and to improve yield of this medicinal plant a balanced meadow management must be found. (CABI-RAMP, 20053211530).


Descriptors: Ecological Functions, Regeneration, Resource Assessment


Descriptors: Case Study, Demography & Population Structure, Population dynamics, Resource Assessment, Threat
Taxa: Aloe dichotoma, Aloe pillansii, Pachypodium namaquanum
Plant Group: Succulents
Countries: South Africa


Descriptors: Regeneration, Resource Assessment
Taxa: Rumohra adiantiformis
Plant Group: Ferns
Countries: South Africa
Part Used: Leaf


Descriptors: Harvest Impact, Resource Assessment
Taxa: Rumohra adiantiformis
| Plant Group: | Ferns |
| Countries: | South Africa |
| Part Used: | Leaf |


Measured growth rates of 121 Taxus brevifolia trees in the Cascade Range of Oregon and Washington that had been damaged from windthrow or logging activity from 3 to 92 years ago, and the growth rate of 121 undamaged trees. Results from the data indicated that yew trees survive and grow well for extended periods after partial bark removal. By inference, trees are likely to survive after partial (<50%) bark stripping for taxol supplies in the event of continued harvests for taxol. (from Hagen & al. 1996, 7.9.2006).

| Taxa: | Taxus brevifolia |
| Plant Group: | Medicinal and aromatic plants |
| Countries: | United States |
| Part Used: | Bark |


| Descriptors: | Resource Assessment |
| Plant Group: | Medicinal and aromatic plants |


| Descriptors: | Resource Assessment |


| Descriptors: | Resource Assessment |
| Plant Group: | Mushrooms |
| Countries: | United States |


| Descriptors: | Resource Assessment, Resource Management Procedures & Approaches |
| Plant Group: | Mushrooms |


| Descriptors: | Non-wood forest products, Resource Assessment |

  Descriptors: Ecological Functions, Resource Assessment

  Descriptors: Resource Assessment
  Taxa: Harpagophyllum procumbens
  Countries: Botswana

  Descriptors: Reproduction, Resource Assessment, Resource management
  Taxa: Arctostaphylos uva-ursi
  Plant Group: Medicinal and aromatic plants
  Countries: Russian Federation
  Part Used: Fruit

  Goldenseal, Hydrastis canadensis L., is harvested from forests in the eastern U.S. for its rhizome, which is considered to have medicinal properties. While listed as rare or threatened in many states, its status in Ohio has not been assessed. To establish the status of historic goldenseal populations, we assessed 71 sites where voucher specimens had been collected from 1845 to 1998. Of these sites, 13% were deforested and no longer supported populations. Goldenseal was found on 65% of the remaining forested sites. Nearly half of documented goldenseal populations have become extinct, suggesting an overall decline of goldenseal in Ohio. The major cause of extinction appears to differ among Ecoregions, with deforestation important in the Eastern Corn Belt Plains, herbivory by white-tailed deer in Erie/Ontario Drift and Lake Plain, and overcollection in the Western Allegheny Plateau. (CABI-RAMP, 20053075367).
  Descriptors: Abundance & Rarity, Case Study, Resource Assessment, Threat
  Taxa: Hydrastis canadensis
  Plant Group: Medicinal and aromatic plants
  Countries: United States
  Part Used: Root

  Descriptors: Case Study, Population Viability Analysis, Reproduction, Resource Assessment
  Taxa: Scorzonera hispanica
  Countries: Czech Republic

  This is the second of a series of three papers. It quantifies and ranks the densities, frequency and importance values, as well as size class distributions and amounts of key products collected, some of the most important of which are medicinal plants such as Phyllanthus emblica, Terminalia chebula and T. bellerica. (A.B. Cunningham, 6.2.1997).
  Descriptors: Collection, Demography & Population Structure, Non-wood forest products, Resource Assessment
  Taxa: Phyllanthus emblica, Terminalia bellerica, Terminalia chebula
  Plant Group: Medicinal and aromatic plants

Descriptors: Ecological Functions, Life Form, Rarity, Resource Assessment


Descriptors: Reproduction, Resource Assessment

Plant Group: Flower


Descriptors: Abundance & Rarity, Diversity, Resource Assessment

Plant Group: Medicinal and aromatic plants


Descriptors: Resource Assessment, Sampling Techniques


Descriptors: Method Manual, Resource Assessment


Descriptors: Resource Assessment

Plant Group: Palms

Countries: India

Additional descriptors from Wong (2000):
- Climbing palm confined to isolated, inaccessible, sheltered 'pockets' in evergreen, semi-evergreen &
- Development of appropriate inventory methods for resource survey of rattans as a prerequisite for scientific
- Inventory design
- State-wide (Kerala) & Forest Division
- Researchers
- Review of design features of appropriate inventory techniques for rattan resource surveys.
- Recommendations for State-wide and Forest Division two stage inventory protocols based on rattan distribution and
- field logistics.


In this investigation, the impact of harvesting on wild populations of Panax quinquefolius and Allium tricoccum was assessed and their extinction thresholds and minimum viable populations were estimated. For both species it was evident that existing populations in Canada, which rarely exceed several hundred individuals cannot support any harvesting without serious threat to their long-term persistence. (from summary, 17.10.1996).


margin of subsistence and thus have limited possibilities for engaging in conservation behavior if other, more lucrative, alternatives for making a living are available. This difficulty is enhanced by the generally low percentage of a product’s market value that reaches the nontimber forest product harvester. Developing marketing systems that enhance the value that reaches harvesters, foster value-added industries in forested locations, and address the threats posed by weak markets and substitution is thus critical to the success of nontimber forest product extraction strategies.

5. Expanding economically and ecologically sustainable nontimber forest product extraction requires reconfiguring existing political and social institutions. Extractive reserves, for example, offer the possibility for providing small holders the tenure security needed to encourage sustainable extraction and discourage forest conversion. Coalitions between extractor groups and nongovernment organizations can help these groups to mobilize more effectively to demand government policies that support rural community development rather than maximizing commodity production. Such coalitions also can level the playing field between multinational corporations and small-scale producers.” (from Hagen & al. 1996, 27.1.2007).

## List of References

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<td>Countries: Zambia</td>
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<td>Part Used: Fruit</td>
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<td>[7756]</td>
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<td>The structural demography of the rhizomatous sand sedge, Carex arenaria, was studied in two dune-slack systems in North Wales. A distinctive architectural feature of this plant is the longevity of the rhizome system. Clonal growth by C. arenaria results in subpopulations of shoot modules (tillers) which may be separated into distinct growth phases in the field (juvenile, adolescent, mature, senile and slack). Field plots were established in the mature, senile and slack phases of natural populations; half the plots received a massive nutrient application of NPK fertilizer. The shoot populations within permanent quadrats were mapped at frequent intervals. (from summary, 10.8.2006).</td>
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<td>Taxa: Carex arenaria</td>
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Descriptors: Resource Assessment, Sampling Techniques
Part Used: Fruit


This study was done to examine the structure and assess the natural regeneration potential of Prunus africana in South Nandi forest and selected sites of Kakamega forest, Western Kenya. Forest survey was carried out to investigate the structure of P. africana, the forest was stratified into three different forest types that is pure, mixed and natural forest in Kakamega forest. South Nandi forest was taken as one stand since the whole forest is natural and it was not possible to stratify it like Kakamega forest. Transect belts measuring 40 m wide and 1.5 km long were laid in both forests along an access line. A total of 140 and 134 plots measuring 0.02 ha each were established along these transects in Kakamega and South Nandi forests respectively. At the centre of each plot was a P. africana tree whose diameter at breast height (dbh), height and crown length were assessed. Saplings of the species (of >1.5 m in height and <5 cm diameter) were counted on each plot, and seedlings (<1.5 m in height) were also counted in smaller plots of 28x10 in 2 rows 20m apart and 3 columns 50m apart - 80m between clusters. Sampling intensity fixed at 10%. In each plot and subplot, all rattan stems > 30cm were tagged, identified to sp., cluster number, stem number, stem length, stem diameter and other observations related to growth.

Analysis: Means, CV and sampling errors for number of clumps, number of stems and stem length calculated for each forest.

Sampling designs compared with 100% enumeration. Strip sampling gives closest estimates in lowland forest while clusters were best in hill forest. Grosenbaugh's criterion (SE% x time) used to compare the efficiency of the sampling methods. Cluster sampling best for determining number of clumps and stem numbers while strip sampling best for estimating stem length in hill forest. In lowland forest strip sampling is most accurate although grid sampling is more efficient.


This study was done to examine the structure and assess the natural regeneration potential of Prunus africana in South Nandi forest and selected sites of Kakamega forest, Western Kenya. Forest survey was carried out to investigate the structure of P. africana, the forest was stratified into three different forest types that is pure, mixed and natural forest in Kakamega forest. South Nandi forest was taken as one stand since the whole forest is natural and it was not possible to stratify it like Kakamega forest. Transect belts measuring 40 m wide and 1.5 km long were laid in both forests along an access line. A total of 140 and 134 plots measuring 0.02 ha each were established along these transects in Kakamega and South Nandi forests respectively. At the centre of each plot was a P. africana tree whose diameter at breast height (dbh), height and crown length were assessed. Saplings of the species (of >1.5 m in height and <5 cm diameter) were counted on each plot, and seedlings (<1.5 m in height) were also counted in smaller plots of 5 m radius from the central P. africana. Sampled trees of P. africana showed a discontinuous size distribution of height and dbh where the young regeneration was not replacing the mature trees coming to the end of their reproductive life in both forests. There is a shift in dbh classes from seedlings and saplings to large diameter classes and this was more pronounced in South Nandi and the natural stand in Kakamega forest. Thus the results do deviate from the hypothesized inverted ‘J’ shape of dbh distribution in both forests. The natural regeneration levels were found to be high in both forests since there were many seedlings counted in the forest floor, but they hardly reach the size of 1 m hence there were few saplings in both forests. As a result, this reduces the rate of regeneration of P. africana in both forests. Stand density, crown size and density of P. africana were found to have little effect on the density of seedlings and saplings counted in both forests suggesting light may not be a significant factor at germination, but could influence subsequent growth. This is evident by the absence of saplings in both forests. This study has given important information on the stand structure of P. africana and the potential for its natural regeneration in Kakamega and South Nandi forests, which can be used as a tool for future management of the species. (CABI-RAMP, 20023115553).

