BfN Bundesamt für Naturschutz — 100 Jahre Naturschutz als Staatsaufgabe — Zukunft mit Natur

UNIVERSITÄT KOBLENZ · LANDAU

Assessing the Sustainable Yield in Medicinal and Aromatic Plant Collection

International Academy for Nature Conservation, Isle of Vilm, Germany

14 - 17 September 2006

ABSTRACTS

Title photo: Marianne Strohbach measuring *Harpagophytum procumbens* growths rates on permanent plots near Gobabis, Namibia.

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Resource assessment – A introduction

What makes a medicinal and aromatic plants special?

DAGMAR LANGE[1]

A starting point: the term MAP

Assessing the sustainable yield in medicinal and aromatic plant collection – thus the title of this expert workshop. To get a common ground for discussions, an elementary need is at the beginning to define the subject. Two questions arise: What is a medicinal and aromatic plant (MAP) and further what makes a MAP special? Living without plants – unimaginable! Since time immemorial, people have used plants above all for food, construction, shelter, tools, fuel, and of course for health care and cosmetic purposes. "Medicinal" and "aromatic" are terms describing properties of chemistry and use. While medicinal plants prevent, alleviate or cure diseases, aromatic plants contain fragrants, essential oils and are valued as perfumes, herbs, spices, and as medicines. Further important plant use areas are sweets, beverages, spirits, liqueurs, varnishes, and also insecticides. The overlap between all these categories of plant use supports the view to apply the term MAP to the whole range of plants used not only medicinally *sensu stricto* but also in the neighbouring fields of, e.g. condiment, food and cosmetic in particular from the point of view of commercial harvest, trade, conservation and agriculture.

Other terms in use …

Besides MAPs, there are many more different terms used in this field: i.a. NWFPs (non-wood forest product), NTFPs (non-timber forest product), pharmaceutical plant, botanical (drug/herb), herbal drug, officinal drug, non-officinal-drug, resin, and gum. Some are associated with the use, such as officinal drug or pharmaceutical plant, others are focusing on the product obtained from plants (botanical, resin, gum, pharmaceutical plant) or even more general on products of biological origin, like NWFP or NTFP. The latter include also the habitat origin. Only the term MAP is not product oriented; instead it focuses on plant **species**, an important distinction to all other terms. Consequently, the terms MAP on one side and NWFP / NTFP on the other side are not directly comparable. NWFP excluding all wood is ± a subset of NTFP including wood for uses other than for timber. Both products are of biological origin and are derived from forests or other wooded land (and in some definitions also from trees outside forests). In contrast, botanicals (= pharmaceutical plants) obtained from MAPs are of plant origin, and may be gathered not only in forests, but also e.g. in grasslands, wetlands, alpine communities, arable land, and ruderal areas.

How many species are MAPs?

The number of plant species that are used for medicinal and aromatic purposes can only be roughly assessed. An estimated 70,000 plant species are used in folk medicine world-wide, a figure recently confirmed by a country-based calculation of national medicinal floras. Of these many plant species, ca. 3,000 species are in international trade, a figure based on investigations of the German MAP trade (ca. 1,500 MAPs), a survey of the equivalent European market (ca. 2,000 MAPs), and the fact that Germany is an important trade centre for MAPs, with trade connections to all regions of the world.

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What makes MAPs special – or – characteristics of MAPs

What do we know about the production of MAPs? In general, there are three options: MAPs may be harvested from the wild, cultivated or obtained from both sources. Although cultivation of MAPs is known since several thousand years (e.g. opium poppy since at least 2700 B.C.), in particular in central Europe with its long tradition of growing MAPs, dating back to the medieval gardens, and today with 70,000 ha of MAP plantations within the European Union, only around 150 MAPs are commercially cultivated within Europe, and about 900 MAPs worldwide. In terms of species numbers, about (70-) 90 % of all MAPs are primarily harvested from the wild - a surprisingly high share. To calculate the share of wild-collected botanicals in terms of volumes is much more difficult. There are no or only few exact figures available of the total production of MAPs or of those under cultivation. Based on some country-based available information e.g. of China (60 % of the quantities in trade are said to be sourced from the wild) of Nepal (wild-collection of 15,000 t of botanicals/a) , and a rough calculation of the quantity of wild-collected botanicals in east and southeast Europe in the late 1990s amounting to a minimum of 30,000-45,000 t of dry plant material, the share of wild-collected plant volumnes is estimated to about 50 (-70%).

MAPs are a very diverse group of plant species. They span all life forms (annual, perennial herbs, shrubs, trees), all plant parts are used, root, stem, wood, bark, leaf, flower, fruit, seed, and they grow in all habitats and all climatic regions of the world. Many internationally traded MAPs show a wide geographic distribution. The geographical origin of the botanicals used in Germany may illustrate these facts well; in general, they originate from all geographical regions of the world, with dominance of the temperate regions of Asia, Europe, and North America not tropical regions. A high number of not less than 605 species are native to Europe, the majority of them distributed across several geographical units, e.g. the Mediterranean area, Eurasia or even the Northern Hemisphere; only 16 species are limited to Europe. A further interesting fact is that 71 of these species are introduced to Europe. Analysing the life form of the MAPs used in Germany, the dominance of perennial herbs (625 species) is striking. This fits well to their geographical origin mostly of temperate regions, as hemicryptophytes and cryptophytes are well represented in the equivalent vegetation types.

Susceptibility to collection varies among species depending on their different biological characters such as life form, growth rates, reproductive systems, and on the different plant parts used. The susceptibility of species to over-collection is above all to a function of life form and plant parts used, well illustrated by the fact that medicinal plants on the CITES lists are mainly the ones harvested for their roots.

Generic issue 1:
Inventory and monitoring methods as information base for resource assessment

Resource assessment methods for medicinal and aromatic plants: Designing sound inventories

JENNY WONG[1]

In order to provide guidelines for the assessment of a sustainable yield for MAPs we have first to develop an understanding of what we mean by various terms and establish some generic principles**.** The collection and use of MAPs is of interest to a great many

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stakeholders representing a range of cultures including a number of academic disciplines. Each of these disciplines uses a range of terms such as 'inventory' and 'assessment' but with little cross-disciplinary consistency. This is itself a considerable barrier to the development of standards for MAP management. This paper opens by laying out some basics as responses to the following questions:

- **What do we mean by 'inventory'?** – In ethnobotany this usually means a simple list of species available at a site or habitat with names particular to an ethnic group. However, if we are concerned with assessing management options, *inventory* should be taken as meaning a set of objective sampling methods designed to quantify the spatial distribution and quantities of species within specified levels of precision for the purpose of management.
- **What is the difference between an *inventory* and an *assessment*?** – This is an important distinction, *inventory* should provide objective data while *assessment* interprets them in the context of management objectives; in other words an inventory will give the stocking of a species as 0.25 stems/ha while an assessment will say whether this is too much or little to support current levels of harvesting.
- **What do we mean by 'sound' and why is this an issue and to whom?** – Colloquially this would mean 'undertaken according to agreed standards', in a statistical sense this becomes an inventory designed according to statistical principles. This in turn means adopting a sampling approach where a number of samples are independently and objectively selected from the area and species of interest. A measure of the quality of an inventory is its ***precision*** (how close sample measurements are clustered) and ***accuracy*** (how close the values estimated from the sample are to their true values). We can measure precision as the standard error of the mean of sample data with small errors indicating precise results. Obviously considerations of desirable levels for the sampling error of an inventory are only of concern to those familiar with academic science but remember that this usually includes statutory regulatory authorities such as Forestry Departments. However, basing management decision on good quality data is important to all stakeholders.

