International Expert Workshop on CITES Non-Detrimental Findings: Case study: *Hoodia gordonii*

Compiled by: Department of Tourism, Environment and Conservation, South Africa, Northern Cape Province

Mexico, November 17-22, 2008

I. Background information on the taxa

1. Biological data

1.1. Scientific and common names

Species: *Hoodia gordonii* (Masson) Sweet ex. Decne

Genus: *Hoodia* (14 *Hoodia* species within the genus) (Germishuizen & Meyer 2003; CITES proposal 2004)

Family: Apocynaceae family (formerly under Asclepidaceae) (Van Wyk & Gericke 2000)

Common names: Ghaap, Bitter ghaap, Xhoba, Hoodia, |goa.-l, |khoba.b, |khowa.b, |goai-l, |hoba, |khoba.b|s, |khobab, |goab, otjinove, !nawa#kharab

Figure 1. *H. gordonii* in flower (and seed set) in the Northern Cape province, South Africa.

1.2. Distribution

H. gordonii has a fairly wide distribution (between 29^0 and 33^0 S), occurring predominantly in South Africa and Namibia, and to a lesser extent in Botswana and Angola. The species has a patchy spatial distribution pattern, meaning that its density varies a lot throughout its distribution range. Although its distribution is not continuous, nor uniform, it is uncertain whether it is fragmented as it has not been investigated.

The species is primarily associated with summer rainfall regions (South Africa and Namibia), but does occur in winter rainfall areas (Namibia) as well.

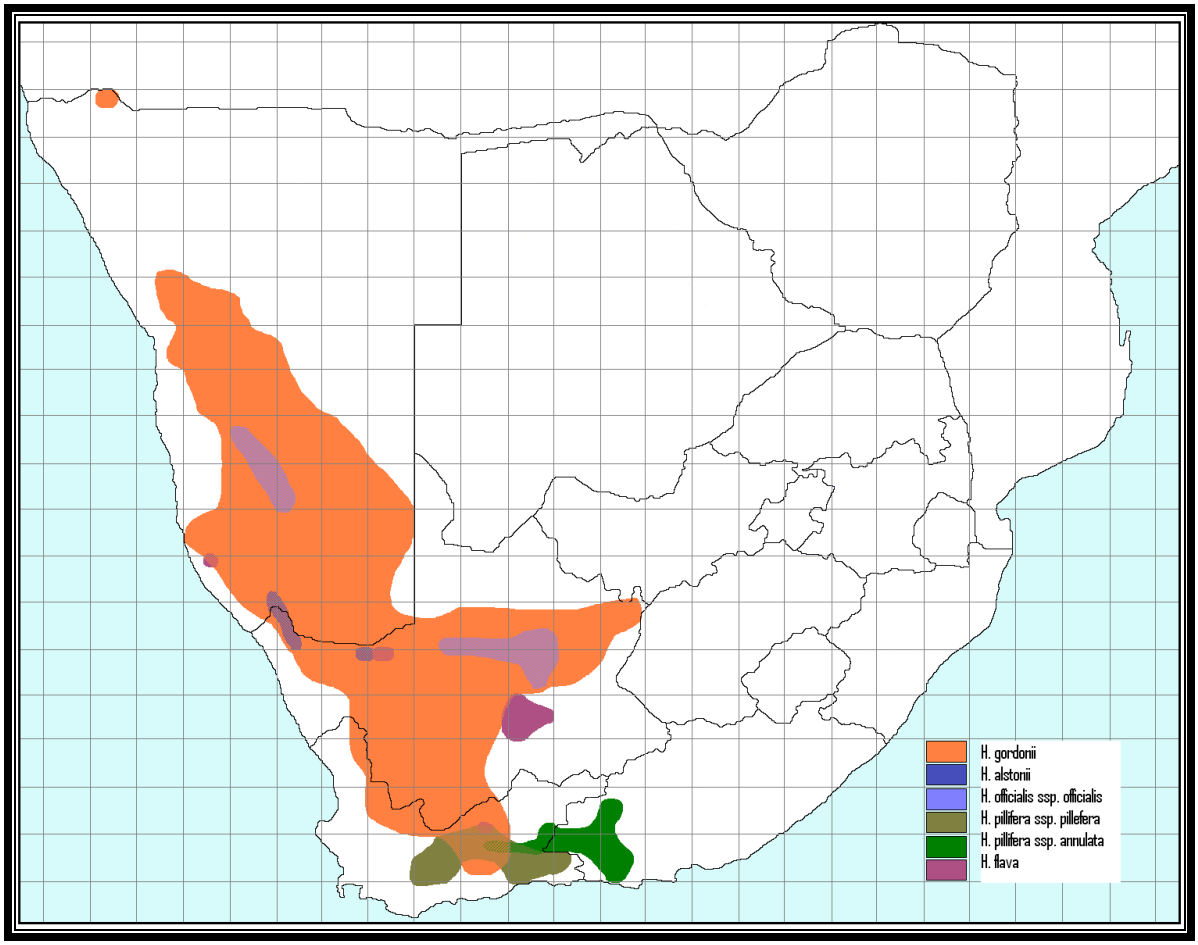


Figure 2. Schematic illustration of the known distribution ranges of six *Hoodia* species in southern Africa (based on PRECIS data 2005, SANBI).

Namibia is regarded as the country with the greatest richness in *Hoodia* species (11 taxa), followed by South Africa (9 taxa). However, there is disagreement amongst some taxonomists as to the species' names and classifications.

1.3. Biological characteristics

1.3.1. Summary of general biological and life history characteristics of the species.

H. gordonii is a slow growing perennial, leafless succulent. This stem succulent forms fleshy fingerlike stems that branch near ground level. The stems are pale-green, round and covered with spiny tubercles found in rows along the length of the stems. The estimated height of an adult plant is around 60cm, while the diameter of the canopy of the finger-like stems reaches more than 40cm.

Figure 3. *H. gordonii* stem illustrating the spiny tubercles running along the length of stems (photo by CSIR).

The life-span and age at maturity of *H. gordonii* is unknown, but anecdotal data indicate it to be 15-20 years, with the first flowering event only occurring after three to six years.

Flowering is protracted (based on herbarium records, PRECIS records) and unsynchronised, reacting to rainfall events irrespective of the season. The herbarium records supported the statement of Gutterman (1993) who stated that *Hoodia* is day-neutral for flowering. During good rainfall events, the plants are covered by flowers, producing masses of seed follicles after one month. Seeds ripen after about two to three months after flowering.