Descriptors: Demography & Population Structure, Population dynamics, Population status, Resource Assessment
Taxa: Prunus africana
Plant Group: Medicinal and aromatic plants
Countries: Kenya

O'Brien, T.G. & Kinnaird, M.F. (1996): Effect of harvest on leaf development of the Asian palm Livistona

The study was carried out in North Sulawesi (ID). Census results for palms in harvested and unharvested areas indicated that palm density was twice as high and reproductive-sized palms were 10 times more common in the unharvested area. Current harvest practices are judged unsustainable. Recommendations include reduction of harvest intensity and waste and preservation of reproductive-sized palms. (from summary, 15.10.1996).

### Descriptors:
- Case Study, Harvest Impact, Regeneration, Resource Assessment
- Livistona rotundifolia
- Palm
- Indonesia
- Leaf

### Taxa:
- Livistona rotundifolia

### Countries:
- Indonesia

### Part Used:
- Leaf

**Additional descriptors from Wong (2000):**
- Characteristics: Determination of growth and replacement rate of leaves under different harvesting levels. Are current harvesting practices sustainable? What might constitute an appropriate harvest.
- Type of study: Growth study
- Scale: Research site - Tangkoko-Dua Sudara Nature Reserve, Sulawesi
- Participants: Researchers
- Protocol: One year study. Experimental harvests on 10 small-sized (0.5-1.4 m tall) palms with 20 controls. Two harvest intensity treatments: light (50% of mature leaves cut on 5 plants) and heavy (all leaves cut on 5 plants). Monitored growth of 2 new leaves per palm in controls and 3 leaves in treatments. Leaf expansion measured weekly and time of emergence, opening of blade, cessation of expansion and damage was recorded for each leaf. Canopy cover and rainfall (known to affect leaf development) also recorded. Inventory of palms in 20 0.25 ha randomly located plots within study area. All palms tagged, heights measured and cut leaves recorded. Distribution of harvested plots used to stratify area into harvest and non-harvest zones.
- Analysis: Analysis of leaf development with canopy closure, rainfall and timing of emergence. Analysis of average daily expansion rate, time until leaf opened, maturation time and final leaf size for harvest treatments using multiple analysis of covariance.
- Comparison of palm density in harvest and non-harvest zones using t test.


### Taxa:
- Coccothrinax readii, Thrinax radiata

### Countries:
- Mexico

### Part Used:
- Leaf

**Additional descriptors from Wong (2000):**
- Characteristics: Palms in dense stands in dry tropical forests and on coastal dunes.
- Objectives: Population biology of two palm species.
- Type of study: Demographic
- Scale: Reserve - Sian Ka'an Biosphere Reserve, Quintana Roo
- Participants: Researchers
- Protocol: PSPs of variable sizes depending on stem density established in 4 sites representing harvested and unharvested secondary forest. 2 year study. Survivorship: recorded every 2 months. Seedlings, in 2 classes counted in subplots (2-25 m²). Saplings, 5 classes of juveniles and 1 m ht classes for adults. Cut stumps counted. Phenology: recorded monthly (number of adults flowering, inflorescences per tree, success of infructescence production). Germination: 100-200 seeds sown into 2x2m subplots. Leaf production, growth rates and age: Monthly tracking of leaves produced for 20-30 marked accessible (sub-adult) plants. Growth quantified as height increment in cm per leaf scar. For adults 3 specimens felled and leaf scars counted and divided by juvenile leaf production rates.
- Analysis: Life table analysis using a linear population projection matrix model. Lefkovitch matrix models used to estimate finite population growth rates. Computer simulations used to explore the possible sustainable harvesting regimes by varying number of stems cut (8-400 per ha) and frequency (1-4 years) of cutting. Sensitivity and elasticity analysis of population growth rate.


### Taxa:
- Chamaedorea tepejilote

### Countries:
- Mexico


Provides and compares methods for estimating lingonberry (Vaccinium vitis-idaea) yields to provide an accurate forecast of crops. Four methods are considered: random coordinates, nearest neighbor, wandering quarter, and random cross. Random coordinates was considered the most costly and laborious with respect to field materials required and plot sizes. The wandering quarter method tended to overestimate or underestimate yields as compared to the other models. The most economical, accurate, and therefore preferred method is the random cross method. With this method, four transects pass from a randomly chosen tree in the four cardinal directions until they encounter the next tree in the respective direction. Random distances to the right or left of the unequal transects are used to anchor sample subplots. (from Hagen & al. 1996, 27.1.2007).

Descriptors: Reproduction, Resource Assessment
Taxa: Vaccinium vitis-idaea
Part Used: Fruit

[Additional descriptors from Wong (2000):]


Descriptors: Non-wood forest products, Resource Assessment
Countries: Estonia
Part Used: Fruit


"Argues that multiple-use management for timber and non-timber products and services can both maximize economic growth and preserve a forest's value. The book describes the history of tropical forest exploitation, the rationale and implications of the undervaluation of tropical timber, and the limited, but important, examples of natural forest management. Non-timber products and environmental "services" provided by the forest are identified and evaluated. Finally, a multiuse management plan is described, which requires a full valuation of these products and services and serves as a mechanism for sustainable forest use. Chapter 6 describes the social and economic importance of nontimber products worldwide and provides a bibliography of over 60 references. The harvest and use of rattan (Calamus spp.) is profiled in a case study at the end of the chapter. " (from Hagen & al. 1996, 27.1.2007).

Descriptors: Non-wood forest products, Resource Assessment


Descriptors: Regeneration, Reproduction, Resource Assessment
Countries: Australia


The aim of the study was "identifying the researchable constraints in the biometrics of current NTFP resource assessment methods"

Criteria for judging biometric quality are (a) Reporting of protocols: "whether protocols had been adequately reported"; (b) Randomisation – reducing bias: "whether the plots were distributed in such a way as to minimise potential bias in the results"; (c) Replication – sample size: "need to contain a number of plots. A good biometric study should be capable of generating sufficient data to calculate a mean and sampling error, which requires a number of plots; (d) Plot independence: "whether plots were independent of each other".

"The overall conclusion of the biometric review is that only 38% of the 97 quantitative studies examined passed my four criteria of biometric quality. However, to be fair some of these studies may not need to be biometrically rigorous. What is perhaps more of a concern is that 43% of resource inventory and 90% of yield studies that failed in some way. Most NTFP studies are associated with management of resources in some form or other. As in all forms of management inventory the methods should be matched to the information needs of the management system and need not be biometrically rigorous as long as objectives are met."

In summary the major problems in NTFP assessment methodology were identified as: 1. Problems with adopting traditional forest inventory techniques for NTFPs; 2. Lack of properly researched NTFP-specific sampling designs; 3. Little guidance available on development of appropriate NTFP measurement techniques; 4. No application to NTFPs of
sampling designs tailored to monitoring needs; 5. Difficulties in determination of the sustainability of harvesting; 6. Application of novel sampling strategies to NTFPs; 7. Cross-disciplinary exchange of ideas and methods suitable for use with NTFPs; 8. Effective communication of advice to fieldworkers and communities. (schp, 27.1.2007).

Descriptors: Ecological Functions, Regeneration, Reproduction, Resource Assessment
Countries: Australia
[7461]


Descriptors: Resource Assessment, Statistics
[2640]


Descriptors: Resource Assessment
Taxa: Diploknema butyracea
Countries: Nepal
[2530]


Descriptors: Rapid Assessment, Resource Assessment
Countries: Bulgaria
[2470]


Descriptors: Demography & Population Structure, Resource Assessment
Taxa: Bertholletia excelsa
Countries: Bolivia, Brazil, Peru
Part Used: Fruit
[7999]


Descriptors: Resource Assessment
Countries: Peru
Part Used: Fruit
[2643]


Descriptors: Demography & Population Structure, Resource Assessment
Taxa: Brosimum alicastrum
Countries: Mexico
Part Used: Fruit
[7794]

This paper is one of the few attempts to outline a step-wise approach which has to be followed to make meaningful resource management decisions. Focus of the manual is “exclusively on non-timber plant resources, with particular emphasis on trees”. It is largely concerned with primary forests, either undisturbed or already subjected to some degree of exploitation. Definition: “A sustainable system for exploiting non-timber resources is defined as one in which fruits, nuts, latexes, and other products can be harvested indefinitely from a limited area of forest with negligible impact on the species being exploited.”

Structure: Section I summarizes the principal ecological characteristics of tropical plants that limit the nature and intensity of resource exploitation. Section II builds on this information by discussing the potential long-term ecological impacts resulting from the harvest of different plant parts. Section III takes a more applied field perspective. A general strategy for managing non-timber forest resources on a sustained-yield basis is outlined, and specific procedures for selecting resources, collecting baseline data, and monitoring the impact of harvesting are described. The complete process of sustainable exploitation is described by the author as composed of six basic steps: (1) species selection, (2) forest inventory, (3) yield studies, (4) regeneration surveys, (5) harvest assessments, and (6) harvest adjustments. He makes it very clear that “users must be actively involved in the six steps outlined in the manual, not just used as a source of limited information.” The basic concept behind this proposed strategy or process is to “provide a constant flow of information about the ecological response of a species to varying degrees of exploitation. Sustainability is achieved through a continual process of adjustment in which any change in seedling establishment or population structure results in a corresponding change in harvest level.” (schp, 2.8.2006).

Descriptors: Method Manual, Resource Assessment, Susceptibility


Descriptors: Non-wood forest products, Resource Assessment

[7793]


Descriptors: Method Manual, Resource Assessment

[7604]


Descriptors: Resource Assessment
Taxa: Shorea atrinervosa
Countries: Indonesia
Part Used: Fruit

[7799]
Tropical forests contain a huge diversity of fruit, nut, oilseed, latex, resin, gum, spice and medicinal plants of great potential economic value. This report summarizes the current state of knowledge on the ecology of these non-timber resources and outlines a series of management recommendations for their sustainable harvest. The discussion is divided into 4 chapters. Chapter I summarizes the basic characteristics of tropical plant populations that limit the nature and intensity of resource exploitation. The major problem areas include the diversity and low density of tree species, the complexity of flowering and fruiting, the specificity of microsites for successful regeneration and growth, and the labile response of population structure to changes in the level of recruitment. Chapter II discusses the potential long-term ecological impacts resulting from the selective harvest of different plant tissues such as reproductive propagules (fruits, nuts, and oilseeds), plant exudates (latexes, resins, and gums), and vegetative structures (fibres, medicinals, rattans, and thatch). It is argued that most of the current commercial exploitation of non-timber resources is plagued by destructive harvesting, over-exploitation, and a basic disregard for the functional ecology of tropical plant populations. Chapter III outlines the basic inventory and yield data needed to develop a programme of sustainable resource use. Two different methodologies for defining a sustainable level of harvest are discussed. The first, a conceptually simple, inexpensive, and straightforward process called successive approximation, monitors the population impact of destructive harvesting, over-exploitation, and a basic disregard for the functional ecology of tropical plant populations.