If we take it that there are circumstances where statistically-sound, quantitative information of the quantities of MAP resources for a defined area will be required, then the next question is **how can we obtain these data in an efficient manner** as financial resources for fieldwork are often severely limited. Unfortunately, *in situ* quantification of MAP resources is not straightforward for a number of reasons which will be elaborated further by CHRISTOPH KLEINN in another contribution to this workshop.

A common response to these difficulties is to avoid statistical issues altogether and argue that we can either do without statistical data and use qualitative information or accept data arising from simple, one-size-fits-all protocols (i.e. designs of low sophistication) even if these generate data with large errors and hence low precision. There are of course many circumstances and purposes for which statistical data is not required and for which qualitative methods are perfectly acceptable. We therefore need to **establish guidelines for the appropriate use of qualitative and quantitative methods**. A simple decision aid to determine an appropriate level of 'soundness' for NWFP studies has been proposed in the new FAO NWFP assessment guidelines and this will be presented for consideration by the workshop participants.

It is further contended that when statistical sound inventories are required, it is a **fallacy to confound cost-efficiency, simplicity and low sophistication**. It is suggested that an alternative response is to *increase* the sophistication to generate cost-efficiency by tailoring protocols to the species, habitats and available resources. It is also contended that more **sophisticated methods can also be simple to use**, especially if they are intuitive and bring together indigenous knowledge and statistical approaches. A few methods drawn from a range of disciplines which appear relevant to MAPs and could be further investigated will be introduced to the workshop.

Guidelines for tailoring inventory protocols to the specific characteristics of MAP species as developed for the FAO NWFP assessment will be briefly presented. These are based on the following considerations:

- Sampling design requires consideration of population density and distribution;
- Plot layout requires consideration of life-form and size of target species;
- Measurements made need to consider the commodity or harvested part and its form;
- Estimation of quantities of a resource (stocking) requires estimation of the spatial extent of the species.

The challenge for this workshop is therefore to

- o agree if, or when, statistical data is required and,
- o to devise a programme to develop and test protocols suitable for the assessment of sustainable yields for MAPs.

Forest inventories: Principles, experiences and lessons for NWFP inventories

CHRISTOPH KLEINN[1]

This paper gives an overview of basic technical principles of forest inventories with reference to designing inventories for NWFPs. The role of forest inventories is described as a **tool for data provision** to support decisions that are oriented towards sustainability of the utilization of the forest resource. As an example, sustainability of timber production is illustrated with some historical background.

Information needs of the natural resource manager can be formulated in **simple questions** to which forest inventories need to generate a suitable data set:

- How much is out there and where and in what quality?
- How much of the growing stock is accessible for harvesting?
- How does the resource change over time, how do human interventions affect the resource and its development?

These questions are the same for timber inventories and for inventories of non-wood forest products. And the most difficult question is probably: To what extent / precision / resolution need these questions actually to be answered?

Forests are complex systems and data collection on the forest resource is likewise a complex undertaking. Many information sources are being utilized to efficiently prepare and implement data collection. Field data are the most comprehensive and valuable source of information. Remote sensing plays a prominent role in forest area estimation and can excellently be combined with field inventories; however, for the inventory of NWFP, its application is probably limited to deliver ancillary information for example for forest type stratification.

Field data are collected on a sampling basis. The **three basic design elements of sampling studies** that need to be worked on and defined when devising a sample based inventory are presented and described: (1) sampling design, (2) response design and (3)

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estimation design. Examples are presented from forest inventories and extensions made towards the inventory of NWFPs. Models which are widely available for forest inventories are largely missing and need to be derived for NWFPs.

While many principles of forest inventories apply immediately also to the inventory of NWFPs, the latter is even more complex and difficult. Some inventory-relevant characteristics of NWFPs are discussed. Probably, for many non-wood forest products an efficient **integration of local knowledge** is required to make inventories workable and efficient, being one of various research topics identified.

Generic issue 2: Indigineous knowledge as information base for resource assessment

Participatory science: Community experiments as a reliable information base for sustainable harvesting

Anna Lawrence[1]

This presentation focuses on the challenge of **enabling ('empowering') local users** to manage medicinal plants sustainably. Specifically, it places sustainability in the context of **adaptive collaborative management**, examines the information needs of different stakeholders, and proposes ways in which those information needs can be met. The approach described can also be used by private resource managers, but will benefit from sharing research processes with other users and from established relationships with partners with the appropriate technical training.

The impact of harvesting medicinals and other NTFPs must be assessed accurately in order to make decisions for adaptive management. This is a particular challenge where the forests are managed by, or in partnership with, rural communities. Local users, harvesters and merchants will engage with sustainability where it affects their livelihoods within cultural context. Whilst reliable data are essential for management, field-based researchers emphasise the **need for methods which are simple, rapid, focused on species with high potential for livelihood improvement**, scientifically valid but usable by non-scientific forest managers. Our work searches for an acceptable balance between locally relevant and valid, and scientifically reliable, information.

To social researchers and development workers the validity of local knowledge is so evident that it can still surprise them that such knowledge needs to be defended to scientists. The approach described in this paper takes it as axiomatic that local knowledge about the resource exists, is evolving, is relevant and contextualised, and complements scientific knowledge, but that parts of it may be dormant or subconscious, or overridden by concerns about resource access and security. Furthermore, it is proposed that the contribution of scientific knowledge may relate more to methodology than to content. This approach therefore requires an open-minded and constructivist approach to knowledge creation, from the start.

Briefly, the **process** consists of the following. A research team is formed, in the tradition of much farmer participatory research, consisting of resource users, other influential or important local stakeholders, foresters and the facilitators (in this case from national NGOs).

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After a participatory and systemic examination of their medicinal plant harvesting situation, and exchange of local with scientific knowledge, the research team propose hypotheses about the effect on yield of biological, social and management factors, including harvest level, period and method. They then **define 'business as usual'** or BAU, a process which can in itself involve much debate and learning. BAU is taken to be the formalised description of what most people do most of the time, when they are harvesting. It has to be standardised, in order to permit rigorous comparison with any alternative management, and defining it requires sharing and negotiation among research team members. Alternative management and harvesting methods are then proposed and defined in the same way.

A key step is the explicit formulation of a **hypothesis** along the lines of "If management is changed from BAU to the alternative, yields and / or regeneration will increase / stabilise because …". With the support of foresters and researchers, **research plots** are then established based on principles of randomisation, replication and controls. These compare indicators, test correlations between indicators and make recommendations about useful proxies for measuring sustainable yield. Data is collected, and analysed in collaboration, and results interpreted in meetings with the wider community of forest users.

The paper examines the effects on different stakeholders of the process, including the formulation of hypotheses about management and yield, usability of indicators of sustainable yield, the need for both quantitative and qualitative data, comparison of scientific monitoring with local monitoring, reliability and validity of the information generated. It concludes with the important consideration of the effects of such monitoring on local perceptions and action, and overall implications for governance.

The paper draws on the experience of a UK DFID Forestry Research Programme project working with NGOs and forest-managing communities in India and Nepal, and complements the paper by G.A. Kinhal.