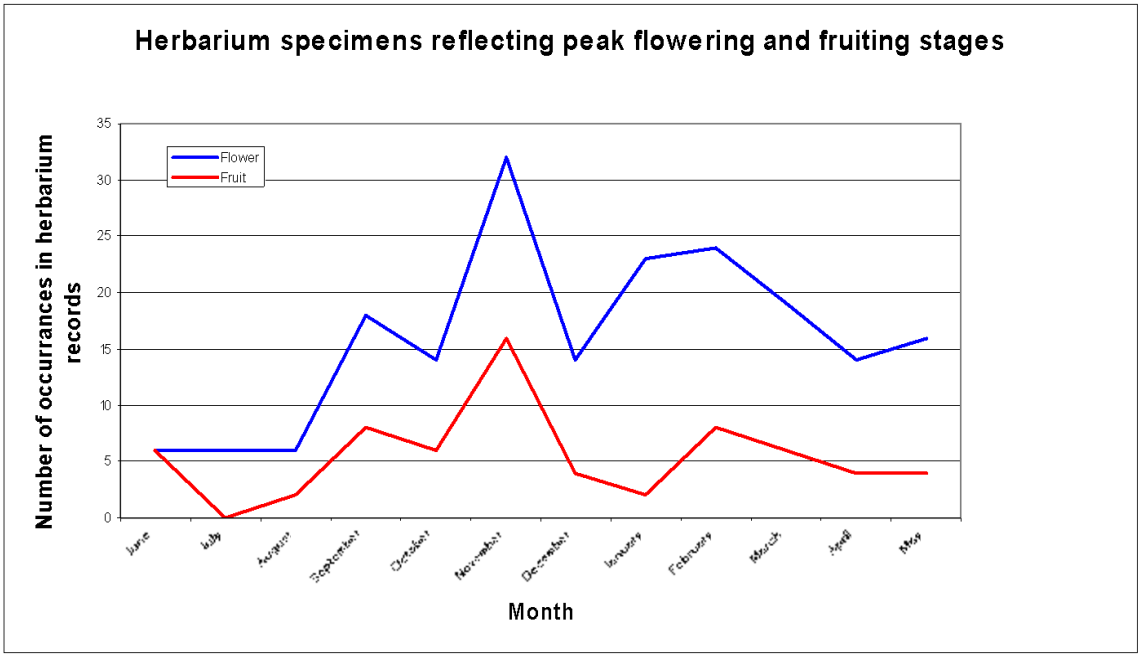


Figure 4. Illustration of the flowering cycles of *H. gordonii* (PRECIS herbarium data, 2005).

Flowers are generally dish-shaped (50-110mm in diameter), with a fleshy colour (colour varies from red to purple to brown to mottled dark yellow). Flowers are also referred to as carrion-flowers or stapeliads, and smell like decaying meat to attract pollinators, namely flies and blowflies. Pollination occurs when the flies lay their eggs inside the flower.

Figure 5. One of the pollinators (a fly) of *H. gordonii.*

Follicles can get up to 250mm long, containing several seeds that are wind dispersed. The follicles split open along the sides, releasing the seeds which are then blown under nurse plants or other protective sites where they germinate and establish themselves. However, the potential seed production (average number of seeds per follicle) and its longevity in the veldt are unknown. According to one expert (P. Bruyns, pers. com.) *H. gordonii* exhibits a weedy character and seeds germinate readily.

Figure 6. *H. gordonii* follicle releasing seed into the wind for dispersal.

Long term population trends are unknown, but drastic population declines have been observed in nature, mostly due to die-back of established plants. The reasons for these drastic die-back events are unknown, but they appear to coincide with prolonged high rainfall events when *Fusarium* sp. (a fungus) and other pests attack the species. No studies have been undertaken to assess the survival rate and recruitment of seedlings.

Population size and density is uncertain. *H. gordonii* clusters vary a lot in density and demography. Cluster densities range between only a few plants per hectare to over 130 plants per hectare (exceptional cases reflected a few hundred plants per hectare).

Figure 7. Die-back event observed in the Northern Cape, South Africa, in the Bushmanland region. Forty percent of a population at one of the sites in the Bushmanland died within two years (2000-2002), while the above photo illustrates that it can result in more than a ninety percent decline (2005).

More information is needed on habitat requirements regarding what conditions favour germination and seedling establishment.

Natural and anthropogenic threats also need to be quantified. Some of the preliminary natural threats that have been identified include fungus infections (Figure 8, *Fusarium* sp. infestation), snout beetles (*Paramecops stapeliae*), mite infestations and fruit flies (Figure 9, *Dacus bistrigulatus*). The milkweed bug (Figure 10, *Spilostethus pandurus*) and the African Monarch butterfly caterpillar (Figure 11, Nymphalidae, *Danaus chrysippus*) impacts negatively on seed production. Natural die-back could result in more than ninety percent decline in clusters (refer to Figure 7). If these die-back events are followed by recruitment events (replacement), there is no immediate concern. However, should these die-

backs not be followed by recruitment events, then there is need for urgent investigation. Another threat that still needs to be evaluated is climate change. Some of the preliminary anthropogenic threats include commercial wild crafted harvesting (illegal harvesting) and habitat destruction (over grazing, trampling, cultivations, road construction, off road driving, urban development, mining).

Figure 8. A *H. gordonii* plant that died due to *Fusarium* sp. infestation.

Figure 9. The fruit fly, *Dacus bistrigulatus*, which lays its eggs in *H. gordonii* stems. Here the caterpillars feed on the inner parts of the stems, causing them to fall over and die.

Figure 10. The Milkweed bug, *Spilostethus pandurus*, lays its eggs in *H. gordonii* follicles.

Figure 11. The African Monarch caterpillar, *Danaus chrysippus*, feeds on *H. gordonii* flowers.

Figure 12. Unidentified ‘fly’ that lays its eggs in *H. gordonii* follicles.

1.3.2. Habitat types.

H. gordonii occurs in a wide variety of arid habitats characterised by sparse vegetation, ranging from coastal to mountainous habitats. Generally the species do, however, prefer arid gravel or shale plains, well-drained and sandy, slopes and ridges, ranging in altitudes from 250m to 1200m. However, the specific habitat requirements (niche habitat) remain unknown. In the Northern Cape Province, South Africa, the species does occur more readily (more densely populated) in some regions.

Figure 13. Examples of some of the habitats of *H. gordonii* in the Northern Cape Province, South Africa.

Habitat availability is not regarded a limiting factor to the species’ distribution range and it is not expected to have a negative impact on the population status at this stage.

1.3.3. Role of the species in its ecosystem

H. gordonii is a minor source of food and moisture to wildlife in arid ecosystems. However, the multiple above ground stems provide shelter and breeding sites for small animals and insects, like spiders or birds. The overall ecological function of the species is unknown.

1.4. Population:

1.4.1. Global population size

The global population size, or available resource, is unknown. Resource information is also not available on Provincial level in South Africa. Accordingly a Resource Assessment Report system was developed to obtain at least local basic information on population health and density. From these surveys, the recorded densities ranged from less than seven plants per hectare to a few hundred plants per hectare. However, as mentioned previously, *H. gordonii* is not evenly distributed; therefore no direct population size can be calculated in reference to the total distribution range of the species.

Surveys for the Resource Assessment Report should cover at least one percent of the total distribution range of the species on the farm to make sure it is at least to some degree representative.

1.4.2. Current global population trends:

The global population trend is unknown, but local decline has been observed at sites where exploitation and die-back have occurred. Recruitment events have also been observed, but these were not necessarily at the sites where decline has occurred (possibly random recruitment).