Objectives: To determine: (1) Density of Illipe in residual forest. (2) Existence of varieties with atypical or annual fruiting. (3) Productivity of natural stands and potential for sustainable exploitation / management of Illipe.

Type of study: Productivity

Scale: Research site - Gunung Poteng

Participants: Researchers

Protocol: Site chosen because of reported occurrence of annual fruiting Illipe. 1 ha plot marked into 25, 20x20m quadrants. All Illipe trees > 1m tall measured for height and diameter, mapped and labelled. Seedlings sampled in 200 randomly located 1m² plots. All the sp. > 5cm d also measured and mapped. Information on local nomenclature and use of each taxa recorded. Fruit production: selection of 4 isolated trees, 15 1m² plots randomly located beneath crown, number of intact and predated immature and mature recorded every 7-10 days. Long term PSP (established 1990 - paper reports results for 2 years).

Analysis: Stand table. Exponential model fitted to fruit production against tree size. Use of regression and stand table to estimate total fruit production per ha. Potential for Illipe production from natural forest to improve income of rural households.

Descriptors: Biomass Production & Yields, Resource Assessment
Taxa: Grias peruviana, Myrciaria dubia, Spondias mombin
Countries: Peru
Part Used: Fruit

**Additional descriptors from Wong (2000):**
Objectives: Estimation of fruit yield.
Type of study: Yield
Scale: Research sites
Participants: Researchers
Protocol: Populations located through interviews and exploration, site selection based on distribution & abundance, distance to town, accessibility and probability of logging. M. dubia - 10, 10x10 m contiguous plots (all trees tagged and measured for ht and basal d). G. peruviana - 15, 20x20 m contiguous plots - (all trees tagged and measured. ht < 1.5m tall; ht & d > 1.5m tall). S. mombin 125 contiguous 20x20 m plots (=5.0 ha plot), (all trees >1cm d counted, measured and mapped). Fruit production: M. dubia fruit marked with paint & counted on 25 adult trees for 2 fruiting seasons. G. peruviana: biweekly censuses of 15 adult trees for 1 year. S. mombin fruit production recorded using 8 randomly located litter traps of 0.5 m² emptied weekly under 8 trees across size range for 1 season.

Analysis: Spatial distribution examined using Morisitas's Index of Dispersion (ID). Stem maps sampled using contiguous square plots of a range of sizes, ID tested for significance difference from 1 using F statistic to determine size of clumps. Size class distribution log transformed - linear regression fitted=negative exponential size distribution. Phenological charts. Regression of fruit production against diameter. Total fruit yield=mean yield x number in size class.


Although many properties of populations, such as spatial dispersion and genetic structure, may be of interest, but population size is the fundamental property to monitor. The authors claim that for intermediate-sized populations, a demographic monitoring scheme should include a combination of monitoring levels within populations. Multistage sampling combines extensive plant counts with intensive demographic monitoring of subsets of individuals which provides both powerful monitoring and simultaneously allows continued use of potential prior data. In the second part of the paper, the authors report on their monitoring design for Echinacea laevigata populations in the eastern US and how the sampling techniques have been carefully adapted and improved over the years of monitoring. (schp, 15.8.2006).

Descriptors: Case Study, Resource Assessment, Sampling Techniques
Taxa: Echinacea laevigata
Countries: United States

**Additional descriptors from Wong (2000):**
Characteristics: Species-rich Amazonian forests; Sandy terra firma, Clay terra firma, Alluvial, Seasonal swamp.
Objectives: Fill information shortfalls concerning annual forest fruit productivity: (1) variability of productivity with forest type; (2) accessibility of fruits to ground based collector; (3) seasonality of fruit production.
Type of study: Yield
Scale: Reserve -Zona Reservada Tambopata
Participants: Researchers
Protocol: Tagged every woody stem and some smaller plants of species known to have edible fruits. Visual phenological observations and counts of immature and mature fruits made every month for 1 yr. For species with low on-plant predation, counts were made on fruits falling onto 1m² quadrats located randomly beneath canopy just after peak fruit-fall. Sample of palm fruits harvested and counted as a check on visual estimates. Sub-sample of fruits from a number of individuals was weighed to get average fruit productivity per plant. For Mauritia trees in swamp forest regression of fruit per raceme with tree height was generated from earlier direct observations. Modelled 'access-weighted' production based on ground collection. Utilised Smithsonian 1 ha PSP plots.
Analysis: Statistical analyses facilitated by random selection of data from 10 (out of 20) subplots non-contiguous subplots. Annual fruit yield by forest type taking into account accessibility.

List of References


Descriptors: Case Study, Resource Assessment
Taxa: Euterpe oleracea
Plant Group: Palms
Countries: Brazil
Part Used: Seed

Additional descriptors from Wong (2000):
- Characteristics: Multi-stemmed palm in flood plain forest.
- Objectives: Economic costs and returns of extraction. Impact of harvest intensity on population structure. Economic potential of sustainable management
- Type of study: Industry viability study
- Scale: Regional - Amazon estuary
- Participants: Researchers
- Protocol: Extraction rates: interview of 50 extractors in 9 counties. Processing: visits to 30 factories and intensive interviews in 9 factories. Heart yield and size: measurements of d, height, weight & diameter of hearts for 68 wild stems across size range. Harvest impacts: high pressure = cutting 1-2 yrs: 2 10x100 m regularly spaced plots in 5 sites. Low pressure = 4-5 yrs: 2 10x100 m plots in 2 sites. Control: 2 10x50 m plots. Recorded number of clumps with stems > 2 m tall, d of all stems >= 2 m tall, number and diameter of recently cut stems. Recorded total living and dead clumps in 2 25x50 m randomly located plots in each strata.
- Analysis: Descriptive statistics. Empirical equations relating height and d of stems with weight and diameter of heart. Equations used to estimate palm yield per ha. Proportion of population in height classes compared across harvesting intensities. Recommended minimum sizes for palm extraction. Economic potential- costs & benefits of 2 types of management.


Descriptors: Resource Assessment, Statistics


Descriptors: Biodiversity, Illustration, Intellectual property rights, Participation & Traditional Knowledge, Resource Assessment


Descriptors: Ecological Damage, Resource Assessment

Pozdnjakov, L.K. (1986): Lesnye rastitelnye resursy Srednej Sibiri, Krasnoyarsk [Herbal forest resources in the middle of Siberia, Krasnoyarsk; in Russian]. - § pp., §, s.loc.

Descriptors: Resource Assessment
Plant Group: Medicinal and aromatic plants


Descriptors: Case Study, Ethnobotany, Participation & Traditional Knowledge, Resource Assessment
Countries: Bolivia, Brazil, Venezuela

List of References


Population viability analysis (PVA) is a collection of methods for evaluating the threats faced by populations of species, their risks of extinction or decline, and their chances for recovery, based on species-specific data and models. Compared to other alternatives for making conservation decisions, PVA provides a rigorous methodology that can use different types of data, a way to incorporate uncertainties and natural variabilities, and products or predictions that are relevant to conservation goals. The disadvantages of PVA include its single-species focus and requirements for data that may not be available for many species. PVAs are most useful when they address a specific question involving a focal (e.g., threatened, indicator, sensitive, or umbrella) species, when their level of detail is consistent with the available data, and when they focus on relative (i.e., comparative) rather than absolute results, and risks of decline rather than extinction. This overview provides guidelines for choosing a PVA model among three categories, from data-intensive individual-based population models to simple occupancy metapopulation models. (from summary, 31.8.2006).

Descriptors: Non-wood forest products, Resource Assessment


The author first presents an internet survey on the usage of the term "ecological damage". A definition of ecological damage is suggested that is flexible enough to keep step with progress in natural sciences and that is independent from different social evaluative concepts of ecological goods. In a second step for specific environmental goods, specific regulations need to be defined to establish instruments for handling practical cases. (from summary, 10.9.2006).

Descriptors: Ecological Damage, Resource Assessment


Descriptors: Reproduction, Resource Assessment
Taxa: Boswellia papyrifera
Plant Group: Medicinal and aromatic plants


Descriptors: Case Study, Participation & Traditional Knowledge, Resource Assessment
Countries: China


At a study site in Uttar Pradesh the authors have compared disturbed (= harvested) sites of Taxus baccata subsp. wallichiana with relatively undisturbed sites regarding the demographic structure of the populations and the extent of canopy damage and regeneration. The study plots represented 8% of the total yew habitat in the region. This undercanopy species never forms extensive cover and needs deeply-shaded, moist and sheltered sites for seedling regeneration. This and the slow growth rate make it susceptible to over-utilization. The authors found 57.4% of the total canopy volume had been removed in the harvested plots. The unclear taxonomic status of T. wallichiana in relation to T. baccata is not discussed in the paper. (schp, 21.5.2001).

Descriptors: Demography & Population Structure, Population status, Resource Assessment, Threat
Taxa: Taxus baccata subsp. wallichiana
Plant Group: Medicinal and aromatic plants
Countries: India
Part Used: Leaf


Descriptors: Harvest Impact, Resource Assessment
Taxa: Allium tricoccum
Plant Group: Medicinal and aromatic plants
Countries: United States
Part Used: Herb, Stem
Characteristics: Perennial spring ephemeral herb in eastern North American temperate hardwood forest.

Objectives: To determine the impact of harvesting, at varying levels, on populations in the Park. To determine the impact of different harvest techniques on populations. To predict the number of years required for populations to regain pre-harvest levels after a single harvest.

Type of study: Impact study. Experimental harvest

Scale: Reserve -Great Smoky Mountains National Park

Participants: National Park staff

Protocol: Harvesting level: 3 sites selected on ease of access, abundance (at least 15 m² with (20 plants m⁻²) and not regularly harvested). 15 1x1m plots (3 replicates of 5 treatments) in a non-linear arrangement at each site. Maximum leaf width of largest plant of each plant in plot measured (leaf width = bulb size). 5 harvesting treatments: control, 25, 50, 75 & 100% harvesting. Plants harvested without bias using traditional methods. Leaf widths and flower/fruit production of remaining plants and recruits measured for 4 years post-harvest without further harvesting. Harvest technique: 3 replicates of 3 0.5x0.5m plots established at one site. Plants harvested using three methods; control, complete removal and partial removal of plants. All plants too small to have been harvested removed from plots to avoid counting as regeneration in subsequent years.