Participatory resource estimation of medicinal plants: A case study from India

GIRIDHAR A. KINHAL, JAGANNATHA RAO and M. ARTHUR SELWYN[1]

Local communities and their knowledge related to natural resources are being increasingly recognized globally. Participatory approach integrates people of different socio-economic and cultural status and helps to establish a need based and objective oriented local institution. Such an institution is aimed to facilitate coherent action and help the stakeholders to contribute in designing, implementation and appraisal of methodology. It also helps the resource managers to decentralize and broad base the conservation of valuable medicinal plants and other NTFPs, which provide livelihood support to many people.

Capacity building through **constituting a local institution called *Task Team*** was attempted in Agumbe of Karnataka state in India, providing opportunities to all stakeholders to apply traditional and scientific knowledge at village level for resource accounting and developing an adaptive management methodology for sustainable harvesting. Documentation of traditional knowledge and practices related to selected medicinal plants and NTFPs was undertaken to characterise and assign roles to different stakeholders in the *Task Team*. A sequential filter technique was applied to enable the local *Task Team* to set objectives for resource

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management. The specific objective was to **evaluate the community's resource assessment potential under different harvest regimes**, and costs involved in undertaking these activities. The *Task Team* members' capacity to estimate the resources was enhanced through training, whenever physical measurements were involved.

The Lauraceae species *Cinnamomum macrocarpum* Hook.f. (locally known as Kadu dalchini), leaves of which are harvested for their high medicinal value, was selected for resource assessment. Different site, plot and tree related parameters were assessed by the community. Resource quantification (leaf yield) was done using visual estimation and actual harvesting under two harvest regimes such as BAU (Business as Usual) and test harvest (selective harvest). The tree leaf yield was assessed visually by the *Task Team* members based on their experience prior to the actual harvest in two harvest regimes. The results were compared and variations between estimated and actual yield were recorded to calculate the accuracy in community's resource estimation. Mean accuracy in estimation was 89% in test harvest and 83% in BAU and variations in leaf weight proved to be non-significant. The *Task Team* members maintained their accuracy across height classes without significant variation between the estimation and actual harvest, which was not the case in respect of girth classes. The labour costs involved in undertaking these two assessment exercises were also juxtaposed. The results justify that a strategically constituted stakeholders' team can set objectives for resource management, assess resource potential, and efficiently estimate possible harvest with high accuracy.

Generic issue 3: When do we consider an impact of harvest detrimental for the population?

Ecological implications of collecting medicinal and aromatic plants at the population, community and ecosystem levels

TAMARA TICKTIN[1]

A growing number of studies have assessed the ecological impacts of harvesting medicinal plants. I present a review and synthesis of the literature on MAP harvesting impacts with the **objectives** of (1) illustrating emerging patterns in the ways in which MAP harvest can have impacts at different ecological scales; (2) identifying the range of ecological methodologies used to make these assessments; and (3) based on this, providing some thoughts and some questions on **potential appropriate and affordable methodologies** for assessing MAP harvest sustainability.

The MAP literature illustrates that MAP harvest can have impacts at the levels of **individuals, populations, communities and ecosystems**. Harvest sustainability for any one species is heavily influenced by variation in biological factors such as the plant part harvested and life history strategies, as well by variation in ecological and environmental factors, including both abiotic and biotic factors. Moreover, the literature has shown that variation in management practices for wild harvested MAP carried out at a **variety of scales**, including those targeted at individuals (such as harvest methods), at the community level (such as weeding, light manipulation) and at the landscape level (such as fire, grazing, logging, agricultural practices) have large effects on harvest impacts and can interact with

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each other. In addition, harvest sustainability at one ecological level may not translate into sustainability at another level, raising the question of what 'impacts' are.

A wide spectrum of methodologies have been used in assessment of ecological sustainability of MAP harvest, including experimental harvests and measures of vital rates; assessment of genetic structure and diversity; documentation of patterns of abundance, density and population structure; modelling of population dynamics and sustainable harvest levels; and assessments of community structure and composition and resource cycling, among others. The majority of ecological assessments for MAP has been at the population level. Many of these methods represent high costs in time and resources. Several case-studies illustrate the ways in which they can be problematic or erroneous when interpreted without adequate analysis of socio-economic, political and cultural factors. However, some high input ecological methods, such as population modelling, have yielded informative results on harvest sustainability that are not obtainable with other more affordable methods, and also shed light on harvest sustainability for many other MAP. The MAP literature, and the gaps in it, suggests ways in which key species for these kinds of studies can be selected.

Patterns emerging from the literature on MAP harvesting impacts point to some ways in which ecological assessments for many MAP may be more affordable and effective, especially when combined with local or **traditional methods** for assessing resource status. Several studies illustrate the ways in which the latter can be highly effective as tools for assessing conservation status of MAP at different ecological levels and lead to **adaptive management**. The latter is particularly important since the MAP literature illustrates the importance of assessing sustainability over the long term, though this is rarely done. Sustainable harvest assessments from market documentation and qualitative observations at the community and ecosystem levels have also been illustrated to be effective. An understanding of the life-history, ecological, socioeconomic, cultural, political context of harvest for any given MAP is key in identifying what methods and combinations of methods can be employed.

How much impact on plant populations is tolerable? – An approach to determine thresholds for significant detrimental impacts in the context of the ISSC-MAP

ULRICH SUKOPP[1]

The International Standard for the Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP) provides a long list of principles and criteria compiled to ascertain the sustainability of wild collection of MAP resources. A basic and most important principle postulates that the wild collection of MAP resources shall be conducted at a scale and rate and in a manner that maintains populations and species over the long term. The collection intensity should be well **balanced with the species ability to regenerate**. Furthermore, **resilience** of the species against (over-)exploitation is requested.

The mentioned criteria of harvest sustainability and resilience should be precisely determined in science-based case studies provided that time, experts and financial resources are available. Regrettably, these scientific and economic criteria alone can not adequately reply to the question how much detrimental impact on MAP populations is acceptable. They

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provide information exclusively on the extreme limit of exploitation: in case of harvesting in a not sustainable manner or reducing the populations to a not resilient size we are obviously beyond the limit and have caused an undesired damage to a part of nature. **Leaving a MAP unexploited or over-exploiting a MAP are two extreme situations opening up a long range of scenarios in between**. It remains an ethical task to determine the threshold of significant detrimental impacts on MAP populations. Scientifically sound data about population parameters and the condition of nature and environment essentially contribute to setting these thresholds. Such **normative** standards correspond to more general nature conservation goals and need to be fixed and legitimized in some sort of societal agreement. In addition, it is most important to consider and address negative environmental impacts which indirectly influence other wild species, habitats, ecosystems and the landscape.

The theoretical concept of environmental damages and its application in the context of cultivation of genetically modified crops is currently elaborated in a joint project of the Federal Agency for Nature Conservation with the Technical University Berlin (INGO KOWARIK, ROBERT BARTZ, ULRICH HEINK). The results of this project can be adapted to the questions raised by ISSC-MAP. **Three conclusions** are particularly important: (1) the definition of environmental damages, (2) the further operationalisation using criteria and indicators and (3) the setting of normative standards for significant detrimental impacts.

(1) An environmental damage caused by wild collection of MAP is a **significant direct or indirect detrimental impact** on a biotic subject of protection/regulation (animals, plants, fungi, microorganisms) or on an abiotic subject of protection/regulation (soil, water, air/climate). The damage may affect the subject of protection/regulation as a whole or any of its components or the functional and structural relations of the protected/regulated subject or the sustainable use of the protected/regulated subject including its functional and structural relations. The definition is based on clearly named **protected/regulated subjects (any biotic or abiotic part of nature)** and on the **causality** of wild collection to the damage. It is important to note that not every impact is seen as detrimental, but a threshold of significance is applied. The significance of an adverse effect arises from its intensity as well as from the value of the protected/regulated subject (two-dimensional approach of environmental risk assessment).