Climatic influences are undoubtedly an important factor that influences the survival rate of the species. The species is neither pure K-selected (perennial

survivalist) nor pure r-selected (ephemeral avoider). Like normal K-selected species it is of larger size, does not mature quickly and has extended reproductive intervals (iteroparity), but unlike K-selected species it does have a lower reproductive allocation with few seeds produced with a big investment in offspring survival. It has been suggested that *Hoodia* acts as a weed at times by responding to favourable environmental conditions with abundant seed production and germination, but this is also true for many perennial species in the arid regions. The relationship with environmental fluxes needs improved understanding.

1.5. Conservation status

1.5.1. Global conservation status (according to IUCN Red List):

Until 2002 *H. gordonii* was regarded Near Threatened. However, towards 2005 it was suggested to change it to Least Concern (unpublished). We await the most recent evaluation which is due for publication this year.

H. gordonii is listed as a CITES Appendix II species.

1.5.2. National conservation status for the case study country

Hoodia is protected in five of the nine Provinces in South Africa, namely the Western Cape, Free State, North West, Northern Cape and Kwazulu Natal Provinces. Legislation include, e.g., the Nature and Environment Conservation Ordinance No. 19 of 1974 in the Northern Cape Province, the Threatened or Protected Species (TOPS) Regulations, i.e. the Biodiversity Act No. 10 of 2004 (the implementation of TOPS only occurred 2006/07, as it was not finalised or delegated to provinces).

The species is protected in Namibia (Nature Conservation Ordinance No. 4 of 1975 and No. 247 of 1977), but Botswana has no legislation specifically addressing the protection of *Hoodia.* The Agricultural Resources Conservation

Act [CAP35:06] of Botswana addresses “harvesting from the veldt”, which is used to manage *Hoodia*.

The current list of Protected Areas and Conservancies said to contain *H. gordonii* need to be reviewed as some of those listed do not have *H. gordonii* but some of the other *Hoodia* species.

1.5.3. Main threats within the case study country

Habitat loss/degradation (human induced), invasive alien species (directly affecting the species), harvesting (illegal gathering), accidental mortality (e.g. bycatch), natural die-back and climatic events appear to be important threats.

Of all the threats listed, illegal gathering is regarded the most important, followed by agricultural activities. It is uncertain whether the establishment of *Hoodia* cultivation sites itself are having negative impacts on its natural distribution, but needs to be investigated as these are established within its habitat.

Legal wild harvesting appears not to be a local threat at this stage as harvested sites have not died-back, and harvested plants are sprouting again.

The possibility of future commercial collection and the accidental (mistake in identity) collection of other *Hoodia* sp. is of concern. *Hoodia pillifera* was the species being investigated by the CSIR for appetite suppressant activity in 1983, and is regarded the preferred food source. The common names are indicative of the reasons for mistaken identity with *H. pilifera* being called ghaap and *H. gordonii* being called “muishondghaap” or “jakkelsghaap”. It therefore makes more sense to manage the genus rather than the individual species.

Internet trade is not quantified, but is of great concern.

2. Species management within the country for which the case study is being presented.

2.1. Management measures

2.1.1. Management history

The Northern Cape Province, South Africa, issued research permits until early 2000, where after permits for commercial harvesting from the wild was put on hold to enable the Department to put systems in place to handle such applications (except Patent Rights Owners of P57). Commercial applications only started after the CSIR announced their 'discovery' in the media.

However, none of the other provinces in South Africa have put *H. gordonii* permits on hold, meaning that harvesting continued in the Western Cape Province and the other Provinces transported and exported without strict cross referencing to make sure that it was legal material. Illegal material were accordingly 'legalised' due to this unsynchronised management by Provinces.

No permits for wild crafted *H. gordonii* was issued until the legal aspects of the Patent Rights contravention were resolved. A Review Report has been compiled and a Resource Assessment and Management Report (RAMR) system has been developed to manage the resource should permits be issued.

In the review process the information available on the species and the Access and Benefit Sharing aspect (the San has been acknowledged as the Indigenous Knowledge Keepers) was taken into consideration.

The RAMR include the applicant's details, resource details, harvesting management details, and trade details (trade information is not mandatory due to the free market system). Only landowners are allowed to harvest on their own properties due to illegal activities that were reported in the Western Cape Province. Harvesting methods were prescribed.

RAMR is similar to TRAFFIC's sustainable harvesting of medicinal plants document, with limitations regarding the social aspects.

No proper national and international management system is in place yet (including Range States). One of the major concerns is the cultivations occurring outside the natural distribution range of the species, thus economic benefits are not being shared with the countries of origin and Knowledge Keepers.

2.1.2. Purpose of the management plan in place

The purpose of the developed system is to enable economic benefits to accrue to the province, to obtain minimum baseline information to ensure that landowners harvest on their own property, to enable quota formulation for sustainable resource use (permitting), to obtain baseline information to build a database for the province on its resources and the impacts harvesting has on *H. gordonii* populations, and to acknowledge and respect the ABS/IKS.

The methodology developed was kept as simple as possible to enable non-scientists to implement the system as the Department is unable to conduct all surveys (not all farmers can afford consultants). It also included prescribed guidelines as to how and when you may harvest to be able to evaluate harvesting impacts (uniform methods enable comparisons).

2.1.3. General elements of the management plan

Landowner confirmation (Deeds)

Available resource and general health of the resource

Harvest reporting (harvested, wet:dry ratios)

Trade information (optional)

Monitoring (harvested sites, permits)

Gap: Management efforts concentrate on *H. gordonii* though related species might also be impacted on.

2.1.4. Restoration or alleviation measures

No restoration is needed if prescripts are followed, only monitoring to evaluate whether adaptive management (harvesting) is needed. The only aspect of high impact is the development of cultivation sites.

2.2. Monitoring system

2.2.1. Methods used to monitor harvesting

Sites harvested are re-visited and visual inspections are done (no quantification). This is followed-up at a later stage (at least one year after harvest) during which time a survey is done within the harvested area, using similar methods as for the original resource assessment (an alternative is fixed point photography and making notes for interpretation).

The Permit Section has put a database system in place which can be used to monitor permits issued.

2.2.2. Confidence in the use of monitoring

The confidence level is moderate – those figures indicated would always be linked to confidence levels or gaps, meaning that you would have an idea of accuracy and confidence.

Species monitoring is not formally structured, and initially the responsibility was placed with the landowner, but it was found that it was not implemented. Accordingly the Department is re-visiting the sites, with the first quantifying survey

being done about one year after the harvesting took place. Due to personnel constraints the responsibility was initially placed with the client.

2.3. Legal framework and law enforcement

Refer to section 1.5.2.

The species is nationally listed as protected under NEM:BA (National Environmental Management: Biodiversity Act No. 10 of 2004, TOPs Regulations of 2007). The species is listed provincially as protected in five of the nine Provinces in South Africa. The species is also listed in CITES Appendices II.

3. Utilisation and trade for range State for which the case study is being presented.

3.1. Type of use (origin) and destinations (purposes)

Traditionally it was used by the San while hunting to suppress appetite, thirst and to maintain their energy levels. They ate portions of the fresh stems. The commercial uses are similar, with dieting and energy boosting (cyclists) being the major consumer markets. Interestingly, the Patent actually includes anti-diabetic and prevention of aspirin induced gastric damage characteristics.