Analysis: Harvest level: Analysis of covariance used to test for differences between harvesting levels, changes over time and between site differences. Leaf totals per plot used in plot comparisons. Harvest technique: Not analysed because of loss of replicate due to windblow of tree onto plots.


Descriptors: Case Study, Regeneration, Resource Assessment, Sustainable Yield Calculation

Taxa: Allium tricoccum

Countries: United States

Part Used: Bulb


Descriptors: Resource Assessment, Resource Management Policies

[7788]


Descriptors: Method Manual, Resource Assessment

[7697]


Descriptors: Resource Assessment

[7747]


Descriptors: Case Study, Resource Assessment

Taxa: Phytelephas aequatorialis

Plant Group: Palms

Countries: Ecuador

Part Used: Seed

[7627]

Additional descriptors from Wong (2000):

Characteristics: Large, single-stemmed palm that forms small monotypic stands.

Objectives: Impact of tagua nut extraction on growth, reproduction and sustainability under three management regimes.

Type of study: Demographic

Scale: Comuna Rio Santiago-Cayapas Research.

Participants: Researchers with management/ seed collection by locals

Protocol: Subjective plot location in three management regimes stratified by inundation. 20x30 m plots - all trees mapped and tallied into age classes (juvenile, sub-adult & adult). Enumerated adult density, distribution, sex, stem height, light exposure, foliage cover, number of living, cut and dead leaves, inflorescences, infructescences and health every 3 mths for 1 yr. Leaf, flower and fruit maturation monitored by painting emergent frond/fruit. Seed production estimated using mark/recapture during collection supplemented by count of those left behind.

Analysis: Individual growth model (POMIB) using size-specific growth and survivorship General Linear Models for leaf and seed production with management, inundation, age and light level.

Forest inventory data were collected in 1998-2000 from fifteen 1 ha permanent plots along a disturbance gradient in a dry tropical forest region of India. A total of 4033 stems, 49 species, 44 genera and 24 families of adult trees (>= 30 cm CBH), occurred in the 15 ha of forest area. The study indicated that the dry tropical forest is characterised by a patchy distribution of species and individuals with mixed species composition, and the sites are represented by different combinations of the dominants and co-dominant species. A PCA ordination indicated that the variation in species composition of the sites is explained by the variation in soil nitrogen as well as the degree of disturbance. About half the analysed species showed changing nature in dispersion along the disturbance gradient. The distribution of Boswellia serrata, Holarrhena antidysenterica and Lannea coromandelica changed from clumped to uniform and the distribution of Butea monosperma, Cassia fistula and Elaeodendron glaucum changed from uniform to clumped as the degree of disturbance increased. The mean stem density was highest (419 stems ha-1) at the least disturbed site and lowest (35 stems ha-1) at the highest value (13.78 m2 ha-1) was for the second least disturbed forest site and the lowest value (1.30 m2 ha-1) was for the most disturbed site. The total number of stems, indices of species richness, evenness and α-diversity decreased with disturbance. A strong influence of number of species per individual on β-diversity suggests that for resisting change in floristics due to disturbance, a site must have low species-individual ratio. (CABI-RAMP, 20033203546).


Goldenseal, Hydrastis canadensis, is a herbaceous understorey plant of the eastern deciduous forest that is harvested from natural populations due to its medicinal value. The objectives of this study were to determine if regrowth from harvest varies between patches and to relate regrowth to preharvest leaf and patch size. We used data from 3 experimentally harvested natural patches and data on recovery of an illegally harvested patch harvested at the end of
We found variation in patch regrowth which suggests that harvest technique and timing may be important. Experimental rhizome removal during mid-summer resulted in a slower recovery of leaf size relative to the patch that was illegally harvested. Leaf area decreased 2 years after harvesting. We also found variation in stem count between patches in response to harvest, which may be due to the preharvest size of ramets. The patch with larger preharvest ramets showed compensatory growth in the year immediately after harvest while the patches comprised of smaller ramets did not. Our results indicate that response to, and recovery from, harvest varies between patches and that individual ramet leaf size may be a better predictor of patch recovery than stem count. Because regrowth may be affected by harvest timing, an established harvest season may alleviate some harvest pressure on H. canadensis. (CABI-RAMP, 20053038831).


The expanding market for herbal remedies has stimulated increased harvest of goldenseal (H. canadensis) from the wild. We examined net population change of H. canadensis over 26 years in Bryan Nature Preserve, central Indiana, USA. Individuals were mapped and censused in 0.1 ha quadrats over the entire preserve, repeating a similar procedure carried out by others in 1974. The net trajectory of abundance was negative: H. canadensis was present in 46 quadrats in 1974, but had become extinct in 31 of those quadrats and decreased in 15; three quadrats contained new patches. Only 10 of the 99 patches present in 1974 were relocated. Fifteen new patches were found in 2000. The total number of quadrats with H. canadensis declined between the two censuses. The number of quadrats in which the abundance trajectory was positive between the two time periods was significantly less than the number showing a negative trajectory. Patches in edge quadrats had higher survival than those in the interior. Extinction probability was not dependent on population size. There is no known cause of the decline in H. canadensis in the preserve, although one possibility is the damage from a severe wind and ice storm that occurred in February 1991. Harvest history is unknown, although recent harvest was not evident. Periodic recensusing of this preserve is needed to understand the causes of H. canadensis decline. (CABI-RAMP, 20023064707).


Shackleton, C.M. (1993): Demography and dynamics of the dominant woody species in a communal and protected...
The paper defines the term "ecological damage" on the basis of existing approaches. The definition relates to specified objects/targets of nature conservation and argues that damages are not simply changes in the ecosystem but substantial impacts on the objects of nature conservation. One key distinction is that an ecological impact on the ecosystem can be measured with scientific methods, to call it a damage, however, is a man-made assessment. (schp, 8.8.2006).


This is the third of a series of three papers. It focusses on Phyllanthus emblica which has 496,6 tons of fruit sold by cooperative societies. They show that 60-80% of all fruits in the local P. emblica population are currently harvested, and that this may have a negative effect on recruitment of new trees into the population. Together, these three papers are important reading - particularly for those northern NGO's which have glamorised NFTP collection in terms of effort, returns or ecological impacts. (A.B. Cunningham, 6.2.1997).


**List of References**

Additional descriptors from Wong (2000):
- Characteristics: Indigenous shrubs & fungi in native forests and timber plantations.
- Objectives: Pilot figures demonstrating the national importance of NTFPs.
- Type of study: Household survey
- Scale: National - 4 surveys 1994-7
- Participants: Researchers (University)
- Protocol: Sample of national population stratified on sex, age (> 15 years), education, profession, household size and district/region population density. 1994 n=856 households, 1995 n=991, 1996 n=1451. Main questions: number of forest visits per year, main purpose of visits, visiting costs, (estimated) weights (kgs) collected of berries and mushrooms, costs of collection, market prices, willingness to pay for forest visit.


- Descriptors: Resource Assessment
- Taxa: Gnetum africanum, Gnetum buchholzianum
- Plant Group: Medicinal and aromatic plants
- Part Used: Leaf


- Descriptors: Resource Assessment, Sampling Techniques


- Descriptors: Abundance & Rarity, Resource Assessment
- Taxa: Desmoncus orthacanthos
- Plant Group: Palms
- Countries: Belize


- Descriptors: Demography & Population Structure, Harvest Impact, Resource Assessment, Sustainable Yield Calculation
- Taxa: Calamus zollingeri
- Plant Group: Palms
- Countries: Indonesia


- Descriptors: Resource Assessment, Sampling Techniques
- Countries: Brazil


- Descriptors: Ecology, Reproduction, Resource Assessment
- Taxa: Hydrastis canadensis
- Plant Group: Medicinal and aromatic plants
- Countries: Canada


Goldenseal (Hydrastis canadensis) is a North American perennial clonal herb highly prized for its medicinal value. It is...
threatened at the northern range limit with only 20 populations known in Canada. To assist recovery planning, 13 populations were sampled to model dynamics. The fate of all ramets in one square meter was monitored from 1998 to 2001 in Ontario, Canada. Transition matrices were built for 2000-2001, using 3-stage classes based on size and reproductive status. A 6-stage pooled matrix, separating established ramets from newly produced ramets, was also constructed. Recruitment by seed was not observed and therefore excluded. The average population growth rate ($\lambda$) was 1.062 plus or minus 0.053, which did not significantly differ from the equilibrium value (1.0) suggesting that the northern population is stationary. However, growth rates among population samples varied largely and had wide confidence intervals. Populations with $\lambda$-values less than or close to 1.0 require environmental change to increase. Recovery of goldenseal, and possibly other woodland perennials at risk, requires intervention aimed at population size augmentation, habitat optimization, and targeted dispersal. (CABI-RAMP, 20053051467).

### List of References


**Descriptors:** Resource Assessment

**Taxa:** Phyllanthus emblica, Phyllanthus indofischeri

**Plant Group:** Trees

**Countries:** India

**Part Used:** Fruit


**Descriptors:** Non-wood forest products, Resource Assessment

**Taxa:** Phyllanthus emblica, Phyllanthus indofischeri

**Plant Group:** Trees

**Countries:** India

**Part Used:** Fruit


**Descriptors:** Resource Assessment, Statistics


In the second part of their study the authors assess the impact of agarwood or gaharu harvesting on populations of A. malaccensis and A. microcarpa in ID and the sustainability of the current harvesting levels. This was achieved by observing and measuring the harvesting activities of gaharu collectors by accompanying them on collecting trips. The quantity of gaharu obtained from felling was very low, 100-180 g per tree for the high grade gaharu. Combining these yield and overall trade figures the authors estimate that 30-100,000 trees per year are felled. The matrix model approaches used showed that A. malaccensis populations will decline if trees with a dbh of <10cm are harvested. A. microcarpa populations are only safe if trees >30cm dbh are used. (schp, 22.5.2001).