(2) The above definition is operated by selecting and applying various criteria and indicators for (a) the nature conservation **value** of the protected/regulated subjects and (b) the **intensity** and range of the negative impact. As **criteria and indicators** for the particular value of the protected/regulated subjects are suggested: rareness and endangerment, responsibility for world-wide conservation, closeness to (pristine) nature of habitats, biocoenoses and ecosystems, importance in land use history, typical composition of species and structures, conflict with local nature conservation goals, legal protection status. The intensity and range in space and time of the negative impact can be indicated by parameters relating to the collection activities (e.g. frequency, period allowed for collection, collected quantities), to the target species' populations (e.g. size, distribution and structure), to non-target species' populations, to habitats directly or indirectly affected by collection, to diversity, structures and functions of ecosystems and landscapes.

(3) The setting of thresholds for significant detrimental impacts is based on **normative** conventions. It is usually performed by expert panels which agree case-specifically on **tolerable negative effects**. The results should be consistent with more general nature conservation goals.

For each unique case of wild collection of MAP as many as possible of the above listed criteria and indicators should be assessed and ranked on a gradual scale. After calculation of the ranking results for both dimensions of the assessment – the value of the affected biotic or abiotic subjects and the intensity of the impact – and after the application of predefined thresholds of significance a clear answer can be given, whether the impact is acceptable or not. The described procedure is a well-known standard of **environmental risk assessment** undertaken for many other human interventions in nature.

Balancing statistical reliability and cost efficiency in resource assessment

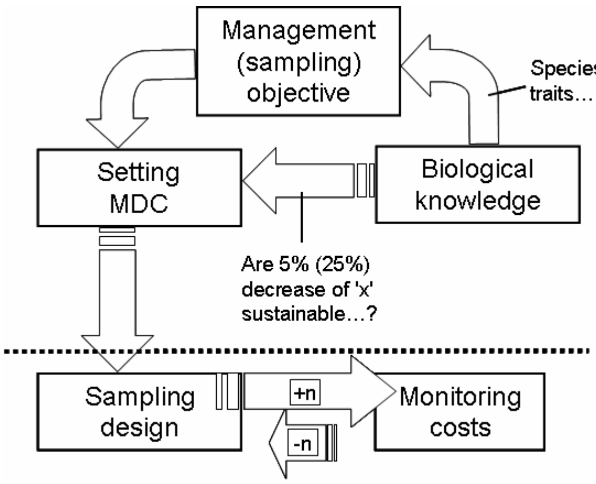
HORST TREMP[1]

In resource assessment of medicinal and aromatic plant species monitoring is part of the adaptive management cycle. The way of application of monitoring results to management activities should be identified before any data are collected. Typically a baseline study of a resource (initial evaluation) and trend monitoring of a used resource can be distinguished. **Monitoring** of a statistically defined plant population means repetitive observations at permanent locations at specified time intervals.

If neither a data intensive (eco-) system approach nor a laborious population viability analysis are intended, cost efficiency in monitoring can be achieved. The **term cost efficiency** is used in that respect that no money should be spent for supplementary data collection and analysis which is not necessary for management decisions. Plant resource monitoring can be simply structured because contrary to vegetation studies not many explanatory variables for species increase/decline exist but only one: **the harvest**. This variable with its direct and indirect effects is known and to a certain extent under control. Further it is questioned if the important scientific concept of cause and effect explanation which needs several hypotheses testing procedures is necessary in every resource assessment procedure.

If carefully defined limits, i.e. securing sustainable population viability, are implemented in the management cycle it might not be necessary to explain specifically why a used plant species resource declines. More important is the ability to adjust harvest procedures in time.

No concessions should be made in setting a **minimum detectable change** (MDC) of viability parameters of the species population.



MDC is directly related to statistical test power and has consequences for the sampling design. Its setting requires consideration of both the biological implications (How large a change should be considered biologically meaningful?) and the monitoring costs which increase with sample size and – but not necessarily – with more sophisticated sampling designs. Thus MDC **links ecologists, statisticians and financing partners** (see figure).

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It is proposed that in resource monitoring a core element should be to state which size of change of a resource is desired to be detected. If no preliminary data about statistical distribution properties and variability of the investigated variables (needed for MDC) are available a pilot study has to be undertaken. This will be more cost efficient as the responsible person can avoid missing a true decline of the resource (plant population) and failing to take action.

But note, the above described concept might not be applied to rare species and such with particular distributions. This however does not limit its applicability in a multitude of cases.

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Resource assessment: Case studies

Community management of medicinal plants in Nepal: Practices and trends towards sustainability

NIRMAL BHATTARAI[1] and MADHAV KARKI[2]

Nepal has been a traditional supplier of about **100 species** of wild harvested medicinal and aromatic herbs to the Indian and other international markets. Some 20 high demand and high value herbal products constitute about 80% of the volume and value. Historically the people of Nepal's far flung mountains controlled and managed the collection of herbs in their forests and pastures primarily for local uses and supplementary cash income. Today, uncontrolled commercial extraction of a number of medicinal plant species has significantly eroded the country's resource base that calls for urgent action towards sustainable management of medicinal plants in the wild.

Sustainability has many different definitions but in the ecological context of medicinal plants, harvesting can be considered sustainable if the harvest has little or no long term harmful effect on the populations being extracted, when compared to equivalent natural populations not subjected to harvest.

In Nepal, although there is considerable evidence of over harvesting of medicinal plants, quantitative analysis of the effect of unsustainable extraction on natural populations are lacking. There are scientific ways to properly extract medicinal plant resources in nature with minimum physiological and ecological damages. However, this requires research and implementation of guidelines of sustainable management. Ideally, technical inputs combined with traditional knowledge should produce an adaptive technology that is based on the cultural, social, environmental and economic factors that are relevant to the local population

Nepal's current forest policy has promoted the **community-based forest management principles and practices**. At the community level, local people are the true resource managers, with a vested interest in sustaining the integrity of natural resources on which they

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heavily depend. Consequently, the management of national forests is being systematically handed over to community of users. As a group they share the rights and responsibilities of managing the forest according to their needs and benefits. About 21% of the national forest totaling approximately 11,85,565 ha represented by 14,227 forest patches have been handed over to the local community of users for management, benefiting 16,35,664 households representing about 29% of the country's population.

An ICIMOD-based project funded by the *Medicinal and Aromatic Plants Programme in Asia* (MAPPA) and operational since 2002 in the Baitadi and Darchula districts of western Nepal has been increasing the **capacity of local communities** by building the technical and institutional capacity of the district chapters of the Federation of Community Forestry Users-Nepal (FECOFUN). Objectives are the conservation and efficient management of medicinal plants and other NTFPs and to generate household income in an economically equitable and environmentally sustainable manner.