Limited cultural and traditional use still continues today. It has been reported by communities that the resource has become scarcer (anecdotal information). Other traditional uses (treatments) include abdominal cramps, haemorrhoids, tuberculosis, indigestion, hypertension, diabetes, peptic ulcers and allergic reactions in eyes.

Horticulture is limited.

At this stage *H. gordonii* is commercialised as a food-source and/or -supplement, not a pharmaceutical product. The CSIR patented P57, and then licensed it out to Phytopharm (UK), who sub-licensed it to Unilever to commercialise it as a food product/supplement. Benefit sharing agreements are in place with the San (6%).

Most exports (wild crafted) from the Northern Cape were to the Western Cape Province of South Africa.

Material is exported as dry material (discs or milled), or as extracts.

Until recently, wild crafted trade was more than cultivated material. However, the number of cultivations has increased and it is anticipated that wild harvesting would not form such a large part of the trade in the future.

The collection of dead wild *H. gordonii* material was combined with wild crafted data and should be kept in mind. Nearly half of the wild harvested material (kg) was dead material that was collected.

3.2. Harvest:

3.2.1. Harvesting regime

No harvesting prescripts are given to cultivated material collection. A register must be kept throughout recording all activities and weights.

General guidance (booklets) was given to wild collection applicants specifying that older plants also contain the active ingredients. Thus, plants larger than 40cm in canopy diameter could be harvested.

For material collected from the wild, the guidelines stipulate that only ten of the stems may be harvested or 25% of a plant that is larger than 40cm in diameter, only on the southern side (down wind), near ground level. Only trained harvesters

may harvest *Hoodia* material, i.e. trained in the prescribed methods provided by the Department. Harvesting will only be considered on sites where an excess of 2500 plants are available that are in good health and of optimal size.

Harvesting of wet plant material may only occur if it is not in flower or seed, which is normally between April and August. Seed collection must be specified and will be evaluated in a similar manner as in wet plant material collection, except for time of year to be collected. Only every second to fourth large plant (larger than 40cm in diameter) should be harvested in the wild.

Stems must be cut off at least three fingers' width (5cm) above ground level with a sharp stainless steel blade (recently evidence indicate that cuts at thin basal stem sections could be less damaging). This is to enable resprouting, if the species has the ability to do so. The blade must be disinfected (3% chlorine solution, like Jik) between each plant being cut. The cut stems that remain on the plant must be dusted with lime sulphur powder. The collected stem-parts are washed and cut into disc shaped pieces. These pieces must be dried in an appropriate manner to ensure quality and prevent rotting. The mass of the harvested plant material must be determined and signed off by Conservation Authorities before and after drying. Drying must occur as close as possible to the harvesting site. The sealed dried discs are sent to accredited and endorsed Processing and Quality Assurance entities. Quality products are sealed with tamper proof Quality Labels and Logos. These products are ready for trade after quality assurance approval and labelling.

Monitoring programmes must be put in place (by the permit applicant) at sites where wild crafted collections occurred / are planned.

Clients were given the opportunity to deviate from the proposed methods, if they can provide scientifically proven data that their proposal is more effective than the prescribed method and must be reported as such in their RAMR.

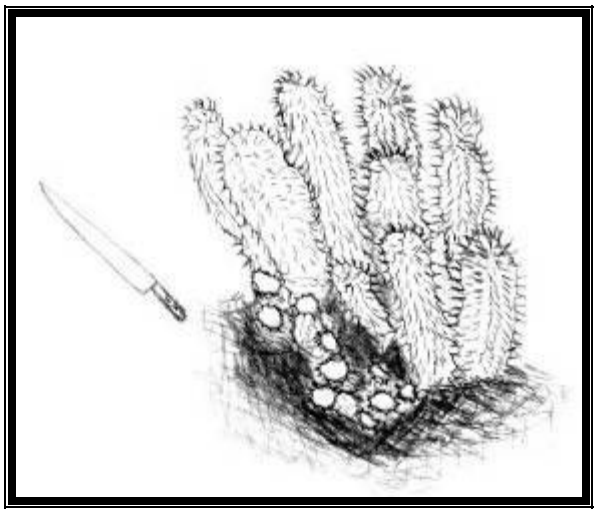


Figure 14. A schematic illustration of how you should cut stems on the southern side of a plant in the veldt, using a sharp stainless steel blade.

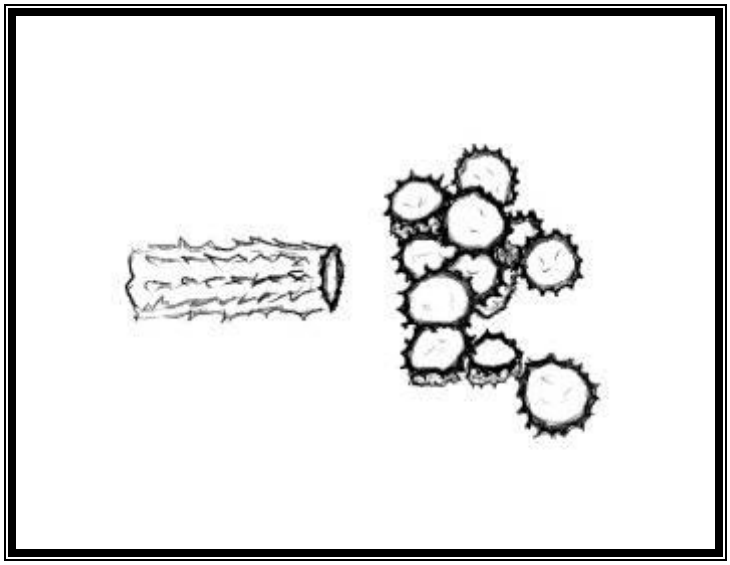


Figure 15. A representation of the cut slices of *Hoodia* stems harvested.

Mature seed pods/follicle should be collected just prior to opening of the pod, or with seed collection bags. If not done at this time, it will compromise the success rate of germination. It is recommended that seeds (not more than 20% of population's follicles) should be collected over two flowering seasons to minimise its impact on natural populations.

Figure 16. Example of a *H. gordonii* seed collection bag.

3.2.2. Harvest management/ control (quotas, seasons, permits, etc.)

Refer to section 3.2.1.

3.3. Legal and illegal trade levels

From 2005 until March 2008 a total of 15.7 tonnes of dry illegal material have been confiscated. Anecdotal data indicate that it could be more (more than 41 tonnes dry weight), but this is unconfirmed. It is suggested that only 10-15% of illegal trade is reported and/or detected.

Legal harvesting peaked in 2008 of which most were obtained from cultivated material.

Wild harvesting peaked in 2007 and it included the collection of dead plants. Dead plant material contributed 52.4% of the total wild harvested weight.

The collective wild harvested weight obtained from live plants since 2002 (until March 2008) potentially relates to ca. 0.25 million plants that were 'harvested'/available resource.