**Descriptors:** Collection, Resource Assessment

**Taxa:** Aquilaria malaccensis, Aquilaria microcarpa

**Plant Group:** Medicinal and aromatic plants

**Countries:** Indonesia

**Part Used:** Wood


One rarely finds papers which primarilary focus on research of the conservation status of species threatened by over-utilization. Therefore this study is most welcome, especially in the context of additional CITES listings. Presently only A. malaccensis is on Appendix II. 6 Aquilaria species occur in ID. The annual export trade value from ID is estimated at US$ 6 million. The authors found population concentrations in Sumatra and eastern Kalimantan. Analysis of national forest inventory data indicated that population densities are low (<1.2 individuals / ha). Continuous recruitment was found in some areas but also a general absence of larger trees. All Aquilaria species in Indonesia are assessed as...
Vulnerable according to the IUCN threat categories. (schp, 27.10.2000).

Descriptors: Distribution, Map, Population status, Resource Assessment

Taxa: Aquilaria beccariana, Aquilaria cumingiana, Aquilaria filaria, Aquilaria hirta, Aquilaria malaccensis, Aquilaria microcarpa

Plant Group: Medicinal and aromatic plants

Countries: Indonesia

Part Used: Wood


Descriptors: Resource Assessment

Plant Group: Medicinal and aromatic plants

[2568]


Descriptors: Resource Assessment

[2570]


Descriptors: Resource Assessment

[7670]


Descriptors: Resource Assessment, Sampling Techniques

[7748]


Descriptors: Resource Assessment

[8001]


The paper begins by identifying the similarities and differences between timber tree and rattan inventories. In the latter, the measuring of length is most important, not diameter. Many rattans form clusters and inventories therefore count clusters as well as stems in clusters. Wild rattans are mostly harvested by people living close to the resource and they can be their major source of income. The author summarizes several good reasons why resource managers should attempt to involve local people in rattan inventory and to think of ways in which the skills and knowledge of both researchers and local people can be used. However, these methods based on local knowledge need to be cross-checked for accuracy. The author calls for a more standardized sampling design to improve comparison of studies. Sampling design should always be chosen in the light of the four criteria: accuracy, precision, cost efficiency, and simplicity. The paper compares the existing rattan studies in the light of stratification, the role of remote sensing, point vs. plot sampling, and systematic vs. random sampling. Re the latter, the author concludes that systematic sampling is more cost effective than random sampling. (schp, 24.7.2006).

Descriptors: Resource Assessment

Plant Group: Palms

[7640 !!]


How to inventory a resource population: "A resource inventory estimates the quantity of a NTFP resource population in a specified area. It estimates both density (i.e. the number of resources per unit area) and abundance (i.e. the total
Sampling design has to consider accuracy, cost efficiency and simplicity: Random vs. systematic sampling; stratification; plot size, plot shape, sampling intensity. How to study yield: "A yield study estimates the average yield, or the average amount of NTFP, collected from a resource in one harvest using specified harvesting practices. Harvested yield is the amount normally harvested in one harvest, potential yield is the amount that is possible to harvest if the plant is harvested as completely as possible." How to study recovery time: "A recovery time study determines the average time a NTFP plant resource needs to recover (if weakened or injured by non-destructive harvest of exudates, leaves, bark or roots), resprout (if resprouting after non-destructive harvest of stems or apical buds) or regrow (if reseeding after destructive harvest) after being harvested using specified harvesting practices." "Ideally, the recovery time should be long enough to ensure that the plant is in good health and is able to reproduce successfully before it is harvested again". "Recovery time studies are needed for all plants that are harvested for their vegetative structures (e.g. exudates, leaves, bark, roots, stems, apical buds or whole plants) whether non-destructively or destructively. Recovery time studies are not needed for plants harvested for their reproductive propagules (e.g. flowers, fruits or seeds), because this does not usually weaken, injure, reduce or destroy the plant." How to study regeneration: "A regeneration study quantifies the amount of regeneration that is present in a plant resource population at a given moment in time. It estimates both density (i.e. the number of plants per unit area) and abundance (i.e. the total number of plants in a specified area). " How to study demography: "A demography study looks how the population structure, or the distribution of individuals across life cycle stages, changes over time. "A demographic study estimates each life cycle stage's probability, over a given time period, of surviving, and if surviving, of growing up to the next stage or remaining within the same stage. For reproductively mature life cycle stages, also the average number of seeds produced by each stage is estimated. " (schp, 27.1.2007).


Descriptors: Participation & Traditional Knowledge, Resource Assessment
Plant Group: Medicinal and aromatic plants


Descriptors: Case Study, Collection, Demography & Population Structure, Resource Assessment
Taxa: Hyphaene petersiana
Plant Group: Palms
Countries: Namibia
Part Used: Fruit, Seed

Additional descriptors from Wong (2000):
Characteristics: Multi-stemmed palm common and abundant in palm savanna.
Objectives: Assess status of populations in selected areas. (1) Derive an understanding of the impact of utilisation on population structure. (2) Make predictions of possible population changes due to heavy exploitation. (3) Assess impact of human and livestock density.
Type of study: Impact study
Scale: Local - Onayena & likeke areas, north-central Namibia
Participants: Researchers
Protocol: Systematic cluster sampling of 100x100 m quadrats placed systematically in lines of 2-3 at 100 m intervals. Each transect was situated approx. 1 km apart on two sites chosen to represent high and low human and livestock densities. 10 quadrats enumerated from each site with 2 from Forestry Dept. exclusion zone (recent regeneration). Enumeration: signs of utilisation, height, basal diameter, clump size, gender, numbers of stems per quadrat.
Analysis: Comparison between sites and with other studies using percent occurrence. ANOVA tests on height and basal diameter between sites. Stand curves in height size classes by gender. Frequency distribution of clump size.


The bark of yohimbe is used to treat male organic impotence and is exploited in large quantities for local and export markets. The demand is generating considerable over-exploitation and local scarcity. Concerned over future supplies, Boehinger Ingelheim, a German pharmaceutical company, commissioned ICRAF to undertake a pilot study. The report covers the following fields: natural distribution, population structure, reproduction biology, current commercial bark exploitation practices in Cameroon, impacts of exploitation, confusion between P. johimbe and P. macroceras, and potential for domestication. It remains to be seen which effect the marketing of Viagra has on the future demand for yohimbe. (schp, 24.5.2001).

Descriptors: Cultivation, Exploitation, Identification, Non-wood forest products, Resource Assessment, Use
Taxa: Pausinystalia johimbe, Pausinystalia macroceras
Plant Group: Medicinal and aromatic plants
Countries: Cameroon, Equatorial Guinea
Part Used: Bark


Descriptors: Resource Assessment, Sampling Techniques


Descriptors: Resource Assessment
Taxa: Genoma macrostachya
Part Used: Leaf

**Descriptors:** Resource Assessment, Sampling Techniques

**Plant Group:** Palms

**Countries:** Philippines

**Additional descriptors from Wong (2000):**

- **Characteristics:** Climbing palms occurring in dense thickets.
- **Objectives:** Determination of an efficient sampling technique for low-cost 'good' estimates. Dispersion, distribution and total counts.
- **Type of study:** Inventory methodology
- **Scale:** Research site 1 ha, Bayugan
- **Participants:** Researchers
- **Protocol:** All rattans (seedlings and mature) counted and mapped within a 1ha plot. Within large plot 5x5m grid =400 quadrats. Records made of: a) average time to travel 10m between plots, b) average time to count rattans within a plot, c) diameter and total commercial length of rattan (of cut culms). 9 plot sizes and shapes (assembled from 5x5m quadrats) tested. Study repeated at second location for verification of conclusions.
- **Analysis:** Plot efficiency determined as SE per 3 hour cruise (best=10x10m plots). Fit of binomial, poisson and negative binomial to density distribution of rattan (best=-ve binomial).


**Descriptors:** Resource Assessment, Sampling Techniques

**Plant Group:** Palms


**Descriptors:** Non-wood forest products, Resource Assessment


Despite growing concern over the conservation of NTFP species, information on the ecological implications of harvest is available only in disparate case studies. In this review 70 studies that quantify the ecological effects of harvesting NTFP from plant species were reviewed, with the aims of assessing the current state of knowledge and drawing lessons that can provide guidelines for management as well as better directing future ecological research in this area. The review showed that NTFP collection can affect ecological processes from individual and population to community and ecosystem level. The majority of research, however, was found to be focused at the population level. The authors conclude that there is a need for longer-term studies that focus on ecological levels ranging from genes to ecosystems and that assess the mechanisms underlying impacts. They urge researchers and forest managers to work with local harvesters in designing and evaluating management practices that can mitigate the negative effects of harvest. (schp, 29.7.2006).

**Descriptors:** Non-wood forest products, Resource Assessment


**Descriptors:** Resource Assessment

As in [6854], the authors present results from their studies on Achmea magdalenae harvest in SE Mexico. The population dynamics of this understory bromeliad was compared between old-growth and secondary rainforests. Population projections using annual transition matrices show that secondary forest populations have finite rates of growth significantly higher than those of old-growth populations, under both ramet harvest and no-harvest conditions. (schp, 29.7.2006).

Descriptors: Case Study, Harvest Impact, Resource Assessment
Taxa: Achmea magdalenae
Countries: Mexico
Part Used: Leaf


Descriptors: Demography & Population Structure, Harvest Impact, Resource Assessment
Taxa: Microlepia strigosa, Sphenomeris chinensis
Plant Group: Ferns
Countries: United States
Part Used: Leaf


Achmea magdalenae is a clonal understory bromeliad harvested from the buffer zone of the Las Tuxtlas Biosphere Reserve in Veracruz, Mexico. The strong, silky fiber extracted from the leaves is used for embroidering. The ramets are also harvested as vegetative propagules for use in forest cultivation programmes.

The authors name three basic requirements to protect NTFPs from overharvesting: (1) the identification of optimal harvest regimes; (2) the accurate estimation of maximum harvest limits; and (3) the implementation of those limits among local harvesters. To determine the maximum sustainable harvest rates, they used a combination of participatory research techniques and demographic modelling. Three types of variation on maximum harvest rates were examined: variation between forest types, between harvest regimes, and over time.

Results: Maximum harvest rates were much higher from secondary forest populations than from primary forest. Populations concurrently harvested for leaves and ramets had higher maximum sustainable levels of ramet harvest than those harvested for ramets only. Participation of local harvesters in the research process enabled them to accept the harvest limits determined, to switch to a more sustainable harvest regime, and to pass a local law to protect the remaining primary forest because of its potential as A. magdalenae habitat. (schp, 29.7.2006).