The project activities included strengthening of the leadership skills and technological knowledge of the Community Forest User Groups through training and capacity building. The major elements of research conducted so far have been: training and skill development in MAP inventory; collection of baseline data on the size-class structure and yield characteristics of the plant population; sample-based quantitative assessment of plant stock; regeneration surveys; life cycle studies and rotational harvesting practices on selected species; determination of the optimum harvestable amounts and periodic adjustment in harvest levels, establishment of medicinal plant nurseries for *in situ* enrichment plantations and *ex situ* cultivation; and impacts of different levels of harvesting on sustainability in *in situ* and *ex situ* experimental plots

The sustainable wild collection and quality control aspects have been concerted with the International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (**ISSC-MAP**). Likewise, the WHO Guidelines on Good Agricultural and Collection Practices (**GACP**) for Medicinal Plants have been used to blend the traditional practices. The progress to date is encouraging. Valuable data and information are being generated that are likely to serve as a model for sustainable management of medicinal plants in the wild. This is expected to be replicated in other areas communities alike.

Sustainable harvest of *Actaea racemosa* from Appalachian forests

JAMES CHAMBERLAIN[1] and A.L. (TOM) HAMMETT[2]

Black cohosh (*Actaea racemosa*; Syn.: *Cimicifuga racemosa*) is an erect perennial found in rich cove forests of eastern North America. Products made from the roots to treat menopausal symptoms have been used for more than 40 years by Europeans and have been more recently available in the United States. The American Herbal Products Association estimates that more than **83,000 kg of roots were harvested in 2001**, and more than **95 % of this was wild harvested**. In 2001, the estimated retail value of cohosh exceeded US$ 6.2 million. NatureServe gives black cohosh a global and national conservation ranking of "apparently secure", while some conservation groups list the species 'at risk', and two states in the US consider it endangered.

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In 2000, the Medicinal Plant Working Group of the Plant Conservation Alliance (which includes representatives from ten federal agencies and more than 250 nonfederal cooperators) fostered a partnership between the Garden Club of America, a non-governmental organization dedicated to the conservation of native plants, and the USDA Forest Service to address growing conservation concerns regarding this species. The group established a **study protocol** to examine the **frequency** and **abundance** of black cohosh, as well as the impact of harvest levels on population sustainability. An overall goal of the project has been to provide information and knowledge that will improve the decision making abilities of the National Forests to better understand sustainable harvest levels to improve management activities for black cohosh. Recognizing that the lack of funding was a major constraint the group designed the study to use **volunteer "citizen scientists"**. The studies are conducted on public land, either National Forests or National Parks. Local Forest Service or National Park Service scientists coordinate the research aspects, while a Garden Club member coordinates volunteer participation.

For the first three years, field activities were limited to the National Forests of North Carolina. 25 permanent plots, each measuring 10 x 10 meters were established in 4 different cove forests. 16 plots were harvested with two different intensities (30 and 60 %). Data have been collected on **number of plants, stem height, canopy width**, as well as **number of inflorescences** for five year. In 2005, more than 50 volunteer citizen scientists participated in the two day data collection activity. Summaries of data provide insight into the effects of harvesting.

In 2003 and 2004, the study was expanded to include one site in the neighboring state of Virginia. In 2005, the original Virginia site was discontinued due to poor site conditions, and two new Virginia sites were established. That year, more than 20 volunteers participated in data collection. The dimensions of the Virginia plots varied from the North Carolina plots (to reflect local plant densities and growth conditions), but similar data collection methods were used. The data collected will aid in **correlating above and below ground biomass**, with the expectation that better and **non-destructive inventory methods** would be developed to estimate the volume of potential root harvest. As data from the Virginia sites have only been collected for two years it is too soon to expect reliable correlations.

Several challenges have surfaced through these projects that influence the viability and reliability of the study. In some locations, particularly North Carolina, black cohosh is often found growing with Yellow cohosh (*Actaea podocarpa*, Syn.: *Cimicifuga americana*) and discerning the difference between them is challenging, even for a trained botanist. Training volunteers in scientific methods as well as plant identification is challenging. Often, volunteers may not understand the necessity for accuracy and rigor. **Keeping volunteers committed** to collecting data though adverse weather conditions can be particularly challenging. In 2006, data collection in both the North Carolina and Virginia sites were suspended due to lack of volunteers. The future for this study is in doubt due to lack of fiscal support for the research coordinators.

This presentation examines the nuances of assessing sustainable harvesting of an important medicinal plant in the Eastern US. In this case the **need for scientific rigor must be balanced with the availability of funds and volunteers**. To ensure greater reliability and broader application of data and results, more replications are needed over a broader geographic scale. To achieve this will require greater investment in time and money, and as each of these are limited, the future of this and similar studies is questionable. Lessons learned from this experience, however, may help develop monitoring and inventory systems where funding and other resources are constrained.

Collecting *Arctostaphylos uva-ursi*, *Gentiana lutea* and *Thymus* in Northern Spain

ROSER CRISTÓBAL and ROSER MELERO[1]

Arctostaphylos uva-ursi, *Gentiana lutea* and *Thymus* spp. are the most important species collected in Spain for industrial uses. Additionally, there are others herbs harvested for the local market or domestic uses like: *Arnica montana, Jasonia glutionosa, Equisetum arvense, Juniperus communis, Ramonda myconii, Rosmarinus officinalis, Santolina chamacyparissus, Tanacetum partenium, Viscum album,* etc.

With the aim of taking advantage of the use of natural resources as an economical activity in the mountain areas, we have worked during the last seven years with *Arctostaphylos uva-ursi, Gentiana lutea, Arnica montana, Thymus vulgaris, Lavandula angustifolia, Satureja montana, Rosmarinus officinalis and Lavandula latifolia* studying different aspects of the wild populations. We have studied the overall condition in some of these species (arnica, rosmary, lavender and savory). In some other species (bearberry, yellow gentian, thyme, savory and lavender) we have evaluated the impact of wild harvesting on the natural habitats and on the species survival, in order to find the best practices to collect them.

During three years different experimental studies were carried out with ***Arctostaphylos uva-ursi*** with the aim to know: (1) the aerial biomass production under different environmental conditions and during different harvesting season; (2) the regeneration capacity of the plant according to the last pruning and to the different intensity of previous gathering, and (3) the best harvesting season for obtaining the highest arbutin concentration. In all the localities, the biomass obtained in spring was a little higher than in autumn. The highest biomass was obtained from localities characterized by a minimum forest cover, southern exposure and calcareous soil. The plants' sprouting capacity was higher in plots gathered previously in autumn than in spring. The sprouting rate also showed higher values in plots where a minimum pruning was applied. The populations gathered every year show, in the third year, a fitness reduction due to a significant decrease in sprouting capacity. In autumn the arbutin concentration is higher than in spring.

Regarding ***Gentiana lutea***, we have carried out different experimental studies focused on the resource assessment in the Pyrenees and on its biology, giving special attention to the reproduction. Also, these first studies evaluated the effect of the traditional harvesting on the regeneration of the plants, considering the extraction intensity. Among the most interesting results, we found that vegetative multiplication is the main way of *G. lutea* populations to grow and survive and that no more than 50% of plants should be harvested during the autumn season. As a conclusion, it was thought that the traditional collection technique could be improved by cutting and planting some of the harvested shoots. Nowadays we are evaluating this recommendation in order to verify any change in the population growth rate.

Finally, the studies of wild collection of mediterranean MAP species, like *Thymus vulgaris*, *Lavandula angustifolia* and *Satureja montana*, evaluate the effect of the collection technique on the survival and on the yield of these species in the wild. The collection technique includes the harvesting method itself, the extraction rate and the collection periodicity.