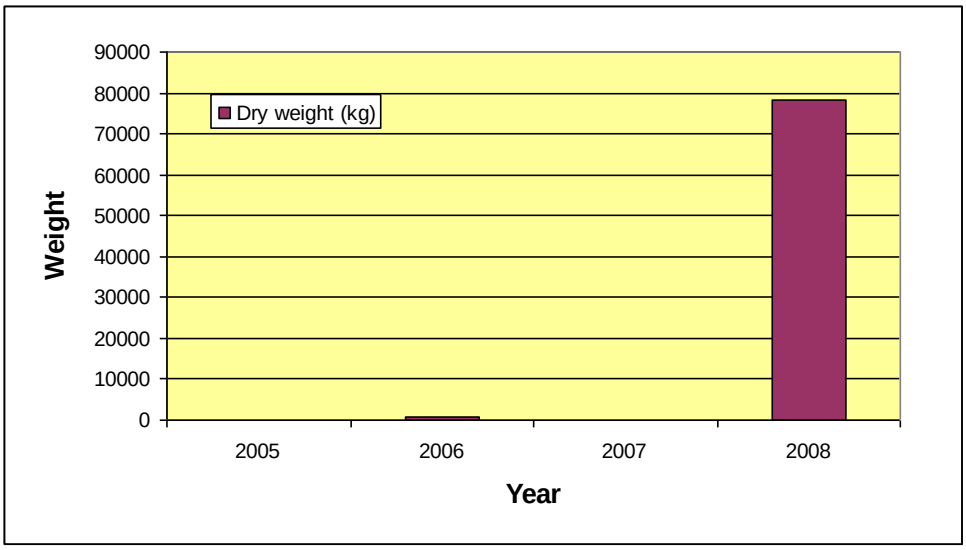


Figure 17. The collective (wild crafted and cultivated) dry weight exported through CITES permits from 2005 until August 2008.

II. Non-detrimental Finding procedure (NDFs)

1. Is the methodology used based on the IUCN checklist for NDFs?

No, although there are various similarities. Several of the aspects to be addressed according to the IUCN checklist have been addressed through our methods being used.

2. Criteria, parameters and/or indicators used

Due to the lack of a provincial resource assessment, site assessments were done according to our developed prescripts (i.e. per farm application) to enable site evaluation and quota estimation.

Each permit application is evaluated individually, i.e. each permit quota is calculated according to each individual resource assessment / inspection. The aspects taken into consideration while evaluating each resource assessment include the following:

a) The surface area surveyed in relation to farm size and *Hoodia* cluster distribution

According to the RAMR guidelines the total size of a farm should be provided, together with the extent of *Hoodia* cluster occurrence on the property.

Improved survey site identification is expected with increased area inspected before placing survey sites.

The greater the percentage surface area surveyed on the farm, the more representative the data (quantification) would be. Accordingly, the more extensive the surveys the more reliant the data presented and resource assessment.

b) The general health of the population surveyed

Aspects taken into consideration while evaluating general health include live:dead ratios, visual observation of infestations and infections, adult:juvenile ratios and associated environmental threats, like alien invasive species, erosion, etc.

It is uncertain whether *Hoodia* can be regarded as a fugitive species, but a population would be regarded 'healthy' if: more live than dead plants are present on the property, if there are no or low visible infections and infestations on the plants, if there are at least no other immediate threats to the species present (e.g. erosion and alien invasive like *Prosopis* sp.). The presence of various size classes is regarded as a representation of continuous re-establishment (no size class variation is regarded sporadic random recruitment, ref. *Opuntia*).

c) The estimated population size / cluster density (extrapolated)

Line transect (1000m and/or 4 x 250m) and sample plot (100 live individuals) data is compared and used for calculations (extrapolations). It is suggested that if the survey sites have been chosen representatively, then the data should be comparative.

Quota calculations are based on the number of adult live plants. Qualitative sustainable resource use studies are extremely limited, but according to Pfab &

Scholes (2004) *Aloe peglerae* (60 year life span) cannot be harvested sustainable (entire plant removal) as less than one percent of the population needs to be harvested to allow for sustainability, which is regarded unfeasible for trade. In the case of *Hoodia* only a part of the plant would be harvested (not destructive) and it has been reported that not all harvested plants in the Western Cape died after harvesting. Accordingly the observed best practices from Western Cape 'trials' were collated into harvesting prescripts for the Northern Cape. Monitoring would reveal whether re-sprouting of harvested plants is possible and if harvesting is not detrimental.

d) The harvesting history on the same farm

The general rule applied is that no harvesting may occur at the same site to allow recovery of harvested plants, while also enabling the monitoring of resilience to harvesting. No information was available to determine rotation periods yet and therefore renewal applications are linked to a re-evaluation and inspection. This means that should it be found that no follow-up harvesting should be allowed, the harvesting permit would be rejected.

If harvesting is requested for the same farm, but different camp or site it must be inspected and/or assessed again before considering the permit application.

No harvesting (extension) would be allowed on a farm where indications of stress are visible in harvested sites.

e) Harvesting method to be used

Harvesting methods are prescribed based on observations recorded in the Western Cape Province (Ceres Karoo) and by Industry members. As the method was not optimised through experimentation, it is allowed to alter it provided that documentary proof can be provided to support the method to be more environmentally friendly and sustainable. (Twisting off branches at ground level is currently being looked at as an alternative)

Only 25% of every second (to fourth) individual plant may be harvested from. Harvesting may only be on the down-wind side as observations in the Western Cape indicated that plants are more susceptible for infections if it is harvested on other sides of the plant.

f) Precautionary principle

If there is any uncertainty in the data, the quota was reduced accordingly. In cases where data is insufficient the re-assessment of the resource is requested.

If the site to be harvested contain less than 2500-3000 harvestable plants, it is regarded unfeasible for trade (the harvested mass does not justify the harvesting expenses, and is too little for trade according to the industry) and the impact regarded unnecessary. Harvesting for research is handled differently as smaller quantities are used in this case.

Quality control measures are useful for the industry, but might also have benefits to Conservation. In situations where illegal material is found, morphological and chemical controls can be used to identify and quantify illegal *Hoodia* (morphologically e.g. grouped spines / thorns, anatomically e.g. presence of druse crystals and hairs and their chromatographic fingerprints using TLC, HPLC and NIR). It remains to be seen whether region of origin can be identified based on chemical analysis (chemotypes). Through an improved knowledge of illegal harvests, an improved conservation assessment can be made regarding harvest impact.

3. Main sources of data, including field evaluation or sampling methodologies and analysis used

Background information: Literature, anecdotal information, Industry (who are willing to share some of their information), and the RAMR (demographic and density data, as well as habitat description) is used.

Field information for assessing habitat condition, population size and impacts of harvesting:

Demographic information was obtained through the following method:

The first live 100 individuals encountered in the densest part (cluster) of each population must be surveyed. A plot of 1 ha (ideally 100 m x 100 m) should be documented. If a plot of 100 m x 100 m cannot be established, plot sizes should be adjusted to enable the documentation of at least 100 live individuals and a surface area of 1 ha. A template for measurements to be taken was provided.

These surveys, thus far, have only been done on the farms where harvesting permit applications were received from. It is anticipated to expand it towards a provincial assessment.