Descriptors: Case Study, Harvest Impact, Resource Assessment, Sustainable Yield Calculation
Taxa: Achmea magdalenae
Countries: Mexico
Part Used: Leaf


Descriptors: Resource Assessment
Countries: United States


Descriptors: Rapid Assessment, Resource Assessment
Plant Group: Medicinal and aromatic plants


United Nations Industrial Developement Organization (s.dat.): Medicinal and aromatic plants. Importance, cultivation, analysis and industrial processing. - § pp., Unpublished draft report, §.


Additional descriptors from Wong (2000):

Characteristics: Natural clumps.

Objectives: To determine the effects of thinning, cutting age and felling cycle on the variation of clump productivity and harvest cut.

Type of study: Experimental harvests

Scale: Research -natural stands in Ilocos Norte.

Participants: Researchers

Protocol: 54 clumps randomly assigned to treatments in a 3x3x2 factorial design (thinning, cutting & felling cycle) with 3 replicates. Treatments: (1) Thinning regimes: 6 clumps in each replicate treated with a range of thinning intensities: heavy= in 2nd yr of experiment all culms cut except those <= 1 yr old, moderate =in 3rd yr all culms cut except those <=2 yrs old, light =in 4th yr all culms cut. (2) Culm cutting age: culms cut at 3, 4 or 5 yrs of age. (3) Felling cycle: culms harvested every yr or every 2 years. Treatments carried on for 10 years (1979-1989).

Analysis: Three main analyses: (1) Preparation of clumps for management (thinning) - Analysis of covariance. (2) Yearly assessment of culm sustainability - data for last 6 years of study. ANOVA (3) Overall yields and culm sustainability - ANOVA. Results indicate that optimal harvesting pattern is to cut 3 yr old culms on a 2 year felling cycle with moderate initial thinning of mature culms in the natural clumps.

The authors have prepared and present standardized medicinal plant inventories for various sites within the Rila National Park and they give recommendations for improved management of the investigated areas. For each site the medicinal plants with economic importance have been assessed regarding the quantity of the resource in kg for the given area. (schp, 15.2.2003).


When long-term, intense levels of harvest nearly extirpated Chinese ginseng (Panax ginseng C. Meyer) in the early 18th century, commercial harvest of American ginseng (P. quinquefolius L.) began and large quantities of the roots were exported to East Asia. Annual export figures have fallen over the past 200 years, but demand for wild American ginseng has not abated. Persistent harvest of long-lived, slow-maturing species can have negative impacts on population growth rates, yet those closest to wild resources are often in a position to be the best stewards of that resource. This study explored the consequences of different harvester behaviors on the population dynamics of American ginseng. Drawing on known behaviors, we developed three harvester types and ran demographic simulations on wild ginseng populations, partitioning the sources of differences in population growth rates using a life table response experiment (LTRE). The simulations showed that ignoring size class limits and harvest season onset dates dramatically affected population growth rates. Existing laws in many states are not adequate to protect wild ginseng populations. A stewardship-oriented harvester, who delays harvest onset by two weeks, self-limits harvest intensity and plants ginseng seeds at the time of harvest can reverse declining population growth rates. (CABI-RAMP, 20063123257).
Goldenseal (H. canadensis) and American ginseng (P. quinquefolius) have been harvested commercially for the past few centuries. Harvested populations can recover if vegetative propagules remain in the soil. Experiment I tested the efficacy of vegetative reproduction in goldenseal and ginseng. Partial and intact rhizomes and roots of goldenseal and ginseng were planted in garden experiments in West Virginia (USA) in 1995 and 1996, respectively. Goldenseal was monitored for one year (1996) and ginseng for 4 years (1997, 1998, 1999 and 2000). During the experiment, more than 40% of the propague types of goldenseal (n=5) and ginseng (n=7) sprouted. Sprouting varied from year to year in ginseng, and dormancy and/or death occurred in both species. Of the ginseng propagules that sprouted, 77% were dormant for at least one year and half of those were not present in the final year of the experiment. Sprouting and reproductive status were dependent on propague type for both species. In Experiment II, we monitored recovery of wild populations of goldenseal and ginseng following natural and simulated harvests. After a harvest leaving only 4 visible plants at the site, a goldenseal population recovered to 932 stems in the first growing season. In the subsequent 3 years, the population declined numerically, but the size of individuals increased significantly. In a harvested ginseng population, less than half the original number of ginseng plants were present one year after harvest. By the second year, stem number exceeded the preharvest count, but the demographic structure of the population had changed dramatically. Before harvest, reproductive plants accounted for 78% of the population. There were no reproductive plants in the year immediately following harvest. In years 2, 3, 4 and 5 postharvest, 4, 7, 18 and 26% of the genets were reproductive, respectively. Both rhizomes and roots of goldenseal and ginseng were capable of regenerating plants, conferring a degree of short term resiliency following harvest. (CABI-RAMP, 20033065485).


Both Pelargonium sidoides and P. reniforme are endemic to South Africa. Both plants have red tubers that are harvested for medicinal purposes. Large quantities are collected and exported for a growing market. Some estimates are as high as 50,000 kg of tubers annually. It appears that only P. sidoides contains the active compound, but both species are obviously in demand. When not in flower, the two species are impossible to identify accurately which may lead to indiscriminate collection. P. reniforme appears to be far more locally abundant than P. sidoides. Most of the trade in the plants is illegal since only very few permits have been granted. A study in 30 plots of harvested and unharvested populations was carried out to discover the impacts of harvesting on total biomass and to discover a measure of the aboveground parts of the plant that may give an indication of the size of the tubers. However, the paper presents no details on the methodology and little on the results and therefore remains superficial. No references are cited. (schp, 27.1.2007).


Species richness, or the number of species in a sample of a specified size, is an instantly comprehensible expression of species diversity. Biologists often need to know how many species there are within an area or, they need to compare the number of species found in different areas. Complete enumeration of species richness within an extensive study area is, however, generally not feasible and consequently a number of different methods for estimating total species richness from a sample have been devised. The challenge is to know how complete the plant inventories are, i.e. how many more species would have been documented with increased sampling effort? Furthermore, how does a researcher objectively decide on the level of sampling effort required to satisfactorily complete a survey or draw conclusions on the adequacy of the effort already executed?

Traditionally, species accumulation functions have been used for plotting species versus sampling effort to estimate visually whether a curve has asymptotically approached some ceiling (and hence whether sampling has been sufficient), as well as estimate the total richness of a site. While the methods for estimating species richness have been applied to the approximate assessment of species richness in faunal and floral groupings at comparative sites, the benefits of such an approach to applied quantitative ethnobotany have yet to be fully explored.

Prediction of the species richness of a sample and the use of species accumulation functions have been addressed little in applied ethnobotany. In this paper, incidence-based (= based on presence/absence data) species richness estimators, species accumulation curves and similarity measures are used to compare and predict species richness, evaluate sampling effort and compare the similarity of species inventories for ethnobotanical data sets derived from the


Yang QingSong, Chen ShaoTian & Zhou ZheKun (2003): [Protection and sustainable utilization of traditional Tibetan
The status of snow lotuses (Saussurea spp.) in Yunnan, China was investigated. There are 22 snow lotuses and one variety in the area. Among these, 5 species are being used as medicine and traded. Around 55000 snow lotuses are traded on markets per year. The number of these is reduced noticeably, particularly those of biennial snow lotuses. Three suggestions on the protection and sustainable utilization of these plants were proposed. Local people are being educated and a quota was set on the collection of snow lotuses. Annual lotus can be collected after September, when seeds of plants have been dispersed. Biennial lotus collection should be banned. (CABI-RAMP, 20033137742).

Descriptors: Population dynamics, Population status, Resource Assessment
Taxa: Saussurea spp.
Plant Group: Medicinal and aromatic plants
Countries: China


Descriptors: Resource Assessment


Descriptors: Demography & Population Structure, Reproduction, Resource Assessment
Taxa: Bertholletia excelsa
Plant Group: Medicinal and aromatic plants
Countries: Bolivia
Part Used: Fruit
2.1 Descriptors

References are listed in an abbreviated form. For a full citation refer to chapter 1.

Abundance & Rarity


Lawrence, D.C., Leighton, M. & Peart, D.R. (1995): Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.


Schwartz, M.W. (1993): The search for pattern among rare plants. Are primitive species more likely to be rare?.


Biomass Production & Yields


Belonogova, T.V. (1988): Yield forecasting and optimization of berry harvesting in the forests of Southern Karelia, USSR.
<table>
<thead>
<tr>
<th>Descriptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cherkasov, A.Ph. (1988): The cranberry yield in the USSR.</td>
</tr>
<tr>
<td>Kuchko, A.A. (1988): Bilberry and cowberry yields and the factors controlling them in the forests of Karelia, USSR.</td>
</tr>
<tr>
<td>Lieth, H. (1975): Primary production of the major vegetation units of the world.</td>
</tr>
</tbody>
</table>

**Case Study**


Clark-Tapia, R., Mandujano, M.C., Valverde, T., Mendoza, A. & Molina-Freaner, F. (2005): How important is clonal recruitment for population maintenance in rare plant species? The case of the narrow endemic cactus, Stenocereus eruca, in Baja California, Mexico.


<table>
<thead>
<tr>
<th>Authors</th>
<th>Title and Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geldenhuys, C.J. (2004):</td>
<td>Meeting the demand for Ocotea bullata bark. Implications for the conservation of high-value and medicinal tree species.</td>
</tr>
<tr>
<td>Lawrence, D.C., Leighton, M. &amp; Peart, D.R. (1995):</td>
<td>Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.</td>
</tr>
<tr>
<td>Mi Yoon Chung, Nason, J.D. &amp; Myong Gi Chung (2004):</td>
<td>Implications of clonal structure for effective population size and genetic drift in rare terrestrial orchid, Cremastra appendiculata.</td>
</tr>
<tr>
<td>Rijsoort, J.van &amp; Zhang Jinfeng (2005):</td>
<td>Participatory resource monitoring as a means for promoting social change in Yunnan, China.</td>
</tr>
</tbody>
</table>


Gill, G.J. (1993): OK, the data's lousy but its all we've got (being a critique of conventional methods).


Fashing, P.J. (2004): Mortality trends in the African cherry (Prunus africana) and the implication for colobus monkeys (Colobus guereza) in Kakamega Forest, Kenya.


Descriptores


**Ecological Damage**


**Ecological Functions**

Pate, J.S., Meney, K.A. & Dixon, K.W. (1991): Contrasting growth and morphological characteristics of fire-sensitive (obligate seeder) and fire-resistant (resprouter) species of Restionaceae (S. Hemisphere Restiads) from south-western Australia.