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Compiling a handbook on NWFP inventories: A project of FAO´s Forestry Department

CHRISTOPH KLEINN[1] and JENNY WONG[2]

The Forest Products Division of FAO has projects in various NWFP related topics. A series of widely accepted NWFP issues are the starting point for FAO´s NWFP research activities, among them the **lack of sufficient quantitative information** on production, consumption and trade. Other issues are the lack of management prescriptions, unclear user rights and a lack of awareness, policy and regulatory instruments.

FAO´s mission covers the fields of definitions, standards and technical assistance. Programme priorities are institutional strengthening, provision of information, conservation and sustainable utilization, and international processes. For these priorities, data on the resource base are required; wherever possible in a good quality and following clear definitions.

Therefore, FAO engaged in the development of a **handbook on NWFP inventory**: "Non-wood forest products. Resource Assessment Guidelines", with JENNY WONG as senior author. That handbook draws upon the experience from various NWFP field projects in Africa and embraces a **compilation of a variety of sampling strategies for field inventories** of a wide range of different NWFPs. There is no such thing as one single ideal sampling technique for all NWFP in all regions so that a wide range of sampling techniques needs to be considered when planning an inventory for NWFP. The handbook offers such an overview of sampling techniques at a statistical level and language which should be accessible to most NWFP project planners.

Structure and contents, and also limitations, of these guidelines are presented and discussed. In addition, some case studies that are part of that FAO handbook are presented.

A preliminary assessment of the harvest impact on *Pelargonium sidoides* in South Africa and Lesotho

DAVID NEWTON[3]

Pelargonium species in general (at least 18 species), have been used in southern Africa as useful medicinal plants for many years providing relief for colic, diarrhoeas and dysenteries. The species harvested medicinally and researched in this report, namely *Pelargonium sidoides* forms part of a group of *Pelargonium* species with red-coloured fleshy roots used to treat the above mentioned abdominal upsets and upper-respiratory tract infections. *P. sidoides* occurs in Lesotho and the Eastern Cape, Free State, Gauteng and Mpumalanga provinces of South Africa.

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During 2003, TRAFFIC was contracted to undertake a **preliminary field assessment** of harvest impact on this species in and around the Eastern Cape towns of Alice, Grahamstown, Wesley, Peddie, Hogsback and Thomas Baines Nature Reserve. During 2006, TRAFFIC also conducted a preliminary analysis of the *P. sidoides* industry in Lesotho.

Annual harvest volumes are estimated to range from 9,000 kg to 45,000 kg. However, based on preliminary field observations **this species does not appear to be facing any imminent threat** because of the plants rapid re-sprouting from remnant root segments, its wide distribution and large populations, the lack of harvesting in other areas of its range, the ease with which the plant propagates from shoot and root cuttings, and existence of commercial plantations in the Western Cape (50 hectares).

In **assessing the impact of harvest** on *P. sidoides,* it became evident that all harvest was being conducted illegally and without the use of formal or informal management plans by conservation staff, harvesters or traders. Hence a methodology was adapted to allow the making of a preliminary "non-detriment" assessment of the industry with particular reference to harvest regime. It must be emphasised that this project did not set out to conduct an exhaustive resource assessment, but concentrated on assessing the general circumstances of the harvest and trade in *P. sidoides* and to identify critical biological and environmental factors exacerbating harvest impact. The following **methodology** (typically adopting procedures for CITES "non-detriment findings") was used, namely:

- Identification of interested and affected parties to ensure that interviews assessed the views and experiences of a representative group of industry participants;
- Confirm during interviews and literature review the existence or lack of formal and/or informal management plans and species threat assessments within government conservation agencies and amongst traders and harvesters;
- Confirm during interviews whether training and support is provided to harvesters to encourage sustainable harvest techniques.
- Conduct socio-economic survey of harvesters to assess factors, such as land tenure arrangements and volume of traditional use, that can be used to identify positive or negative incentives and pressures that would encourage sustainable or non-sustainable harvest;
- Clarify life history of *P. sidoides* to identify characteristics (e.g. longevity and reproductive rate) that make it resilient or susceptible to harvest;
- Assess ecological adaptability to identify characteristics (e.g. ability to grow in wide variety or highly specific soil types) that may make it resilient or susceptible to harvest;
- Establish the plants preferred habitat to identify its suitability for growth under disturbed conditions or as part of mature climax communities;
- Without conducting detailed population surveys obtain available quantitative and qualitative data on population status and distribution;
- Identify the plant part utilised and whether this indicates destructive or sustainable harvest;
- Assess the ability of the plant to regenerate easily or not through the set of seed or through vegetative propagation. It is of importance to distinguish between vegetative regeneration of the plant and actual recovery of the commercially valuable product. It is possible that recovery of the latter may lag behind the former by several years;
- Assess the legal means to protect *P. sidoides* and the existence of ongoing monitoring of harvest in the field and compare this during interviews with the actual situation regarding legal or illegal harvest in the field;

- Identify harvest and post harvest techniques utilised by harvesters and traders to assess wasteful or inappropriate techniques that may be the cause of supplementary harvest to replace spoiled materials;
- Identify the main target species and other species that may be mistakenly harvested to ensure that harvest impact is not assigned to the wrong species;
- Quantify the volume of material harvested for comparison against total population;

For a rapid assessment such as *P. sidoides* the harvest assessment methodology has to be flexible enough to maximise the collection of data directly relevant to measuring harvest impact so that the researcher can make basic management decisions and/or identify future research priorities.

In the case of *P. sidoides*, despite the apparent resilience to harvest it is not known how quickly new commercially valuable tuberous roots form out of the re-growth and too frequent follow-up harvests may compromise the **survival of re-sprouting plants**. Considering the harsh environmental conditions prevalent in habitat, it is provisionally suggested that re-grown plants should not be re-harvested within a period of four to five years and that further research into root re-generation times be conducted to enable revision of this minimum period. In addition, although trade data indicates export volumes in the order of 50,000kg (wet weight) per annum, it is not clear if this matches volumes processed by the main importing countries. It is necessary that a supplementary trade study be conducted in Europe, to identify other international consumers and finally to confirm that trade levels are within sustainable limits.

Resource assessment methods for sustainable collection of Arnica flowers in the Apuseni mountains in Romania

HORAȚIU EMIL POPA[1]

The Apuseni Mountains are located in western Romania and are among the most important source regions of *Arnica montana* in Romania. The WWF-UK / WWF DCP / USAMV project „The Conservation of the Eastern European medicinal plants: *Arnica montana* in Romania" (hereafter called 'Arnica Project') is funded by the DARWIN Initiative and has developed a model for sustainable *Arnica* harvesting and trade (www.arnica-montana.ro). The major **threats to *Arnica*** and its habitats are the change of traditional mountain meadow management into more intensively managed agricultural systems and over-harvesting of *Arnica*.

Both species conservation and economical sustainability rely on appropriate **resource assessment methods**, aiming to provide reliable data to determine the optimum maximum sustainable yield of *Arnica* and set annual quotas for its harvesting in the project area, the commune of Gîrda de Sus. Therefore, all *Arnica* habitats were inventoried, the number of flower-heads monitored, the 'generative : vegetative' ratio determined, and the density of flowering *Arnica* plants and their flowering rates analyzed. In addition, the project studies the biodiversity of the *Arnica* meadows and investigated their management through interviews with farmers.