As part of the assessment of general habitat condition, the level of plant damage through infection, or infestation, or physical damage, was rated as 0 (no damage), 1 (presence), 2 (moderate, up to 60%) and 3 (severe).

Rating: 0 (healthy plant)	Rating: 2 (infested plant)	Rating: 3 (dying plant)
		

Figure 18. Examples of plants to illustrate ratings of health as per RAMR.

Photographic records (with GPS co-ordinates) are also collected for each plot, and include a photograph of the site as well as, where possible, photos of each individual plant next for use in monitoring of growth rate and survival.

GPS mark and note each individual *Hoodia* surveyed, dead and/or alive on a spreadsheet.

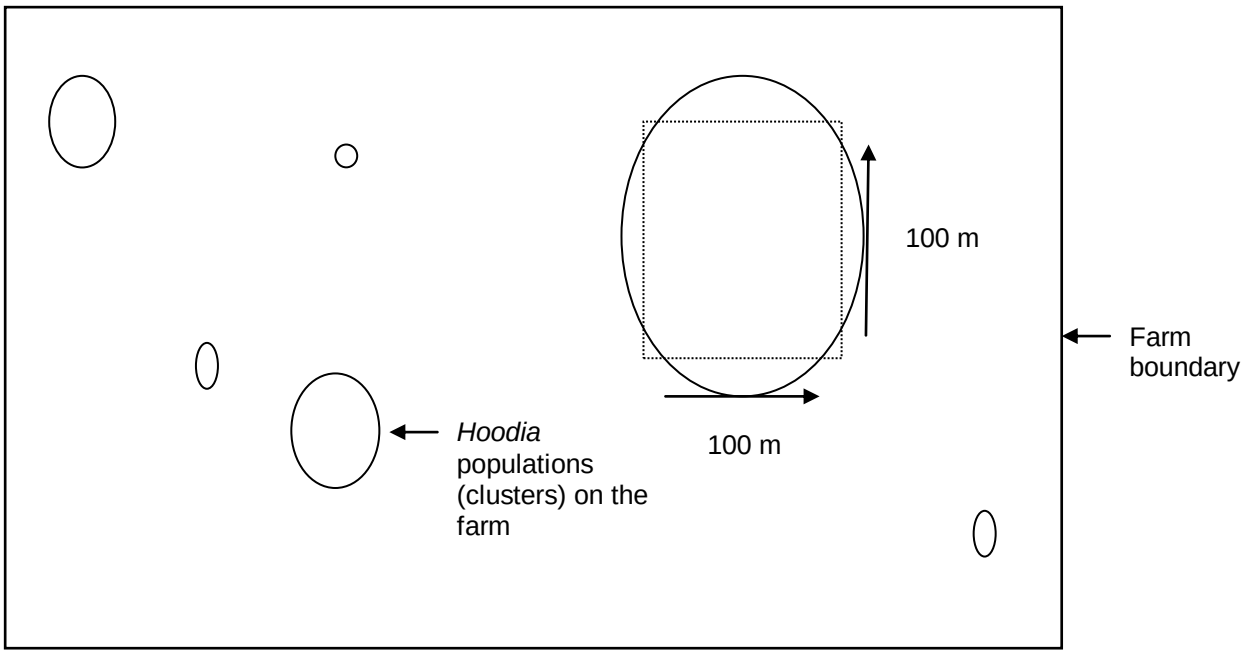
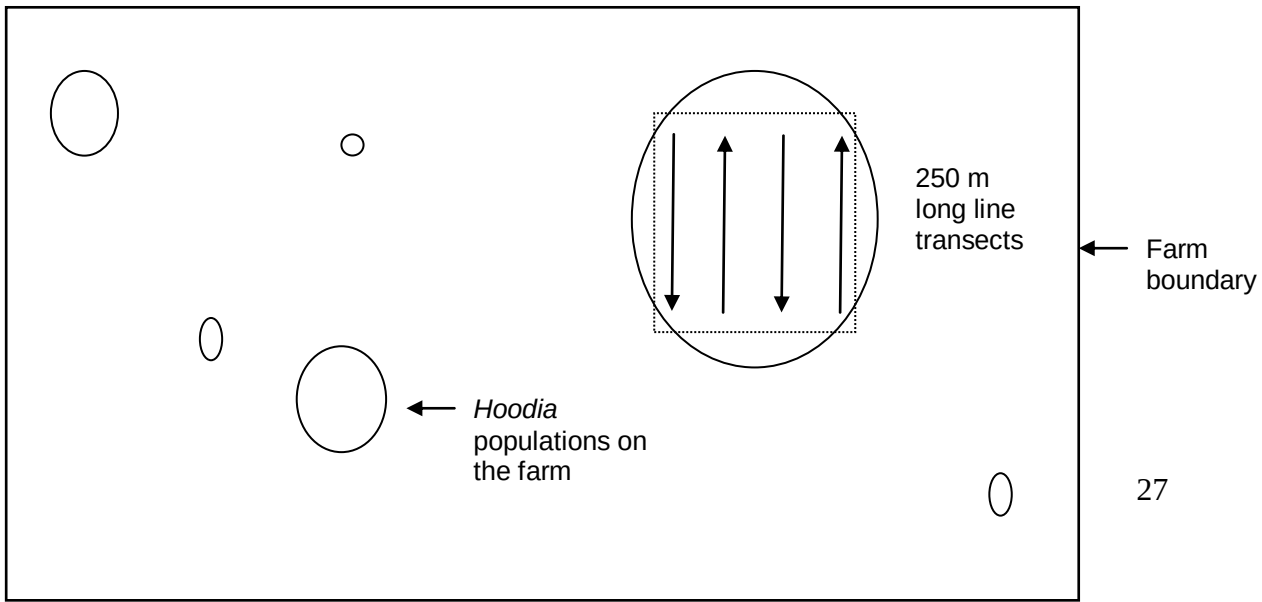


Figure 18. A schematic illustration: How to identify the site for the survey and how to place your quadrant in which you then survey individual plants.

Density information was obtained through the following method:
Applicants are expected to provide information on population density and mortality derived from 4 parallel, 250m long line transects that bisects the densest part of the population (and the demographic survey plot) and spans its topographic gradients. Applicants are expected to count all individuals occurring within the range of 2m on each side of the line transect (thus, total area covered is 4000m^2). Note whether the dead individuals are standing or lying and its possible cause of death.

Further population and habitat information is obtained from permit application's RAMRs. Site characteristics like aspect, habitat, grazing intensity (dung frequency



and type), mountainous, plains, and soil type should be noted.

Figure 18. A schematic illustration of your line transects' layout.

This information (4 x 250m transects) relates to the optimum potential resource. An indication should be given to the extent of the clusters and the number of clusters on the farm to enable extrapolation.

It is recommended that a 1000m line transect is also walked to get a more general indication of density, but has not been done at all sites.

4. Evaluation of data quantity and quality for the assessment

Wild harvesting has only been granted for farms ca. 55983ha in total surface in the Northern Cape (ca. 8 332 700.2ha). It is expected that *H. gordonii* occurs throughout about 50% of the Northern Cape, i.e. harvesting occurred within ca. 1.34% of the distribution area of the species (based on farm sizes, not cluster sizes). However, it should be noted that it is not an accurate spatial representation of the actual *Hoodia* distribution vs harvesting surface area.