**Genetic Variability**

Mi Yoon Chung, Nason, J.D. & Myong Gi Chung (2004): Implications of clonal structure for effective population size and genetic drift in rare terrestrial orchid, Cremastra appendiculata.

**Harvest Impact**

Descriptors


Geldenhuys, C.J. (2004): Meeting the demand for Ocotea bullata bark. Implications for the conservation of high-value and medicinal tree species.


Virtucio, F.D. & Tomboc, C.C. (1994): Effect of thinning, cutting age and felling cycle on culm yield of Buho (Schizostachyum lumampao) natural stands.


Life Form


Method Manual


Descriptors


Participation & Traditional Knowledge

Geldenhuys, C.J. (2004): Bark harvesting for traditional medicine. From illegal resource degradation to participatory management.
Lawrence, A. (): "No personal motive?" Volunteers, biodiversity, and the false dichotomies of participation.
Lawrence, A. & Román, F.S. (1996): The role of inventory in the communally managed forests of Quinata Roo, Mexico.
Rijsoort, J.van & Zhang Jinfeng (2005): Participatory resource monitoring as a means for promoting social change in Yunnan, China.

**Population Viability Analysis**

Descriptors


Rapid Assessment


Regeneration


Fashing, P.J. (2004): Mortality trends in the African cherry (Prunus africana) and the implication for colobus monkeys (Colobus guereza) in Kakamega Forest, Kenya.


Manipula, B.M., Gianan, N. So. & Virtucio, F.D. (1996): Culm removal effect on culm yield and biomass productivity of laak (Bambusa sp. 2) in flatland and hillyland sites in Pandangan, Tagum, Davao del Norte.


## Descriptors

<table>
<thead>
<tr>
<th>Authors</th>
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<tr>
<td>Pate, J.S., Froend, R.H., Bowen, B.J., Hansen, A. &amp; Kuo, J. (1990)</td>
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<td>Pate, J.S., Meney, K.A. &amp; Dixon, K.W. (1991)</td>
<td>Contrasting growth and morphological characteristics of fire-sensitive (obligate seeder) and fire-resistant (resprouter) species of Restionaceae (S. Hemisphere Restiads) from south-western Australia.</td>
</tr>
</tbody>
</table>

## Reproduction

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
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<tr>
<td>Männi, R. (1988)</td>
<td>Biology and berry production of the cowberry in Estonian SSR.</td>
</tr>
<tr>
<td>Pate, J.S., Froend, R.H., Bowen, B.J., Hansen, A. &amp; Kuo, J. (1990)</td>
<td>Seedling growth and storage and characteristics of seeder and resprouter species of Mediterranean-type ecosystems of south-western Australia.</td>
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</table>
**Descriptors**

Pate, J.S., Meney, K.A. & Dixon, K.W. (1991): Contrasting growth and morphological characteristics of fire-sensitive (obligate seeder) and fire-resistant (resprouter) species of Restionaceae (S. Hemisphere Restiads) from south-western Australia.


**Resource Management Policies**


**Resource Management Procedures & Approaches**

Geldenhuys, C.J. (2004): Bark harvesting for traditional medicine. From illegal resource degradation to participatory management.


Peters, C.M. (1996): The ecology and management of non-timber forest resources.


**Sampling Techniques**


Brown, J.A. (s.dat.): The application of adaptive cluster sampling to ecological studies.

Descriptive tags:

- Chhikara, R.S. (s.dat.): Efficient sampling designs for estimating ecological resources.
- Silva, J.A.A. da & Vasconcelos, A.J.N. de (1996): Application of the relative efficiency methodology to select plot area and shape in forest inventories of the caatinga of Pernambuco-Brazil.
Descriptors


Species Richness


Statistics

Jessen, R.J. (1955): Determining the fruit count on a tree by randomized branch sampling.

Sustainable Yield Calculation

Descriptive Terms


Taxonomic Aspects

Schwartz, M.W. (1993): The search for pattern among rare plants. Are primitive species more likely to be rare?
2.2 Plant Species

References are listed in an abbreviated form. For a full citation refer to chapter 1.

**Acacia nilotica**

**Adansonia digitata**

**Aechmea magdalenae**

**Alchemilla vulgaris**

**Allium tricoccum**

**Aloe dichotoma**

**Aloe pillansii**

**Ancistrocladus korupensis**

**Aquilaria beccariana**

**Aquilaria cumingiana**

**Aquilaria filaria**
Aquilaria hirta

Aquilaria malaccensis

Aquilaria microcarpa

Arctostaphylos uva-ursi

Arnica montana

Astrocaryum mexicanum

Banksia hookeriana

Beaucarnea gracilis

Berchemia discolor

Bertholletia excelsa

**Betonica officinalis**


**Bombax ceiba**


**Boswellia papyrifera**


**Boswellia serrata**


**Brosimum alicastrum**


**Calamus poilanei**


**Calamus zollingeri**


**Carex arenaria**


**Cercis canadensis**


**Cetraria islandica**


**Chamaedorea radicialis**


**Chamaedorea tepejilote**


**Cimicifuga racemosa**


**Cinnamomum mollissimum**

**Coccothrinax readii**

**Combretum micranthum**

**Cremasandra appendiculata**
Mi Yoon Chung, Nason, J.D. & Myong Gi Chung (2004): Implications of clonal structure for effective population size and genetic drift in rare terrestrial orchid, Cremasandra appendiculata.

**Cyathea hornei**

**Desmoncus orthacanthos**

**Desmoncus polyacanthos**

**Dicholostemma capitatum**

**Diploknema butyracea**

**Durio spp.**
Lawrence, D.C., Leighton, M. & Peart, D.R. (1995): Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.

**Echinacea laevigata**

**Encephalartos cycadifolius**

**Encephalartos spp.**

**Encephalartos villosus**
### Plant Species

**Eusideroxylon zwageri**

Lawrence, D.C., Leighton, M. & Peart, D.R. (1995): Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.

**Euterpe oleracea**


**Frangula alnus**


**Garcinia lucida**


**Genoma macrostachya**


**Geonoma congesta**


**Geonoma deversa**


**Gnetum africanum**


**Gnetum buchholzianum**


**Grias peruviana**


**Harpagophytum procumbens**


Mpho Mosate (): Natural resource monitoring concepts and tools of veld products research and development.

**Heteropsis flexuosa**


**Hevea brasiliensis**

Lawrence, D.C., Leighton, M. & Peart, D.R. (1995): Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.
Hippophae rhamnoides

Hydrastis canadensis

Hyphaene coriacea

Hyphaene petersiana

Iriartea deltoidea
Pinard, M. (1993): Impacts of stem harvesting on populations of Iriartea deltoidea (Palmae) in an extractive reserve in Acre, Brazil.

Ischnosiphon polyphyllus

Leptopteris wilkesiana

Livistona rotundifolia
**Magnolia dealbata**

**Matteuccia struthiopteris**

**Microcycas calocoma**

**Microlepia strigosa**

**Myrciaria dubia**

**Myrica esculenta**

**Nardostachys grandiflora**

**Nardostachys jatamansi**

**Neodypsis decaryi**

**Neopicrorhiza scrophulariiflora**

**Nypa fruticans**

**Ocotea bullata**
Geldenhuys, C.J. (2004): Meeting the demand for Ocotea bullata bark. Implications for the conservation of high-value and medicinal tree species.
Geldenhuys, C.J. (2004): Bark harvesting for traditional medicine. From illegal resource degradation to participatory management.
**Pachypodium namaquanum**

**Panax quinquefolius**

**Panax spp.**

**Pausinystalia johimbe**

**Pausinystalia macroceras**

**Pedicularis furbishiae**

**Pelargonium reniforme**

**Pelargonium sidoides**

**Phoenix reclinata**

**Phyllanthus emblica**
**Plant Species**


**Phyllanthus indofischeri**


**Phytelephas aequatorialis**


**Phytelephas seemannii**


**Primula elatior**


**Primula veris**


**Protium spp.**


**Prunus africana**


Fashing, P.J. (2004): Mortality trends in the African cherry (Prunus africana) and the implication for colobus monkeys (Colobus guereza) in Kakamega Forest, Kenya.


**Rubus fructicosus**


**Rubus idaeus**


**Rumohra adiantiformis**


**Sabal uresana**

**Sabal yapa**

**Sambucus nigra**

**Saussurea laniceps**

**Saussurea medusa**

**Saussurea spp.**
Yang QingSong, Chen ShaoTian & Zhou ZheKun (2003): [Protection and sustainable utilization of traditional Tibetan medicine "snow lotuses" (Saussurea) in Diqing Autonomous Prefecture, Yunnan; in Chinese].

**Schizostachyum lumampao**
Virtucio, F.D. & Tomboc, C.C. (1994): Effect of thinning, cutting age and felling cycle on culm yield of Buho (Schizostachyum lumampao) natural stands.

**Sclerocarya birrea**

**Scorzonera hispanica**

**Shorea atrinervosa**
Peters, C.M. (1996): Illipe nuts (Shorea spp.) in West Kalimantan. Use, ecology, and management potential of an important forest resource.

**Shorea stenoptera**
Lawrence, D.C., Leighton, M. & Peart, D.R. (1995): Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.

**Skimmia laureola**

**Sphenomeris chinensis**
**Spondias mombin**


**Stenocereus eruca**

Clark-Tapia, R., Mandujano, M.C., Valverde, T., Mendoza, A. & Molina-Freaner, F. (2005): How important is clonal recruitment for population maintenance in rare plant species? The case of the narrow endemic cactus, Stenocereus eruca, in Baja California, Mexico.

**Swertia chirayita**


**Swietenia macrophylla**


**Taxus baccata subsp. wallichiana**


**Taxus brevifolia**


**Terminalia bellirica**


**Terminalia chebula**


**Thrinax radiata**


**Vaccinium myrtillus**


Kuchko, A.A. (1988): Bilberry and cowberry yields and the factors controlling them in the forests of Karelia, USSR.


**Vaccinium vitis-idaea**


Kuchko, A.A. (1988): Bilberry and cowberry yields and the factors controlling them in the forests of Karelia, USSR.

Männi, R. (1988): Biology and berry production of the cowberry in Estonian SSR.


**Valeriana celtica**


**Zanthoxylum armatum**

2.3 Plant (Use) Groups

References are listed in an abbreviated form. For a full citation refer to chapter 1.