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Out of 8,741 hectares (total surface of the commune of Gîrda de Sus), about 1,600 hectares of open land were surveyed. During three flowering seasons in 2002 (MICHLER 2005), 2004 and 2005, 597 *Arnica* polygons with a total surface of 547 hectares were identified in 32 days of walking through the area. The most important tools for the mapping process were the 1:5000 topographical maps. The borders of the polygons were drawn on the maps and then, using GIS software, the polygons were digitized.

The number of *Arnica* stems was counted in random transects of 30m x 2m for 38 polygons in 2004, 130 polygons in 2005 and 98 polygons in 2006. 9.3 transects were counted on average per polygon during the 2005 field season. The number of flower heads per stem was also analyzed, resulting in an average of two flower heads per stem. Also, knowing the average number of the flowering individuals per square meter, allows to estimate the total number of flower heads.

After data analysis and related statistical calculations, an **annual harvesting quota** of six tonnes of fresh *Arnica* flower heads was determined as sustainable within the commune of Gîrda de Sus (BARBARA MICHLER, pers. comm.). The descriptive statistics of flowering individuals per square meter consist in the calculation of mean, average, maximum and standard deviation. In 90% of the habitats, the flowering individuals have a density between 0.02 and 2.9 flowering individuals per m^2 (all descriptive statistics were provided by BARBARA MICHLER, internal report, unpublished).

The overall **cost of the resource assessment** for the three field seasons is estimated at 22,000 US$. This calculation includes the costs of the inventorying, the monitoring, the biodiversity research, the soil study research and the meadows management interviews and does not include the costs of a 4x4 car, of IT equipment and software and transport costs. It does also not include the salaries of specialists for analyzing the data and for producing technical reports. Over the long term, the recurring costs of resource assessments of the same area are costs for salaries for field work and data interpretation, accommodation, meals and transport. If more local people are involved in monitoring accommodation costs could be reduced. According to the accepted error of the assessment, a lower number of transects per square hectare could be established, which would offer a possibility to reduce the working days and the costs for accommodation and meals which are in average 11.5 US$ for a person per day.

The questions on how precise this resource assessment method is and if the costs of the assessment can be sustained by a local company who will not benefit from external project funds, still needs to be discussed.

The data obtained from resource assessments and the subsequent data analyses are valuable information for the development of a **management plan** for *Arnica* habitats and for *Arnica* collection. This management plan is hoped to be included in the general management plan of the Apuseni Natural Park established in the region.

To guarantee the long-term sustainability of *Arnica* (and potentially also other MAPs) in the region, an ethical buyer of the product was found, who will also indirectly have an eye on adequate resource assessment in the future. Third party certification is an additional tool of external resource control; an assessment to obtain organic certification (EEC 2092/91) and ISSC-MAP (International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants) pilot assessment were carried out by IMO (Institute for Marketecology) in summer 2006.

Reference

MICHLER, B. (2005): Leitprojekt “Heilpflanzen”. – In: RUSDEA, E., REIF, A., POVARA, I. & KONOLD, W. (eds.): Perspektiven für eine traditionelle Kulturlandschaft in Osteuropa. Ergebnisse eines inter- und transdisziplinären, partizipativen Forschungsprojektes im Apuseni-Gebirge in Rumänien. pp. 378-380. Institut für Landespflege, Freiburg (Culterra 34).

Determining the potential production area (PPA) and effective productivity area (EPA) of medicinal plant resources in Bulgaria

SLAVCHO SAVEV[1]

The study aims at the assessment of the species composition of MAPs in the Western Balkan Mountains range and to assess their **total and effective potential productivity area**. Several habitat types were studied: pure beech forests with two subtypes: wet and drier beech formations; wet habitats along the rivers; forest meadows, clearings and pastures; and cutting yards and forest roads. An inventory of MAPs is performed for each habitat type. The plant inventory has been done in three stages: mapping, assessment of productivity, and assessment of stock.

Forest maps have been used as a basis and route sampling method was applied to determine the map units where the target species occur. The relationship among the basic ecological variables of stands and the presence of target species was determined by means of regression statistical analysis. The total area resulted of the analysis was considered as **potential productivity area** (PPA).

Determining the effective productivity area (EPA) was performed by means of experimental plots; in each plot the following characteristics were assessed:

- Coverage of the target species;
- Area covered by the populations of the target species;
- Productivity (g/m^2 and kg/ha);
- Growing stock (kg/ha or t/ha).

These characteristics were used to determine the **effective productivity areas** (EPA). Only areas where enough stock for exploitation was available were considered as EPA. Exploitation stock should meet the following criteria:

- Economical effectiveness of the harvesting;
- Accessibility to the localities;
- Possibility for application of **criteria for sustainable use**.

These criteria are:

(1) Possibility for application of rotations of harvesting. It is determined according to the period of full regeneration of the population. If such regeneration continues, for example, 5 years, then the rotation period of harvesting is 5 years (each year 1/5 of the stock is harvested).

(2) Possibility for proper determining of the period for regeneration of the population after the harvesting.

(3) Possibility to determine the annual harvest on a territory that will not destroy the population of the target species. This parameter is determined as a ratio of exploitation stock and the rotation period.

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Resource assessment methods for sustainable collection of Devil's Claw (*Harpagophytum procumbens* DC.) in Namibia

MARIANNE STROHBACH[1]

Harpagophytum procumbens is a geophyte restricted to sandy areas of the semi-arid Kalahari basin of southern Africa. It survives unfavourable seasons by storing water and assimilates in its **tuberous root system** – the latter consisting of a central main tuber extending into a deep taproot, and secondary tubers, which form on roots growing horizontally off the main tuber, often close to the soil surface. The plant emerges during favourable conditions in spring from the main tuber, and the prostrate-growing shoots die off completely either at the end of the growing season, or when conditions become excessively arid before.

The **secondary tubers** have been used for centuries as a panacea by the San people, and since scientific confirmation of their medicinal value in the 1960s have been harvested extensively for the production of analgesic and anti-inflammatory medicine. Recently, harvesting of the closely related *Harpagophytum zeyheri*, which is distributed in the northern, higher-rainfall outliers of the Kalahari basin, has also increased. **Annual exports** of sliced and dried secondary tuber of both species range between 500 and 800 t, but have already exceeded 1000 t. The majority of this material comes from Namibia, supporting an estimated 10 000 of the poorest households in the country.

In an effort to investigate and demonstrate that harvesting practices can be sustainable in the long term, **annual resource assessments** were undertaken with target communities to set annual harvesting quotas.

Initial methods determining harvesting quotas consisted of plant counts along **randomly walked transects**, extrapolating densities to the total estimated area indicated by community members and multiplying the estimated number of plants with an assumed tuber regeneration weight. **Detailed population studies** on permanent observation sites over a five-year period, carried out in the central Omaheke Region in eastern Namibia, yielded information on typical plant distribution patterns, harvesting impact on age-state distribution within populations, as well as secondary tuber (re)generation rates related to rainfall and harvesting practice. Observed **phenological patterns** enabled an optimal timing of annual resource assessments and harvesting periods. It could also be confirmed that by following a **four-year rotational harvest system** as well as leaving the main tuber intact ensured the continued survival of the population, while overgrazing and bush-encroachment lead to a decline in plant productivity and numbers.