The spatial statistics should still be confirmed using GIS analysis, which can only be done after the provincial assessment.

The harvesting method was developed based on observations made in the Western Cape where wild harvesting occurred. No die-back has been reported to date using the prescribed harvesting methods, and the continual collection of monitoring data is hoped to confirm these preliminary data. At this stage permits are used to gather valuable harvesting information to enable more informed decision making in the future.

Wild harvesting is regarded non-detrimental on a provincial scale based on preliminary observations and data. It is also not regarded destructive at this stage

as only a part of the fingers are removed. However, no qualitative data is available to support our inferences at this stage. Resprouting has been recorded at harvested sites though (in the process of being quantified). In a worst case scenario where all harvested sites might have died, it would be localised.

There is concern with respect to a more localised scale (site level) as the harvesting applications are concentrated towards its southern distribution ranges in the Northern Cape and there is a possibility that it (in a worst case scenario) might result in the southern distribution patterns to be altered in the future if harvesting pressure increases (collective impact of plant material and seed harvesting).

Resource assessments were the responsibility of the permit applicants. Resource assessment guideline booklets were compiled to assist applicants (or consultants) to do these assessments in a uniform manner. Generally most of the data received was of acceptable quality; however there were differences in how and what various people interpreted, even after training by Conservation. This means that not all data can be collated directly. It is hoped that with an increased number of surveys we would be able to have improved data for a better understanding of the species.

Data collected by departmental personnel is generally of good quality.

The line transect method (4 x 250m) is a questionable method. Overestimation is a concern with the four parallel transects, though it provides better guidance with regard to the cluster's resource specifically. Some of the methods consulted during the development of the *Hoodia* methods included, amongst others, the method used by Hachfeld B (2003) for *Harpagophytum procumbens*, as the spatial distribution pattern is also regarded patchy. The method used by DTEC for *Aloe dichotoma* surveys (based on the method used by Foden W, 2002) was also consulted, especially for health rating.

The methods used for the RAMR surveys are regarded sufficient in gathering basic information to enable some quota formulation. The shortcomings at this stage include: Possible overestimation of the resource through placing line transects through the densest clusters, especially if no comparative 1000m line transect was done. The provincial resource is not known, meaning that no comparison can be made on a provincial scale. Regeneration and survival information is critical in determining the impact on the population, which lack currently. It is inferred that the protracted production of seed will ensure resettlement. The tolerance of the species to harvesting is not known, but it is anticipated to have some level as it is known to be browsed by goat and sheep at times.

Most of the information used for calculations is based on anecdotal information from the industry and preliminary data, and is not yet quantified to have potential deviation (statistics).

Preliminary resource assessments reflected that the average density on farms varied between 15-105 plants per hectare, with exceptions where several hundred plants per hectare have been recorded (based on 1000m transect data). The cluster sizes varied, but the 1000m line transect was regarded representative of the general density on the various properties as it always have crossed at least one cluster.

The potential resource that provided for harvesting from 2002 until March 2008, relates to ca. 0.25 million plants. The potential available resource according to preliminary resource assessments (using averages, not exact data) relates to ca. 0.033 to 0.23 million plants. Large variability exists with data and only after the collation of more extensive survey data can an improved comparison be made (having average and, minimum and maximum estimated). Spatial impact evaluation might proof valuable.

On site level harvesting is regarded sustainable due to the fact that no die-back has been recorded to date.

It is suggested that wild harvesting alone will not sustain the market needs as more than one product is expected to be launched.

With regard to cultivations, similar calculations can reflect whether plantations are sufficient in meeting the market demand (weight per year needed by the market vs production per ha). However, an independent market analysis is needed in this regard as the industry views this as confidential information as it relates to their financials of trade.

5. Main problems, challenges or difficulties found on the elaboration of NDF

The lack of biological information is problematic (regeneration cycles, population trends, longevity of seed, seedling survival, etc.). Biological information, especially on survival rate, can enable stochastic analysis. This means that an estimated sustainable quota guideline can be developed. Similarly, if habitat requirements are known (environmental conditions favouring recruitment) recruitment cycles can be modelled. In the absence of such data, monitoring is important and an adaptive management approach needs to be implemented (the shorter the life-span of a species and the less specialised the lower the risk).

Hoodia harvesting is limited to succulent stems of adult plants and seed. This is regarded non-destructive and therefore harvesting is not regarded detrimental if managed and monitored. However, monitoring is essential in ensuring sustainable utilisation.

Departmental staff shortages prevent them from being present at all harvesting activities for monitoring and recording. Although it was requested that harvesting dates should be arranged with the department beforehand to enable scheduling

and their presence, it was difficult to execute. If harvesting is not done according to prescripts, e.g. harvesting of entire plants, the risk of exploitation increases. To date all farmers have adhered to harvesting procedures though. The integrity of permit applicants and the working relationship between the applicant and Conservation therefore plays a major role.

Also, if monitoring is done after harvesting occurred it is reactive and not pro-active as nothing can be done to change the harvesting impact, it can only be recorded. Through spatially (distribution) evaluating potential harvesting impact, some guidance is given with regard to 'worse case scenario' evaluations.

Although it was thought to be a simple method, easy understandable guideline to be used for RAMR, most were unable to execute it properly. This can be attributed to the fact that most applicants do not have biological backgrounds. The fact that applicants were willing to participate helped a lot as they were patient with criticism from Conservation regarding their data. The option of explanatory videos should be considered if manpower at Conservation is limited for training.

Alternatively, a consultant should be appointed by Conservation to do assessments. Where trust and personal relationships play a role, it is always a risk as not everyone would participate.

Lack of cooperation between provinces prevents proper management and monitoring of material/permits, enabling illegal trade via 'less-strict' provinces. Permit monitoring is one of the ways through which illegal trade can be detected: If all provinces share their information and ensure that the material being applied for is of legal origin before issuing the next permit, illegal quantification can be improved. There are permit holders who use one permit for several transactions, meaning that they use a legal permit for illegal material as well. Other permit holders export to less strict provinces where they apply for another permit, legalising illegal material.

Provincial and National collaboration should improve to address 'legalisation of illegal material'. It would also be helpful in conservation assessments.

Development of the management of systems occurred within a timeframe where national legal structures (ref. Biodiversity Act) was not in place, causing uncertainties, lack of guidance and difficulties in Range State collaboration on government level. Through collaboration, southern Africa can evaluate their natural resource and assess harvesting impact on an international level. If similar methods are used for data collection, it can be collated for conservation and sustainable use assessments, representing the entire distribution area of the species.

6. Recommendations

Capacity on provincial level is limited, varies in expertise and personnel turnover is of concern. It is uncertain as to how one can address these aspects, but a checklist (ticking off yes or no blocks) might be an option for evaluation (with reference to permit evaluations). However, for this more information is needed on the biology and regeneration of the species. Field experience and personal knowledge play a role in the permit evaluation processes currently, meaning that it is dependant on the person doing the evaluation (subjective to an extent).