Cycads

Ferns

Grasses, incl. bamboo
Manipula, B.M., Gianan, N. So. & Virtucio, F.D. (1996): Culm removal effect on culm yield and biomass productivity of laak (Bambusa sp. 2) in flatland and hillyland sites in Pandapan, Tagum, Davao del Norte.
Virtucio, F.D. & Tomboc, C.C. (1994): Effect of thinning, cutting age and felling cycle on culm yield of Buho (Schizostachyum lumampao) natural stands.

Medicinal and aromatic plants
Alexan, M. (s.dat.): Methodology of economic mapping methods for the collection, drying, primary formulation and storage of medicinal plants. Technico-economic aspects.
Bojor, O. (s.dat.): Economic listing and mapping of medicinal plants in a geographical area.
Borisova, N.A. (1977): O roli wiborochnych metodov pri izychenii zapasov syr’ja dikorastuschich lekarstwennyh rastenii [About the significance of sampling-methods regarding the assessment of medicinal plant resources in the forest area].
Borisova, N.A. & Reznikova A.S. (1978): Metodika ispol`zovaniya materialov lesoustroistva pri opredelenii zapasov syr`ja lekarstvennykh rastenii w lesnoi zone [Methodology for the utilization of forestry materials for the assessment of medicinal plant resources in the forest area].


Fashing, P.J. (2004): Mortality trends in the African cherry (Prunus africana) and the implication for colobus monkeys (Colobus guereza) in Kakamega Forest, Kenya.


Geldenhuys, C.J. (2004): Bark harvesting for traditional medicine. From illegal resource degradation to participatory management.

Geldenhuys, C.J. (2004): Meeting the demand for Ocotea bullata bark. Implications for the conservation of high-value and medicinal tree species.


Isaev, D.I., (2005): Resursy dikorastuschich lekarstvennych rastenij zagatalskogo rajona (Azerbaidschan) [Resources of wild growing medicinal plants in the region of Zagatal'skij (Aserbaidschan); in Russian].

Kuzmanow, B. (1989): Postigenija i perspektivi na izsledwane, opazwane i razionalno izpolzwane na lechebnite rastenija w Institutu po botanika s botanicheska gradina pri BAN [Research on conservation and sustainable use of medicinal plants; in Russian].
Lawrence, A. (2003): No forest without timber?.
Lawrence, A. (): 'No personal motive?' Volunteers, biodiversity, and the false dichotomies of participation.
Newidomov, A.M. & Petuchov, N.W. (2001): [Biological active resources of forests (birch sap, turpentine, food plants, technical plants and medicinal plants) ; in Russian].
Pozdnjakov, L.K. (1986): Lesnye rastitelnye resursy Srednej Sibiri, Krasnojarsk [Herbal forest resources in the middle of Siberia, Krasnojarsk; in Russian].
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<tr>
<th>Author(s)</th>
<th>Title and Details</th>
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<tr>
<td>Schwezowa, N.E.</td>
<td>(2005): <em>Resursy nekotoryh lekarstwennyh i pischewych rastenij w basseinach rek Tungui-Suhara</em> [Resources of some medicinal plants and food plants in the basin of the rivers Tungui-Suhara ; in Russian].</td>
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<td>Sotnik, W.F.</td>
<td>(1968): <em>K metodike ispolzovanja perfokart pri polewich i kameralnich rabotach po kartirowaniu resursow lekarstwennych rastenij</em> [Methods for using perfo-maps for field work and editing data for mapping of medicinal plants; in Russian].</td>
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<tr>
<td>United Nations Industrial Developement Organization (s.dat.):</td>
<td><em>Medicinal and aromatic plants. Importance, cultivation, analysis and industrial processing.</em></td>
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Yang QingSong, Chen ShaoTian & Zhou ZheKun (2003): [Protection and sustainable utilization of traditional Tibetan medicine “snow lotuses” (Saussurea) in Diqing Autonomous Prefecture, Yunnan; in Chinese].


Mushrooms


Orchids

Mi Yoon Chung, Nason, J.D. & Myong Gi Chung (2004): Implications of clonal structure for effective population size and genetic drift in rare terrestrial orchid, Cremastre appendiculata.

Palms


Plant (Use) Groups


Pinard, M. (1993): Impacts of stem harvesting on populations of Iriartea deltoidea (Palmae) in an extractive reserve in Acre, Brazil.


Runk, J.V. (1998): Productivity and sustainability of a vegetable ivory palm (Phytelephas aequatoria) under three management regimes in northwestern Ecuador.


Succulents


Clark-Tapia, R., Mandujano, M.C., Valverde, T., Mendoza, A. & Molina-Freaner, F. (2005): How important is clonal recruitment for population maintenance in rare plant species? The case of the narrow endemic cactus, Stenocereus eruca, in Baja California, Mexico.


Trees

Jessen, R.J. (1955): Determining the fruit count on a tree by randomized branch sampling.
Lawrence, A. & Román, F.S. (1996): The role of inventory in the communally managed forests of Quinata Roo, Mexico.
Sakai, A, Sakai, S. & Akiyama, F. (1997): Do sprouting tree species on erosion-prone sites carry large reserves of resources?
## 2.4 Plant Parts Used

References are listed in an abbreviated form. For a full citation refer to chapter 1.

### Bark


Geldenhuys, C.J. (2004): Bark harvesting for traditional medicine. From illegal resource degradation to participatory management.

Geldenhuys, C.J. (2004): Meeting the demand for Ocotea bullata bark. Implications for the conservation of high-value and medicinal tree species.


### Bark, Fruit


### Bark, Wood


### Bulb


### Exudate


### Exudate, Fruit, Herb


### Exudate, Fruit, Seed, Wood

Lawrence, D.C., Leighton, M. & Peart, D.R. (1995): Availability and extraction of forest products in managed and primary forest around a Dayak village in West Kalimantan, Indonesia.
**Plant Part Used**

### Flower


### Fruit


Belonogova, T.V. (1988): Yield forecasting and optimization of berry harvesting in the forests of Southern Karelia, USSR.


Cherkasov, A.Ph. (1988): The cranberry yield in the USSR.


Jessen, R.J. (1955): Determining the fruit count on a tree by randomized branch sampling.


Kuchko, A.A. (1988): Bilberry and cowberry yields and the factors controlling them in the forests of Karelia, USSR.


Männi, R. (1988): Biology and berry production of the cowberry in Estonian SSR.


Peters, C.M. (1996): Illipe nuts (Shorea spp.) in West Kalimantan. Use, ecology, and management potential of an important forest resource.


Plant Part Used


Fruit, Leaf


Fruit, Seed


Herb, Stem


Leaf


Root


Plant Part Used

Seed


Pinard, M. (1993): Impacts of stem harvesting on populations of Iriartea deltoidea (Palmae) in an extractive reserve in Acre, Brazil.


Virtucio, F.D. & Tomboc, C.C. (1994): Effect of thinning, cutting age and felling cycle on culm yield of Buho (Schizostachyum lumampao) natural stands.

Wood


2.5 Countries

References are listed in an abbreviated form. For a full citation refer to chapter 1.

**Australia**


Pate, J.S., Froend, R.H., Bowen, B.J., Hansen, A. & Kuo, J. (1990): Seedling growth and storage and characteristics of seeder and resprouter species of Mediterranean-type ecosystems of south-western Australia.

Pate, J.S., Meney, K.A. & Dixon, K.W. (1991): Contrasting growth and morphological characteristics of fire-sensitive (obligate seeder) and fire-resistant (resprouter) species of Restionaceae (S. Hemisphere Restiads) from south-western Australia.

**Austria**


**Azerbaijan**

Isaev, D.I., (2005): Resursy dikorastuschich lekarstwennich rastenij zagatalskogo rajona (Azerbaidschan) [Resources of wild growing medicinal plants in the region of Zagatal’skij (Aserbaidschan); in Russian].

**Belize**


**Benin**


**Bolivia**


Botswana

Mpho Mosate (): Natural resource monitoring concepts and tools of veld products research and development.

Brazil


Pinard, M. (1993): Impacts of stem harvesting on populations of Iriartea deltoidea (Palmae) in an extractive reserve in Acre, Brazil.


Silva, J.A.A. da & Vasconcelos, A.J.N. de (1996): Application of the relative efficiency methodology to select plot area and shape in forest inventories of the caatinga of Pernambuco-Brazil.

Bulgaria


Cameroon

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<td>Rijsoort, J.van  &amp; Zhang Jinfeng (2005): Participatory resource monitoring as a means for promoting social change in Yunnan, China.</td>
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Korea, Republic of

Mi Yoon Chung, Nason, J.D. & Myong Gi Chung (2004): Implications of clonal structure for effective population size and genetic drift in rare terrestrial orchid, Cremasstra appendiculata.

Lao People’s Democratic Republic


Lithuania


Madagascar


Malawi


Malaysia


Mexico


Clark-Tapia, R., Mandujano, M.C., Valverde, T., Mendoza, A. & Molina-Freaner, F. (2005): How important is clonal recruitment for population maintenance in rare plant species? The case of the narrow endemic cactus, Stenocereus eruca, in Baja California, Mexico.


Countries

Lawrence, A. & Román, F.S. (1996): The role of inventory in the communally managed forests of Quinata Roo, Mexico.


Namibia


Nepal


Peru


Philippines

Manipula, B.M., Gianan, N. So. & Virtucio, F.D. (1996): Culm removal effect on culm yield and biomass productivity of laak (Bambusa sp. 2) in flatland and hillyland sites in Pandapan, Tagum, Davao del Norte.


Virtucio, F.D. & Tomboc, C.C. (1994): Effect of thinning, cutting age and felling cycle on culm yield of Buho (Schizostachyum lumampao) natural stands.

Poland


Romania


Russian Federation

Belonogova, T.V. (1988): Yield forecasting and optimization of berry harvesting in the forests of Southern Karelia, USSR.

Cherkasov, A.P. (1988): Classification on nontimber resources in the USSR.

Cherkasov, A.Ph. (1988): The cranberry yield in the USSR.


Kuchko, A.A. (1988): Bilberry and cowberry yields and the factors controlling them in the forests of Karelia, USSR.

South Africa


Geldenhuys, C.J. (2004): Meeting the demand for Ocotea bullata bark. Implications for the conservation of high-value and medicinal tree species.

Geldenhuys, C.J. (2004): Bark harvesting for traditional medicine. From illegal resource degradation to participatory management.


Sri Lanka


Turks and Caicos Islands


Uganda


### United Kingdom


Schwartz, M.W. (1993): The search for pattern among rare plants. Are primitive species more likely to be rare?


### United States


Venezuela


Zambia


Zimbabwe