Several survey methods developed for sampling plant densities were tried out in the study area; of these the **Variable Area Transect (VAT) method** proved to be the most rapid, easily understood and yet relatively accurate resource survey method, which, with a few modifications, could also be used by trained community members. The VAT method consists of a fixed-width transect that is investigated from a random point until a set number of individuals has been found. We adapted the method to carry on counting plants in 100-step segments. Depending on the distribution of *Harpagophytum* in the area, the 100 steps will be walked in a random fashion, or in a continuous belt until no more plants can be found. This gives us a better indication as to the actual local distribution of *Harpagophytum* and hence the extrapolation of recorded densities to a specific harvesting area is more accurate.

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In addition, repeatedly practising and evaluating the survey method with harvesters and other community members showed that besides ecologically based issues, resource assessment methods also need to take into consideration **community knowledge** of the plant's life-cycle and ecological requirements, the management of the total available resource (past and present), overall lifestyle and income-generating opportunities of communities as well as the need for a **trusting relationship** between ecologist and harvesting community to ensure a long-term sustainability of harvesting *Harpagophytum* tubers.

Resource Assessment methods for sustainble collection of Ratanhia (*Krameria lappacea*) in Peru

Maximilian Weigend and Nicolas Dostert[1]

In the past few years botconsult GmbH in collaboration with WELEDA GmbH and GTZ has established methods for the sustainable wild harvest of Ratanhia [*Krameria lappacea* (Dombey) Burdet & Simpson] roots in a designated collection area near San Antonio south of the city of Arequipa (Depto. Arequipa, Peru).

The biology and life cycle of *Krameria lappacea* are complex, involving a hemiparasitic life form and very slow growth, with plants taking approximately 7 to 10 years to reach maturity, a size warranting a harvest of the root system. A commercial cultivation of the species appears not feasible. Also, due to the far-reaching root system, its strong lignification and the extremely hard soils **partial harvest of individual plants is not practicable**. Sustainable harvest levels therefore had to be established on the basis of an **estimate of the total number of plants** present in the protected area and their annual regrowth (establishment/recruitment). A maximum harvest level was arbitrarily set at 35% of the annual regrowth. Re-assessment of the status of the population will have to be carried out every second or third year to test for changes in population size or structure and adjust harvest level accordingly, if necessary.

Additional studies have been carried out towards a "Plan Nacional de Manejo Sostenible" for *Krameria lappacea* in Peru in additional Departments of the country to estimate possible sustainable harvest levels on a wider scale and the degree of depletion of this resource at a national level. Population sizes were studied by making a census for repeated 10 x 10 m squares in various populations and counting the number of plants in four age groups plus the excavation holes from harvest (as a proxy for the number of plants that have already been harvested in a given area). Totals of population sizes were used to calculate the **"standing crop"** (total number of plant individuals per age group/ha and total weight of dried *Krameria* roots in kg/ha) and **annual recruitment** (absolute resource regeneration per year in kg/ha). The research shows that while the species as such is still very widespread and locally abundant, it already is commercially extinct (i.e., a commercial harvest is no longer viable) in the Department Lima and parts of the Department Ancash. On the other hand, there are very extensive populations of *Krameria lappacea* in some parts of Depto Ancash reaching 20 to over 40 times the density of San Antonio. Future commercial exploitation should concentrate on these large and healthy populations.

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The importance of taxonomic accuracy in resource assessment

MAXIMILIAN WEIGEND[1]

“Management plans” for sustainability purposes are focussed on a given botanical resource in a clearly delimited geographical region. However, very little if any attention is given to the **correct identification of the plant material** involved and no botanical vouchers are routinely deposited in scientific collections, so that the real identity of the plant material harvested is frequently entirely untraceable and commonly incorrect. Many botanicals on the international market represent wild **mixtures belonging to various species**, which were either mixed at some stage of the post harvest treatment or originate already from mixed collections in the field. Some of the taxa collected may be rare in nature and should not be collected at all and may even be protected by local or national laws.

These problems abound particularly in many plant groups which are taxonomically difficult, even to taxonomists, e.g., many Lamiaceae such as *Thymus* (thyme), *Mentha* (mint), *Minthostachys* (muña) or other plant groups such as *Gentianella* (gentians). However, even common and seemingly well-known plants species such as *Crataegus* (hawthorn) and *Urtica* (stinging nettle) frequently have poorly known and locally endemic subspecies. Different taxa will usually differ in their ecology, abundance, distribution and pharmacological value. Correct identification is of paramount importance for resource assessment, since the actual population sizes and sustainable levels of harvest have to be identified for the resource collected and it has additional ramifications for both conservation and quality management.

The quality of plant identifications depends on several variables: The expertise of the botanist carrying them out, the quality of the literature and reference material at his disposal, and the availability of useful voucher material and data on the plant resource to be collected.

For the purposes of an efficient resource management I propose the following **procedure** to deal with the problem of taxonomic identity:

- Herbarium vouchers are prepared from a representative set of populations in the collection area and labelled according to the standard procedure.
- Vouchers are identified by a knowledgable biologist.
- Vouchers are permanently deposited in a public herbarium (e.g., the National History Museum of the country concerned)
- Area management plan includes the following information:
  - scientific name of the plant;
  - voucher data of the plant material deposited (collector, date, locality, where deposited);
  - name of the scientist who identified the plant;
  - literature used for determination;
  - other, readily confused species in the collection area (*if any*) and differential characters.

This procedure, while appearing tedious to a non-scientist, assures maximum security for the parties concerned in resource management and involves very little costs. Phytochemical analysis, which are routinely carried out as part of the quality control, are then also automatically vouchered and can be readily verified.

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75 years of VILAR scientific work to explore medicinal plant resources of Russia: approaches, methods and results

LEONID N. ZAYKO, V.Y MASLYAKOV and NICOLAY B. FADEEV[1]

The All-Russia (former All-Soviet-Union) Institute of Medicinal and Aromatic Plants (VILAR) is a center of expertise in the field of medicinal plant research in Russia. Since its creation in 1931, **numerous studies** have been carried out on biodiversity of the Russian flora in order to find new biologically active substances and plant raw material resources used for drug substances production.

All steps of plant drug development from target plant identification and raw material resources evaluation to drug production are performed in the Institute. One of the fundamental tasks of the Institute has always been constitution, enrichment and preservation of herbal funds, enlargement of the botanical garden medicinal plant and seed collections.

In the process of wild-growing medicinal plant (WGMP) investigation, **different approaches of natural resources evaluation** are used: ecologico-geographical, coenotical, cartographical and others. Two main methods have been worked out for resource assessment: evaluation of given populations and the method of key areas.

About **600 expeditions** have been organized on a large spectrum of medicinal plants distributed in all climatic zones; taiga, broad-leaved forests, forest-steppe, steppe and high-altitude belt areas displaying the highest biodiversity.

Excessive exploitation of certain plant species (for example, *Rhodiola rosea*, *Rhaponticum carthamoides*) raised the question of their conservation. Monitoring of resources and regeneration after harvesting should be carried out for these species and in situ conservation procedures should be developed.

Based on VILAR's long experience and through developing external collaborations, new goals and perspectives have been formulated:

- Analysis of expedition results on WGMP areas and resources investigation;
- Study of WGMP resources in key regions reflecting physico-geographical, phyto-coenotic, ecological, nature conservation and economic specificity of medicinal plant species growth (reserves, specially protected natural areas, agricultural regions);
- Development of the geo-informational system “Medicinal flora geography of Russia” and establishment of the electronic atlas “Medicinal plant areas and resources of Russia”;
- Creation of a modern system of standardized and legal documentation for sustainable use, control, exploitation and preservation of WGMP resources.

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