At times allowing / permitting utilisation in a controlled manner is the best way of obtaining information to improve future evaluations, especially if capacity is limited. However, this will only work if monitoring is done and adaptive management implemented strictly. Generally, in arid regions, one might need to regard a species more susceptible for harvesting the longer the life-span (ref. *Aloe dichotoma, Aloe pillansii, Welwitchia* sp. e.g.).

A consultant or student should be sponsored / given a bursary to obtain the relevant biological information needed to enable the development of improved quota systems that inexperienced scientists can use to evaluate applications.
In most cases, biological information lack to make a confident scientifically based quota recommendation. However, with supplementary information from Research Institutes, Conservation can improve on their confidence levels.

If a spatial analysis could guide your impact on a spatial distribution level while gathering information. Harvesting is expected not to be detrimental with regard to non-destructive harvesting methods. The identification of core conservation areas (where no harvesting is allowed) might also be valuable in ensuring that a 'seedbank' is maintained. However, it might not be possible to know where to place such a protected area, nor what minimum size it should be to supply sufficient seed.

Preferably Conservation should do the resource assessments because it was found that the clients struggle too much with it, while simultaneously capacitating the scientist to make improved evaluations. The time it takes to train and assist them in getting it right, means that it is not really less time consuming as anticipated. Then you also need to either computerise their data, because they do not have computers, or you must try to unravel what applicants tried to say in their documents.

A review report is recommended (to be compiled by the person who would attend to the NDF) before trying to develop quotas. Through this process the scientist is forced to obtain and learn about the species to be utilised. In addition, literature on sustainable utilisation of other species can sensitise the scientist with regard to aspects to consider when 'guessing' guidelines for quota formulation.

References

ARNOLD, T.H. & DE WET, B.C., 1993. Plants of southern Africa: names and distribution. Memoirs of the Botanical Survey of South Africa No. 62. Eds. Arnold T.H. & De Wet B.C.

BARBOUR, M.G., BURK, J.H. & PITTS, W.D. 1987. Terrestrial Plant Ecology, 2nd Edition. The Benjamin/Cummings Publishing Company, Inc.

BRUYNS, P. 1993. A revision of *Hoodia* and *Lavrania*. Bot. Jahrb. Syst. 115: 145-207.

CARR, S.J., 2004. Namibia NBG propagates *Hoodia*. SABONET News, Vol. 9(1): 43-44, 1 September 2004.

GERMISHUIZEN, G. & MEYER, N.L. (Eds) 2003. Plants of southern Africa: An annotated checklist. Strelitzia 14, National Botanical Institute, Pretoria.

GUBIC, K., 2005. Could *Hoodia*-hype be robbing the San? In: *Progress: The Sustainable Development Quarterly*, pp 51-52.

HACHFELD, B. 2003. Ecology and Utilisation of *Harpagophytum procumbens* (Devil's Claw) in Southern Africa. Results of the R+D Project 800 86 005, Federal Agency for Nature Conservation, Bonn – Bad Godesberg.

KRUG, R.M., HOFFMANN, T. & SWART, E. 2008. Determination of Recruitment-events and their interpretation: A new Methodology demonstrated for the tree aloe *Aloe pillansii* (draft publication).

LAIRD, S.A. (Ed.), 2002. Biodiversity and Traditional Knowledge: Equitable partnerships in practice. People and Plants Conservation Series, Earthscan Publications Ltd.

LANGE D. & SCHIPMANN, U., 1997. Trade survey of medicinal plants in Germany: A contribution to international plant species conservation. Bundesamt für Naturschutz.

MULLIKEN, T. 2005. Editorial. In: *Traffic Bulletin*. Results of 13th CITES Meeting. The Journal of the TRAFFIC network dissiminates information on the trade in wild animals and plant resources. Vol. 20, No. 2, February 2005.

PFAB, M.F. & SCHOLES, M.A., 2004. Is the collection of *Aloe peglerae* from the wild sustainable? An evaluation using stochastic population modeling. Biological Conservation 118:695-701.

VAN DER WALT, W., 2004. Plants as cut-price medicine factories. In: *Farmer's Weekly*, 19 November 2004, Issue 94045.

VAN HEERDEN, F.R. 2008. *Hoodia gordonii*: a natural appetite suppressant. Journal of Ethnopharmacology (2007), doi:10.1016/j.jep.2008.08.023.

VAN WYK, A.E. & SMITH, G.F., 2001. Regions of floristic endemism in Southern Africa. A review with emphasis on succulents. Eds. Du Plessis E. & Steffens F., Printed by CTP Book Printers, Cape Town.

VAN WYK, B-E. & GERICKE, N., 2000. People's Plants. 1st Edition, Edited by Janine Smit, Briza Publications, Pretoria.

VERMEYLEN, S. 2008. From life force to slimming aid: Exploring views on the commodification of traditional medicinal knowledge. Applied Geography 28:224-235.

WALTER KS & GILLETT HJ, 1997. Threatened Plants: IUCN Red List of Threatened Plants. IUCN Survival Commission. Eds. Walter & Gillett.

WILLIAMS, V.L., 2003. The Traditional Medicine Trade: A Challenge for Protected Areas Management. Walking with Nature, Protected Areas, People and Prosperity, In support of the World Parks Congress 2003.

WILLIAMSON, G., 2000. Richtersveld: The enchanted wilderness, Eds. Diesel V. & Steffens F., Printed by Tien Wah Press (Pte) Ltd, Singapore.

Reports

BARSCH, F., 2005. Report on *Hoodia* species in Botswana: Distribution, Ecology and Conservation. Unpublished report.

CITES Proposal, 2004. Proposal for Amendment to Appendices II: *Hoodia* species. Presented at the 13th meeting of the Conference of Parties to CITES, October 2004. Unpublished report.

MARSHALL, N.T., 1998. Searching for a cure: Conservation of Medicinal Wildlife resources in east and southern Africa. A TRAFFIC report, Published by TRAFFIC International, Cambridge, UK.

WYNBERG, R., 2002. A review of Benefit-Sharing Arrangements for Biodiversity Prospecting in South Africa. Report prepared for the IUCN.

POWELL, E. 2004. Preliminary review on *Aloe dichotoma* (Quiver tree) in the Northern Cape Province. Internal Departmental Report, DTEC.

POWELL, E. 2005. The medicinal plant *Hoodia gordonii* (Ghaap): A review. Internal Departmental Report, DTEC.

SWART, E. 2006. Report-back: Harvested *Hoodia* Inspections. Internal Departmental Report, DTEC.

GELDENHUYS, C. 2008. Report-back: *Hoodia* harvest response assessment 26-27 June 2008. Internal Departmental Report, DTEC.

SWART, E. & GELDENHUYS, C. 2008. Preliminary information for a conservation assessment of *Hoodia gordonii* in the Northern Cape Province (Draft). Internal Departmental Report, DTEC.

GELDENHUYS, C. 2008. Report-back: *Hoodia* response to harvest assessment and filed sample collection 8-12 September 2008. Internal Departmental Report, DTEC.